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Importation of Naranjilla (*Solanum quitoense* Lam.) from Colombia into the Continental United States

A Qualitative, Pathway-Initiated Pest Risk Assessment

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Executive Summary

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) prepared this risk assessment to examine plant pest risks associated with importing commercially produced fresh fruit with calyx and stem tissue of naranjilla, *Solanum quitoense* Lam. (Solanaceae), also called lulo, for consumption, from Colombia into the continental United States. The risk ratings in this risk assessment are contingent upon the application of all components of the pathway as described in this document.

Based on the scientific literature, port-of-entry pest interception data, and information from the government of Colombia, we developed a list of all potential pests with actionable regulatory status for the continental United States that are known to occur in Colombia (on any host) and to be associated with the commodity plant species (anywhere in the world). Of these, we found six organisms that have a reasonable likelihood of being associated with the commodity following harvesting from the field and prior to any post-harvest processing, and thus are potentially able to follow the pathway.

We analyzed the pest risk potential of these organisms and determined that the following three are *not* candidates for risk management, either because there is no endangered area within the continental United States, they did not meet the threshold to likely cause unacceptable consequences of introduction, or they received a Negligible overall risk rating for likelihood of introduction (i.e., entry plus establishment) into the endangered area via the import pathway: *Thrips palmi* Karny, Solanum quitoense machorreo phytoplasma (group 16SrIII-J), and *Tomato yellow mosaic begomovirus* (ToYMV) (Geminiviridae).

The remaining three organisms met the threshold for unacceptable consequences of introduction and had a non-negligible likelihood of introduction. We therefore consider these pests to be candidates for risk management:

Pest type	**Taxonomy**	**Scientific name**	**Likelihood of Introduction overall rating**
Arthropod	Diptera: Lonchaeidae	*Neosilba glaberrima* Wiedemann	Medium
	Diptera: Tephritidae	*Anastrepha fraterculus* Wiedemann	High
	Lepidoptera: Crambidae	*Neoleucinodes elegantalis* Guenée	Medium

Detailed examination and choice of appropriate phytosanitary measures to mitigate pest risk are part of the pest risk management phase within APHIS and are not addressed in this document.

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1. Introduction

1.1. Background

This document was prepared by the Plant Epidemiology and Risk Analysis Laboratory of the Center for Plant Health Science and Technology, USDA Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), to evaluate the pest risk associated with the importation of commercially produced fresh fruit with calyx and stem tissue of naranjilla (*Solanum quitoense* Lam.), also called lulo, for consumption from Colombia into the continental United States.

This is a qualitative risk assessment, meaning that the likelihood and consequences of pest introduction are expressed as qualitative ratings rather than in numerical terms. Methodology and rating criteria used are detailed in the *Guidelines for Plant Pest Risk Assessment of Imported Fruit and Vegetable Commodities, Version 6.0* (PPQ, 2012). 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, Including Analysis of Environmental Risks and Living Modified Organisms" (IPPC, 2013). The use of biological and phytosanitary terms is consistent with ISPM No. 5, "Glossary of Phytosanitary Terms" (IPPC, 2012).

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 (7 CFR § 319.56,). Currently, under this regulation, the entry of naranjilla from Colombia into the continental United States is not authorized. This commodity risk assessment was initiated due to a request by the Instituto Colombiano Agropecuario (ICA) to change the Federal Regulation to allow entry (ICA, 2002).

1.3. Determination of the necessity of a weed risk assessment for the commodity

In some cases, an imported commodity could become invasive in the pest risk analysis (PRA) area. If warranted, the pest risk posed by the commodity itself is evaluated in a weed risk assessment, conducted separately from the commodity risk assessment.

Weed risk assessments are unnecessary for plant species that are widely established (native or naturalized) or cultivated in the PRA area, for commodities that are already enterable into the PRA area from other countries, or when the plant part(s) cannot easily propagate on its own or be propagated. We determined that a weed risk assessment is not needed for naranjilla because fresh naranjilla fruit is already enterable into the United States from Ecuador, Guadeloupe, Guatemala, Mexico, Nicaragua, and Saint Barthélemy (PPQ, 2015).

1.4. Description of the pathway

A pathway is "any means that allows the entry or spread of a pest" (IPPC, 2012). In the context of this risk assessment, the *pathway* is the commodity to be imported, together with all the processes the commodity undergoes (from production through importation and distribution) that may have an impact on pest risk.

In this risk assessment, the specific pathway of concern is the importation of fresh fruit with calyx and stem tissue of naranjilla (*Solanum quitoense* Lam.) for consumption from Colombia into the continental United States; the movement of this commodity provides a potential pathway for the introduction and/or spread of plant pests.

The following description of this pathway focuses on the conditions that may affect plant pest risk, including morphological and physiological characteristics of the commodity, as well as processes that the commodity will undergo from production in Colombia through importation and distribution in the continental United States. The risk ratings in this risk assessment are contingent upon the application of all components of the pathway as described below.

1.4.1. Description of the commodity

The common name for *Solanum quitoense* is naranjilla, which means "little orange" in Spanish (Morton, 1987; Paull and Duarte, 2011). It is also called lulo, naranjilla de Quito, nuqui, and toronja. The naranjilla plant is a spreading, herbaceous, perennial shrub the grows 6.5-9.8 feet (2-3 meters) tall. Stems become woody as they age. Wild plants have leaves with spines, but many cultivars grown commercially are spineless. The fruit are covered in a brown, hairy coat until ripe, at which time the hairs can easily be rubbed off. Ripe fruits are produced in clusters of three to six and are 1.5-4 inches (4-10 cm) in diameter, round, orange, and have a persistent, 5-pointed calyx. The leathery peel contains a translucent green or yellowish pulp with the flavor of pineapple and lemon. The seeds and pulp can be consumed fresh, used to make juices and jellies, or cooked in desserts (Morton, 1987; Paull and Duarte, 2011). Figure 1 contains a photograph of *S. quitoense* fruit.

Figure 1. Photograph of *Solanum quitoense* fruits displayed with a U.S. dime for scale (Fabhawk, 2006).

1.4.2. Production and harvest procedures in the exporting area

Production and harvesting procedures in Colombia are not being considered as part of the assessment.

1.4.3. Post-harvest procedures in the exporting area

Post-harvest procedures in Colombia are not being considered as part of the assessment.

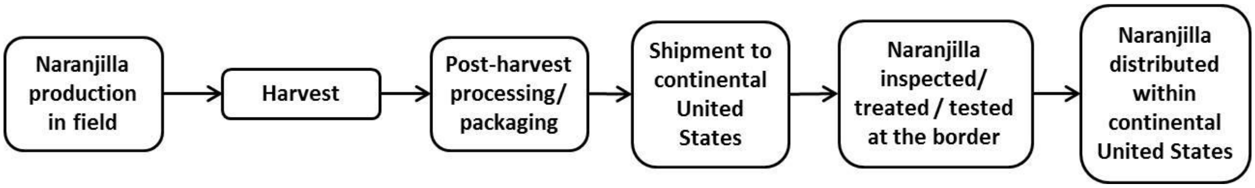
1.4.4. Shipping and storage conditions

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

1.4.5. Summary of the pathway

Figure 1 summarizes the pathway of concern: the importation of fresh fruit with calyx and stem tissue of naranjilla for consumption from Colombia into the continental United States.

Figure 2. Pathway diagram for imports of naranjilla from Colombia into the continental United States.



2. Pest List and Pest Categorization

The pest list is a compilation of all plant pests with actionable regulatory status for the continental United States that are present in Colombia (on any host) and associated with naranjilla (anywhere in the world). Species on the pest list with a reasonable likelihood of being present on naranjilla at the time of harvest could follow the pathway into the continental United States, and are therefore analyzed in more detail to determine their pest risk potential. Pests are considered to be of regulatory significance if they are actionable at U.S. ports-of-entry. Actionable pests include quarantine pests, regulated non-quarantine pests, pests under official control or considered for official control, and pests that require evaluation for regulatory action.

2.1. Pests considered but not included on the pest list

<u>2.1.1. Pests with weak evidence for association with the commodity or for presence in the export area</u>

Posada (1989) lists *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae) as being trapped in *Solanum quitoense* in Colombia. This polyphagous fruit fly is widespread in Colombia (CABI, 2015; Castaneda et al., 2010), but no *Solanum* spp. are listed as hosts (CABI, 2015;). Based on a review of the scientific literature [including a review of the Nearctic and Neotropical tephritid fruit flies (Aluja et al., 2003; Foote et al., 1993; Norrbom and Kim, 1988; Steck, 2001; Yepes and Velez, 1989)], as well as a risk analysis published by the Ecuadorian Agricultural Health Service (SESA) and the Galapagos Inspection and Quarantine System (SICGAL) (Lincango and Morales, 2005) for the importation of plant products to the Galapagos Islands, we found no other evidence that naranjilla is a host of *A. obliqua*. Based on the above, we conclude there is weak evidence for the association of naranjilla with *A. obliqua*, and we did not include it in the pest list.

Posada (1989) lists the leafhopper *Depanisca sulcata* (Signoret) [syn. *Tettigonia sulcata*] as feeding on the leaves of naranjilla in Colombia. However, Freytag and Sharkey (2002) do not list any *Depanisca* species as being present in Colombia. Additionally, McKamey (2000) only lists *Tettigonia sulcata* as being present in Venezuela and Bolivia. Because we found no other evidence of this pest being present in Colombia or feeding on naranjilla, we did not include *D. sulcata* in the pest list.

Living larvae of *Diaphania indica* Saunders complex and *Leucinodes orbonalis* Guenée (Lepidoptera: Crambidae) were intercepted in/with passenger baggage containing naranjilla fruit (PestID, 2015). Although these are reportable pest species, we did not find any evidence of these pests occurring in Colombia (CABI, 2015; Montilla et al., 2013). Additionally, *L. orbonalis* is predominately a pest of eggplant and has been reported on other solanaceous plants, but not on *S. quitoense* (Montilla et al., 2013).

The following slugs and snails that are quarantine pests for the United States are present in Colombia: *Cornu asperum* (Müller), *Boettgerilla pallens* Simroth, *Deroceras* (*Deroceras*) *panormitanum* (Lessona & Pollonera, and *Ovachlamys fulgens* (Gude) (Capinera and White, 2014; Gregoric et al., 2013; Hausdorf, 2002; PestID, 2015). We did not include these mollusk species in Table 2 because we found no specific information about these mollusks feeding on *Solanum quitoense*. However, terrestrial mollusks are often polyphagous (Barker, 2002), so some of these species may be present on naranjilla in Colombia. Additionally, the pest list does not include Colombian forest snail species from the genus *Hirtudiscus* Hylton Scott. *Hirtudiscus* species are highly unlikely to occur in naranjilla production areas since they are known only from Andean forests (Hausdorf, 2003; Hausdorf and Bermúdez, 2006).

The potato cyst nematodes *Globodera pallida* (Stone) Behrens and *G. rostochiensis* (Wollenweber) Skarbilovich occur in Colombia (Baeza, 1972; Evans et al., 1975; Nieto Paez, 1972) and infect *Solanum* species (Subbotin et al., 2010). However, *S. quitoense* is considered to be resistant to these species because they are unable to complete their life cycle on it (Roberts and Stone, 1979; Roberts and Stone, 1983; Scholte, 2000). Thus, we did not include these potato cyst nematodes in the pest list.

The nematode *Meloidogyne enterolobii* Yang & Eisenback (syn. *M. mayaguensis* Rammah & Hirschmann) can infect naranjilla roots (Crozzoli et al., 2012) and occurs in Central and South America (Perry et al., 2009). We found no records of this nematode in Colombia though, so we did not include *M. enterolobii* in the pest list.

Laboratory studies indicate the fungus *Helminthosporium carposaprum* Pollack can infect naranjilla (Esquivel, 1975). *Helminthosporium carposaprum* has been intercepted on tomato fruit imported from Mexico into the United States, and this fungus is known to occur in Panama (Esquivel, 1975). However, we found no evidence that *H. carposaprum* occurs in Colombia, so we did not include it in the pest list.

The fungus *Fusarium oxysporum* f.sp. *quitoense* J.B. Ochoa, Yangari, M.A. Ellis & R.N. Williams damages naranjilla plants in Ecuador (Ochoa et al., 2004; Ochoa et al., 2005). However, we found no records of this fungus occurring in Colombia. Thus, we did not include it in Table 2.

The fungus *Moniliophthora perniciosa* (Stahel) Aime & Phillips-Mora [syn. *Crinipellis perniciosa* (Stahel) Singer] occurs in Colombia (Osorio-Solano et al., 2012; Wheeler and Mepsted, 1988). However, we did not include this fungus in the pest list because the only evidence for its association with naranjilla is a laboratory study (Dickstein and Purdy, 1995). *Moniliophthora perniciosa* primarily infects *Theobroma cacao* (Osorio-Solano et al., 2012) and has not been recorded infecting *S. quitoense* in the field. Additionally, *M. perniciosa* is unable to complete its life cycle on solanaceous hosts (Marelli et al., 2009).

The rust fungus *Puccinia pittieriana* Henn. occurs in Colombia (Buritica and Pardo Cardona, 1996). It primarily infects potato (*Solanum tuberosum*) and tomato (*S. lycopersicum*), but laboratory studies indicate that it can also infect several wild *Solanum* species (Buriticá et al., 1968). However, we found no records of *P. pittieriana* infecting naranjilla, so we did not include this fungus in Table 2.

The oomycete species *Phytophthora andina* Adler & Flier was described from infected *Solanum quitoense* plants in Ecuador (Oliva et al., 2010). However, the validity of this species name is uncertain (Cárdenas et al., 2011), and we found no records of this pathogen in Colombia. Thus, we did not include *P. andina* in the pest list in Table 2.

The fungus *Stagonosporopsis crystalliniformis* (Loer., R. Navarro, M. Lôbo & Turkenst.) Aveskamp, Gruyter & Verkley (syn. *Phoma andina* var. *crystalliniformis* Loer., R. Navarro, M. Lôbo & Turkenst.) occurs inoccurs in Colombia (Boerema et al., 2004; Navarro Alzate and Lobo Arias, 1989). *Stagonosporopsis crystalliniformis* naturally infects tomato, pepper, and wild potato plants (Boerema et al., 2004; Navarro Alzate and Lobo Arias, 1989). A laboratory study indicated that *S. crystalliniformis* can also infect *S. quitoense* (Boerema et al., 2004), but this fungus has not been detected on *S. quitoense* plants in the field. Because this host association only comes from laboratory studies, we did not include *S. crystalliniformis* in Table 2.

An unidentified race of *Ralstonia solanacearum* (Smith) Yabuuchi et al. [syn. *Pseudomonas solanacearum* (Smith) Smith] is associated with *S. quitoense* in Colombia (Buriticá, 1999; Salazar Pineda and Castaño Zapata, 1996). It is unclear which *Ralstonia* race infects naranjilla, and multiple races and strains of *Ralstonia* are present in Colombia (Allen et al., 2005). Because the race infecting naranjilla in Colombia is unknown, we did not include this pathogen in the pest list. Additionally, the U.S. quarantine pathogen *R. solanacearum* race 3 biovar 2 (phylotype II, sequevar I) is unlikely to become established in the United States if introduced on commodities for consumption, such as naranjilla (PERAL, 2011).

The tymovirus *Andean potato latent virus* (APLV) occurs in Colombia and infects members of the genus *Solanum* (Gibbs et al., 1966). However, we did not include this virus in the pest list because we found no records associating APLV with *S. quitoense*. Likewise, the crinivirus *Potato yellow vein virus* (PYVV) occurs in Colombia and infects potato, but does not infect *S. quitoense* (Salazar et al., 2000), so we did not add PYVV to the pest list.

We found information about two additional viruses reported from naranjilla in Colombia with unclear identities and taxonomies. The "virus de la hoja pequeña" (little leaf virus) on naranjilla in Colombia (Gomez, 1990; Tamayo M. et al., 2001) is reportedly very similar to *Potato leafroll virus* (Tamayo M. et al., 2001), but that common name is used to describe the symptoms of several viruses in different hosts (Horst, 2001). Likewise, the "virus del Amarillamiento Intervenal" or "Amarillamiento de la hoja" (interveinal yellowing virus or leaf-yellowing virus) infects naranjilla in Colombia (Bustillo et al., 1988; Gomez, 1997; Salazar Pineda and Castaño Zapata, 1996; Zuluaga R., 1994), but that common name is also associated with the symptoms caused by several virus species (Horst, 2001; Stevenson, 2001). Neither of these viruses are listed as accepted species names by the International Committee on the Taxonomy of Viruses

(ICTV, 2016). Because of uncertainty about the identify of these viruses, we did not list "virus de la hoja pequeña" or "virus del Amarillamiento Intervenal" in the pest list.

2.1.2. Organisms with non-actionable regulatory status

We found evidence of the organisms listed in the appendix being associated with naranjilla and being present in Colombia; however, because these organisms have non-actionable regulatory status for the continental United States, we did not include them in Table 2 of this risk assessment.

2.1.3. Organisms identified only to the genus level

In commodity import risk assessments, the taxonomic unit for pests selected for evaluation beyond the pest categorization stage is usually the species (IPPC, 2013), as we focus assessments on organisms for which biological information is available. Therefore, generally, we do not assess risk for organisms identified only to the genus level, in particular if the genus in question is reported in the import area. Many genera contain several or more species, and we cannot know if the unidentified species occurs in the import area and, consequently, whether it has actionable regulatory status for the import area. On the other hand, if the genus in question is absent from the import area, any unidentified organisms in the genus can have actionable status; however, because such an organism has not been fully identified, we cannot properly analyze its likelihood and consequences of introduction.

In light of these issues, we usually do not include organisms identified only to the genus level in the main pest list. Instead, we address them separately in this sub-section. The information here can be used by risk managers to determine if measures beyond those intended to mitigate fully identified pests are warranted. Often, mitigation measures developed for identified pests will be effective against the pests for which we have little information, but only risk managers can make this judgement.

For this risk assessment, we identified the following organisms identified only to the genus level that are reported on *Solanum quitoense* in Colombia and that also occur in the continental United States, and listed these organisms in Table 1.

Table 1. Organisms identified to the genus level that are reported on *Solanum quitoense* (naranjilla) in Colombia in genera that also occur in the continental United States.

Pest type	Taxonomy	Scientific name	Evidence of presence on *Solanum quitoense* in Colombia
Arthropods	Coleoptera: Cerambycidae	*Alcidion* sp.	Castaño, 1996; Gallego and Velez, 1992; Posada, 1989
		Nyssodrys sp. (syn. *Nyssodrysina*)	Figueroa, 1977; Gallego and Velez, 1992; Posada, 1989
	Coleoptera: Chrysomelidae	*Diabrotica* sp.	Gallego and Velez, 1992
	Coleoptera: Curculionidae	*Anthonomus* sp.	Castaño, 1996; Clark and Burke, 1996; Gallego and Velez, 1992
		Faustinus sp.	Castaño, 1996; Posada, 1989

Pest type	**Taxonomy**	**Scientific name**	**Evidence of presence on *Solanum quitoense* in Colombia**
	Diptera: Agromyzidae	*Phytobia* sp.	Gallego and Velez, 1992; Posada, 1989
	Diptera: Tephritidae	*Anastrepha* sp.	Gallego and Velez, 1992; PestID, 2015
	Hemiptera: Coreidae	*Leptoglossus* sp.	Gallego and Velez, 1992
	Hemiptera: Diaspididae	*Diaspis* sp.	Posada, 1989
		Pinnaspis sp.	Castaño, 1996; Posada, 1989
	Hemiptera: Margarodidae	*Margarodes* sp.	Castaño, 1996; Posada, 1989
	Hemiptera: Pseudococcidae	*Pseudococcus* sp.	Gallego and Velez, 1992
	Lepidoptera: Crambidae	*Neoleucinodes* sp.	Montilla et al., 2013: PestID, 2015
Nematodes	Criconematidae	*Criconemoides* spp. (syn. *Criconemella* spp.)	Múnera Uribe, 2008
	Hoplolaimidae	*Helicotylenchus* sp.	Salazar Pineda and Castaño Zapata, 1996; Tamayo M. et al., 2001
	Meloidogynidae	*Meloidogyne* spp.	Gomez, 1990; Salazar G. et al., 2012
	Pratylenchidae	*Pratylenchus* spp.	Buriticá, 1999; Múnera Uribe, 2008
	Trichodoridae	*Trichodorus* spp.	Buriticá, 1999; Múnera Uribe, 2008; Salazar Pineda and Castaño Zapata, 1996
Fungi and Oomycetes	Agaricomycetes: Agaricales	*Armillaria* sp.	Buriticá, 1999; Franco et al., 2002
	Dothideomycetes: Capnodiales	*Cercosporella* sp.	Cordoba and Pineda, 1986
		Cladosporium sp.	Buriticá, 1999; Gomez, 1990
		Ramularia sp.	Salazar Pineda and Castaño Zapata, 1996
		Septoria sp.	Cordoba and Pineda, 1986
	Dothideomycetes: Pleosporales	*Phoma* sp.	Salazar Pineda and Castaño Zapata, 1996
	Leotiomycetes: Helotiales	*Gloeosporium* sp.	Lobo Arias and Girard, 1977
		Sclerotinia sp.	Gomez, 1990
	Peronosporea: Peronosporales	*Phytophthora* sp.	Salazar Pineda and Castaño Zapata, 1996
		Pythium sp.	Buriticá, 1999; Franco et al., 2002
	Sordariomycetes: Hypocreales	*Cephalosporium* sp.	Zuluaga R., 1994
		Fusarium sp.	Gomez, 1997; Salazar Pineda and Castaño Zapata, 1996
	Sordariomycetes: Incertae sedis	*Colletotrichum* sp.	Montes Rojas et al., 2010
		Verticillium spp.	Gomez, 1997

Pest type	Taxonomy	Scientific name	Evidence of presence on *Solanum quitoense* in Colombia
Bacteria		*Erwinia* sp.	Franco et al., 2002; Salazar Pineda and Castaño Zapata, 1996

2.2. Pest list

In Table 2, we list the actionable pests associated with naranjilla that occur in Colombia. The list comprises those actionable pests that occur in Colombia on any host and are associated with naranjilla whether in Colombia or elsewhere in the world. For each pest, we indicate 1) the part of the imported plant species with which the pest is generally associated and 2) whether the pest has a reasonable likelihood of being associated, in viable form, with the commodity following harvesting from the field and prior to any post-harvest processing. We developed this pest list based on the scientific literature, port-of-entry pest interception data, and information provided by the government of Colombia. Pests in shaded rows are pests identified for further evaluation, as we consider them reasonably likely to be associated with the harvested commodity; we summarize these pests in a separate table (Table 3).

Table 2. Actionable pests associated with *Solanum quitoense* (in any country) and present in Colombia (on any host).

Pest name	Evidence of presence in Colombia	Association with *Solanum quitoense*	Plant part(s) association[1]	On harvested plant part(s)?[2]	Remarks
ARTHROPODS					
Coleoptera: Chrysomelidae					
Colaspis aeruginosa Germar	Gallego and Velez, 1992; Lincango and Morales, 2005; Posada, 1989	Gallego and Velez, 1992; Posada, 1989; Rogg, 2000	Leaf (Gallego and Velez, 1992; Posada, 1989; Rogg, 2000)	No	
Colaspis lebasi Lefevre	Figueroa, 1977; Gallego and Velez, 1992; Rubiano and Morera, 2006	Gallego and Velez, 1992; Rubiano and Morera, 2006	Leaf (Gallego and Velez, 1992; Rubiano and Morera, 2006)	No	"*Colaspis* sp. prob. *lebasi*" was collected on *Hibiscus* in Florida (Clark et al., 2004).
Exora encaustica Germar	Gallego and Velez, 1992; Peck et al., 2014	Gallego and Velez, 1992	Leaf (Gallego and Velez, 1992)	No	
Coleoptera: Coccinellidae					

[1] 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.

[2] "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 in Risk Element A1 as part of the Likelihood of Introduction assessment (section 3).

Pest name	Evidence of presence in Colombia	Association with *Solanum quitoense*	Plant part(s) association[1]	On harvested plant part(s)?[2]	Remarks
Epilachna flavofasciata (LaPorte)	Gallego and Velez, 1992; Gordon, 1975; Jadwiszczak and Wegrzynowicz, 2003; Posada, 1989	Gallego and Velez, 1992; Posada, 1989; Rogg, 2000	Leaf (Gallego and Velez, 1992; Posada, 1989)	No	
Coleoptera: Curculionidae					
Anthonomus ciliaticollis Champion	Clark and Burke, 1996; Gallego and Velez, 1992; Posada, 1989	Clark and Burke, 1996; Gallego and Velez, 1992; Posada, 1989	Flower (Gallego and Velez, 1992; Posada, 1989)	No	
Faustinus apicalis (Faust)	Davis, 1996; Gallego and Velez, 1992	Davis, 1996; Gallego and Velez, 1992; Paull and Duarte, 2011; Rogg, 2000	Root (Rogg, 2000), Stem (Davis, 1996; Gallego and Velez, 1992; Paull and Duarte, 2011; Rogg, 2000)	No	Because larvae make galleries in the main stems of the host plant and migrate downwards until they ultimately reach the roots (Dias de Almeida et al., 2009), they are unlikely to be found in the stems attached to naranjilla fruit.
Coleoptera: Scarabaeidae					
Ancognatha scarabaeoides Erichson	Rubiano and Morera, 2006; Vallejo and Morón, 2008	Rubiano and Morera, 2006	Root (Rubiano and Morera, 2006)	No	
Clavipalpus ursinus Blanchard	Rubiano and Morera, 2006	Rubiano and Morera, 2006	Root (Rubiano and Morera, 2006)	No	
Diptera: Agromyzidae					

Pest name	Evidence of presence in Colombia	Association with *Solanum quitoense*	Plant part(s) association[1]	On harvested plant part(s)?[2]	Remarks
Liriomyza solanita Spencer	Posada, 1989; Spencer, 1990	Posada, 1989	Leaf (Posada, 1989)	No	Larvae of the congenic species *Liriomyza sativae* may pupate on the calyx end of tomato fruit (Johnson et al., 1984). However, we did not find any information about *L. solanita* behaving in this way on naranjilla; *L. solanita* has only been recorded mining the leaves of naranjilla (Posada, 1989).
Diptera: Lonchaeidae					
Neosilba glaberrima Wiedemann	Maes, 2015; McAlpine and Steyskal, 1982; Yepes and Velez, 1989	Yepes and Velez, 1989	Fruit (McAlpine and Steyskal, 1982; Yepes and Velez, 1989)	Yes	Present in St. Croix, U.S. Virgin Islands (Maes, 2015). Generally a secondary pest that attacks fruit damaged by other insects, primarily tephritid fruit flies (McAlpine and Steyskal, 1982). More recent reports indicate that *Neosilba* flies may be primary invaders of some hosts (e.g., Uchôa-Fernandes et al., 2003).

Pest name	Evidence of presence in Colombia	Association with *Solanum quitoense*	Plant part(s) association[1]	On harvested plant part(s)?[2]	Remarks
Diptera: Tephritidae					
Anastrepha fraterculus Wiedemann	Botha et al., 2004; CABI, 2015; Cladera et al., 2014; Norrbom and Kim, 1988; Patiño, 2002; Sequeira et al., 2001; Stone, 1942; White and Elson-Harris, 1994	Botha et al., 2004; CABI, 2015; Norrbom and Kim, 1988; Patiño, 2002; White and Elson-Harris, 1994	Fruit (Botha et al., 2004; CABI, 2015; Norrbom and Kim, 1988; White and Elson-Harris, 1994)	Yes	Restricted distribution in the United States (TX) (Botha et al., 2004; CABI, 2015; Cladera et al., 2014; Stone, 1942, White and Elson-Harris, 1994).
Hemiptera: Tingidae					
Corythaica cyathicollis Costa	Correa et al., 2012; Figueroa, 1977; Gallego and Velez, 1992; Montemayor and Coscaron, 2005; Olckers et al., 2002; Posada, 1989; Rubiano and Morera, 2006	Figueroa, 1977; Gallego and Velez, 1992; Montemayor and Coscaron, 2005; Posada, 1989; Rubiano and Morera, 2006	Leaf (Figueroa, 1977, Posada, 1989; Rubiano and Morera, 2006)	No	Polyphagous (Stonedahl et al., 1992). Evaluated as a potential biological control agent for *Solanum viarum* in the United States (Olckers et al., 2002).
Corythucha fuscomaculata (Stal)	Couturier, 1988; Gallego and Velez, 1992; Montemayor and Coscaron, 2005; Posada, 1989	Couturier, 1988; Gallego and Velez, 1992; Posada, 1989	Leaf (Posada, 1989)	No	
Lepidoptera: Crambidae					
Neoleucinodes elegantalis Guenée	CABI, 2015; Castaño, 1996; Diaz and Alma, 2007; EPPO, 2015a; Gallegos et al., 2003; PERAL, 2012	CABI, 2015; Castaño, 1996; Diaz and Alma, 2007; EPPO, 2015a; Gallegos et al., 2003; PERAL, 2012	Fruit (Castaño, 1996; Diaz and Alma, 2007; EPPO, 2015a; Gallegos et al., 2003; PERAL, 2012), Stem (CABI, 2015)	Yes	
Lepidoptera: Gelechiidae					
Keiferia colombiana Povolny	Adamski and Brown, 2002; Povolny, 1975	Adamski and Brown, 2002; Povolny, 1975	Leaf (Povolny, 1975)	No	

Pest name	**Evidence of presence in Colombia**	**Association with *Solanum quitoense***	**Plant part(s) association**[1]	**On harvested plant part(s)?**[2]	**Remarks**
Phthorimaea isochlora (Meyrick)	Gallego and Velez, 1992; Posada, 1989; Povolny, 1975	Gallego and Velez, 1992; Posada, 1989; Povolny, 1975	Leaf (Gallego and Velez, 1992; Posada, 1989; Povolny, 1975)	No	
Scrobipalpula motasi (Povolny)	Gallego and Velez, 1992; Vélez and Povolny, 1988	Gallego and Velez, 1992; Vélez and Povolny, 1988	Leaf (Gallego and Velez, 1992; Vélez and Povolny, 1988)	No	
Symmetrischema insertum Povolny	Martínez Córdoba et al., 2010; Gallego and Velez, 1992; Vélez and Povolny, 1988	Martínez Córdoba et al., 2010; Gallego and Velez, 1992; Vélez and Povolny, 1988	Flower (Martínez Córdoba et al., 2010; Gallego and Velez, 1992; Vélez and Povolny, 1988), leaf (Vélez and Povolny, 1988)	No	
Tuta absoluta (Meyrick) [syn. *Scrobipalpula absoluta*]	CABI, 2015; EPPO, 2005; PERAL, 2009; Povolny, 1975; CPHST, 2011	Povolny, 1975	Leaf (Povolny, 1975)	No	Povolny, 1975) states that *Scrobipalpula absoluta* was reared from the common weed "lulo," but we found no other records listing naranjilla as a host of this pest.
Lepidoptera: Nymphalidae					
Mechanitis polymnia Haensch	Gallego and Velez, 1992; Muriel et al., 2011	Gallego and Velez, 1992; Rogg, 2000	Leaf (Gallego and Velez, 1992)	No	
Lepidoptera: Tineidae					
Prosetomorpha falcata Davis	Davis, 1996	Davis, 1996	Stem (Davis, 1996)	No	Larvae are scavengers in stem tunnels made by *Faustinus apicalis* (Davis, 1996).
Thysanoptera: Thripidae					
Thrips palmi Karny	CABI, 2015; Durán et al., 1999; Belalcazar, 2011; Rubiano and Morera, 2006	Durán et al., 1999; Belalcazar, 2011; Rubiano and Morera, 2006	Leaf (Rubiano and Morera, 2006)	Yes	Restricted distribution in the United States (FL, HI) (Capinera, 2013; Seal, 2004).

Pest name	Evidence of presence in Colombia	Association with *Solanum quitoense*	Plant part(s) association[1]	On harvested plant part(s)?[2]	Remarks
NEMATODES					
Meloidogyne exigua Goeldi	Betancourth García et al., 2011; Múnera Uribe, 2008	Betancourth García et al., 2011	Root (Múnera Uribe, 2008; Sasser and Carter, 1985)	No	
Mesocriconema peruense (Steiner) Loof & De Grise	Volcy, 1998	Volcy, 1998	Root (Volcy, 1998)	No	
BACTERIA					
Solanum quitoense machorreo phytoplasma (group 16SrIII-J)	Alvarez et al., 2003; Álvarez et al., 2005	Alvarez et al., 2003; Álvarez et al., 2005	Entire plant (Mejia, 2014)	Yes	This phytoplasma in the 16SrIII-J (X-disease) group (Mejia, 2014) is very similar to the coffee crispiness phytoplasma in Colombia (Galvis et al., 2007).
VIRUSES					
Tomato yellow mosaic begomovirus (ToYMV) (syn. *Potato yellow mosaic virus*)	Morales et al., 2001; Morales et al., 2002	Infante et al., 1996	Entire plant (Infante et al., 1996)	Yes	ToYMV is associated with *S. quitoense* based on greenhouse and field experiments (Infante et al., 1996).

2.3. Pests selected for further analysis

We identified five pests for further analysis (Table 3). All of these organisms are actionable pests for the continental United States and have a reasonable likelihood of being associated with the commodity plant part(s) at the time of harvest and remaining with the commodity, in viable form, throughout the harvesting process.

Table 3. Pests selected for further analysis.

Pest type	Taxonomy	Scientific name
Arthropod	Diptera: Lonchaeidae	*Neosilba glaberrima*
	Diptera: Tephritidae	*Anastrepha fraterculus*
	Lepidoptera: Crambidae	*Neoleucinodes elegantalis*
Phytoplasma		Solanum quitoense machorreo phytoplasma (group16SrIII-J)
Viruses	Geminiviridae	*Tomato yellow mosaic begomovirus* (ToYMV)

3. Assessing Pest Risk Potential

3.1. Introduction

For each pest selected for further analysis, we estimate its overall pest risk potential. Risk is described by the likelihood of an adverse event, the magnitude of the consequences, and uncertainty. In this risk assessment, we first determine for each pest if there is an endangered area within the PRA area. The endangered area is defined as the portion of the import area where ecological factors favor the establishment of the pest and where the presence of the pest will result in economically important losses. Once an endangered area has been determined, the overall risk of each pest is then determined with two separate components: 1) the likelihood of its introduction into the endangered area on the imported commodity (i.e., the likelihood of an adverse event) and 2) the consequences of its introduction (i.e., the magnitude of the consequences). In general, we assess both of these components for each pest. If we determine that the risk of either component is negligible, however, assessing the other is not necessary, because the overall pest risk potential will be negligible regardless of the result of the second component. For example, if we determine that pest introduction is highly unlikely, we do not assess the consequences of it being introduced.

The likelihood and consequences of introduction are assessed using different approaches. For the consequences of introduction, we determine if the pest meets the threshold (Yes/No) of being likely to cause unacceptable losses. We base that determination on the physical damage the pest is likely to cause and/or the proportion of exports likely to be disrupted, rather than on an absolute value or amount of monetary loss.

The likelihood of introduction is based on the likelihoods of entry and establishment. We qualitatively assess risk using the ratings Negligible, Low, Medium, and High. The risk factors comprising the model for likelihood of introduction are interdependent and, therefore, the model is multiplicative rather than additive. Thus, if any one risk element is rated as Negligible, then the overall likelihood will be Negligible. For the overall likelihood of introduction risk rating, we define the different categories as follows:

High: Pest introduction is highly likely to occur.

Medium: Pest introduction is possible, but for that to happen, the exact combination of required events needs to occur.

Low: Pest introduction is unlikely to occur because one or more of the required events are unlikely to happen, or the full combination of required events is unlikely to align properly in time and space.

Negligible: Pest introduction is highly unlikely to occur given the exact combination of events required for successful introduction.

3.2. Assessment results

3.2.1. *Anastrepha fraterculus*

We determined the overall likelihood of introduction to be High. Although naranjilla has been shown to be a host of *A. fraterculus*, there have been no reports of *A. fraterculus* causing economic damage to naranjilla. Additionally, we are unsure of the actual population density of this pest in naranjilla growing areas of Colombia; therefore, our overall uncertainty in that rating was moderately high. We present the results of this assessment in the table below.

We determined that the establishment of *A. fraterculus* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below.

Determination of the portion of the continental United States endangered by *Anastrepha fraterculus*

Climatic suitability	*Anastrepha fraterculus* occurs in North, Central, and South America and the Caribbean, ranging from southern Texas to Argentina (CABI, 2015; Foote et al., 1993; PPQ, 2002). More specifically, it occurs in southern Texas (Rio Grande Valley), Mexico (localized distribution), Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Trinidad and Tobago, Argentina (localized distribution), Bolivia, Brazil, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela (CABI, 2015; PPQ, 2002). This distribution covers a temperature range corresponding to USDA Plant Hardiness Zones 8-11 (Magarey et al., 2008; PERAL/CIPM, 2008).
Potential hosts at risk in PRA Area	*Anastrepha fraterculus* feeds on multiple genera in multiple plant families, including Actinidiaceae (*Actinidia*), Anacardiaceae (*Mangifera*, *Spondias*), Annonaceae (*Annona*), Combretaceae (*Terminalia*), Ebenaceae (*Diospyros*), Juglandaceae (*Juglans*), Lauraceae (*Persea*), Moraceae (*Ficus*), Myrtaceae (*Eugenia*, *Psidium*, *Syzygium*), Oleaceae (*Olea*), Punicaceae (*Punica*), Rosaceae (*Cydonia*, *Eriobotrya*, *Fragaria*, *Malus*, *Prunus*, *Pyrus*, *Rubus*), Rutaceae (*Citrus*, *Fortunella*), Sapotaceae (*Manilkara*, *Pouteria*), Solanaceae (*Solanum*), and Vitaceae (*Vitis*) (CABI, 2015; White and Elson-Harris, 1994).
Economically important hosts at risk	The *A. fraterculus* species complex may infest such important crops as apple, citrus, and grapes (CABI, 2015).
Pest potential on economically important hosts at risk[a]	The *A. fraterculus* species complex damages economically important plants (Weems, 2006). In Argentina, *A. fraterculus* is considered the most important pest of citrus (PPQ, 2002). The oviposition punctures ("stings") alone may render fruit unmarketable (Gould and Raga, 2002). In Brazil, it causes severe yield losses in apple due to fruit malformation and drop, and significantly restricts fresh fruit exports to countries with quarantine barriers (Sugayama et al., 1996). *Anastrepha fraterculus* is considered the most important fruit fly in Colombia, where it affects coffee, mango, and guava (Nuñez Bueno, 1996). The introduction of *A. fraterculus* into new areas of the continental United States would likely stimulate control programs (APHIS, 1984; Guillen and Sanchez, 2007; Vera et al., 2007), thereby increasing crop production costs.
Defined Endangered Area	The area endangered by *A. fraterculus* comprises citrus, grapes, *Prunus* and other important hosts in Plant Hardiness Zones 8-11.

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2013).

Assessment of the likelihood of introduction of *Anastrepha fraterculus* into the endangered area via the importation of naranjilla fruit from Colombia

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Likelihood of Entry			
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	High	U	In this analysis, we did not consider any field practices that would reduce the prevalence of this species in the field. Furthermore, this species has a high level of fecundity. Females can lay up to 50 eggs in a single fruit, depending on maturity and variety of the host fruit (PPQ, 2002). Naranjilla has been listed as a host of *A. fraterculus* in Colombia (Botha et al., 2004; Norrbom and Kim, 1988; Patiño, 2002; White and Elson-Harris, 1994), but we did not find any information on the prevalence of this pest on this host. *Anastrepha* spp. are major pests of naranjilla in other countries (Tapia B. et al., 1993). Because there was very little information about the pest status and the population density of *A. fraterculus* in the naranjilla-growing areas of Colombia, our uncertainty rating was uncertain.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	High	MC	Fruit infested with fruit flies are highly likely to escape detection during culling (White and Elson-Harris, 1994). We did not consider culling or any other post-harvest practices in this assessment and therefore did not change the previous rating.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	High	MU	U.S. ports-of-entry have intercepted live *Anastrepha* species over 39,000 times from a number of counties, mostly in a variety of fruit (PestID, 2015), indicating that the genus is little affected by normal shipping conditions.
Risk Element A: Overall risk rating for likelihood of entry	High	N/A	

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	High	C	*Anastrepha fraterculus* feeds on multiple genera in multiple plant families (CABI, 2015; White and Elson-Harris, 1994) and *Anastrepha* spp. can fly up to 135 km (CABI, 2015). Suitable hosts are widely and regularly distributed throughout the entire endangered area.
Risk Element B2: Likelihood of arriving in the endangered area	High	C	More than 25 percent of the U.S. population lives in the endangered area (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	High	N/A	
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment	High	N/A	

C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

Assessment of the consequences of introduction of *Anastrepha fraterculus* into the continental United States (i.e., the PRA area)

Criteria	**Meets criteria? (Yes/No)**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
Direct Impacts			
Risk Element C1: Damage potential in the endangered area	Yes	MC	The *A. fraterculus* species complex damages economically important plants (Weems, 2006). Suitable hosts (i.e., apple, citrus, grapes) are found in the endangered area (CABI, 2015); therefore, this species has significant damage potential.
Risk Element C2: Spread potential	Yes	C	In mark-release-recapture experiments in Brazil, adults of *A. fraterculus* were captured up to 800 meters from their release point (Kovaleski et al., 1999). *Anastrepha fraterculus* also moves in trade via infested fruit (CABI, 2015; PestID, 2015).

Criteria	Meets criteria? (Yes/No)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	N/A	
Trade Impacts			
Risk Element D1: Export markets at risk	N/A	N/A	
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	N/A	N/A	
Risk Element D: Pest is likely to cause significant trade impacts	N/A	N/A	
Conclusion			
Is the pest likely to cause unacceptable consequences in the PRA area?	Yes	N/A	

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

3.2.2. *Neoleucinodes elegantalis*

We determined the overall likelihood of introduction of *N. elegantalis* to be Medium. We present the results of this assessment in the table below.

We determined that establishment of *N. elegantalis* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below.

Determination of the portion of the continental United States endangered by *Neoleucinodes elegantalis*

Climatic suitability	*Neoleucinodes elegantalis* is distributed from Mexico to northern Argentina, Costa Rica, Cuba, Grenada, Guatemala, Honduras, Jamaica, Panama, Puerto Rico, Trinidad and Tobago, Brazil, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela (Anteparra et al., 2010; CABI, 2015; Díaz-Montilla et al., 2013). *Neoleucinodes elegantalis* is described as the only species within the genus that can survive in both warm and cold climates in Colombia (Diaz and Alma, 2007). The climatic conditions in Plant Hardiness Zones 9-11 (Magarey et al., 2008; PERAL/CIPM, 2008) are likely to be suitable for the survival and establishment of this insect in the continental United States.
Potential hosts at risk in PRA Area	This fruit borer attacks only plants in the Solanaceae family (CABI, 2015; Díaz-Montilla et al., 2013). Hosts include *Capsicum annuum*

	(pepper), *Cyphomandra betacea* (tree tomato), *Solanum acerifolum, Solanum atropurpureum, Solanum betaceum* (tomato tree), *Solanum crinitum, Solanum hirtum, Solanum melongena* (eggplant), *Solanum lycopersicum* (tomato), *Solanum pseudolulo, Solanum quitoense* (naranjilla), *Solanum sessiliflorum* (cocona), *Solanum sisymbriifolium,* and *Solanum torvum* (Anteparra et al., 2010; Aponte et al., 2005; Diaz and Alma, 2007; Díaz-Montilla et al., 2013).
Economically important hosts at risk[a]	Economically important hosts present in the area of concern include tomatoes, peppers, and eggplant.
Pest potential on economically important hosts at risk	*Neoleucinodes elegantalis* causes significant economic damage to solanaceous host plants in Central and South America (e.g., Cabrera et al., 2001; Diaz and Alma, 2007; EDA, 2007; Eiras and Blackmer, 2003; EPPO, 2015a). *Neoleucinodes elegantalis* is the major economic pest that impacts tomato-growing regions in Brazil, Colombia, and Venezuela (Anteparra et al., 2010; Eiras and Blackmer, 2003). Yield losses as great as 90 percent due to infestations of *N. elegantalis* in tomato have been recorded (Blackmer et al., 2001; EPPO, 2015a; Picanço et al., 2007).
Defined Endangered Area	Pepper, tomato, eggplant, and other Solanaceous crops in Plant Hardiness Zones 9 to 11 in the continental United States are at risk for *N. elegantalis* establishment.

[a] As defined by ISPM No. 11, supplement 2, “economically” important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2013).

Assessment of the likelihood of introduction of *Neoleucinodes elegantalis* into the endangered area via the importation of naranjilla fruit from Colombia

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Likelihood of Entry			
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	Medium	MU	*Neoleucinodes elegantalis* causes economic losses throughout South America in crops of solanaceous vegetables, including naranjilla (Diaz and Alma, 2007). It lays its eggs on host flowers, on the fruit calyx, and on immature fruit (Blackmer et al., 2001; EPPO, 2015a). Larvae enter the fruit, leaving a small hole that heals over time (EPPO, 2015a). Frequently, fruit may show no symptoms of infestation until larvae mature and exit the fruit. In other instances larvae feed on seeds and fruit, destroying the fruit in the

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
			process (EDA, 2007). Additionally, naranjilla fruit infested with *N. elegantalis* may fall from the plant before reaching maturity (Gallegos et al., 2003).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MU	Larvae bore directly into young fruits after hatching, leaving only minor scars as evidence of infestation (Anteparra et al., 2010; Blackmer et al., 2001; Picanço et al., 2007), and would therefore escape detection during culling. Additionally, larvae are not readily detected in packed fruits (EDA, 2007). Thus, we did not change the previous rating.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	MC	Larvae of *N. elegantalis* have been detected at U.S. ports of entry over 1,250 times since 1984; approximately 70 percent of the interceptions were in fruit in baggage (PestID, 2015). Late instar larvae abandon naranjilla fruits after 4-5 days, just before the pre-pupal stage, which lasts from 7-10 days (Gallegos et al., 2003). At 14-22 °C and ~75 percent relative humidity, the pupal stage takes 15-20 days, and the adults live for approximately 22 days. Also, infested fruit begin to rot after 7 days, which kills any remaining larvae in the fruit (Gallegos et al., 2003). For these reasons, we are moderately certain that larvae could survive in transport and storage conditions, so we did not change our previous rating.
Risk Element A: Overall risk rating for likelihood of entry	Medium	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	Medium	MC	Suitable hosts are widely and regularly distributed throughout the endangered area (see Endangered area section), and the adults can disperse on their

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			own (EPPO, 2015a; Gallegos et al., 2003; PERAL, 2009). However, the life stage most likely to arrive with the commodity would be the larvae, and possibly eggs (Gallegos et al., 2003). Therefore, the pest would need to complete development within the fruit in a suitable environment, find a suitable location to pupate (see Likelihood of surviving transport section above), emerge, find a mate, mate, and locate a suitable host on which to deposit eggs. Thus, we rated this risk element Medium due to the lower likelihood of events required for this pest to contact host material.
Risk Element B2: Likelihood of arriving in the endangered area	High	C	More than 25 percent of the U.S. population lives within the endangered area (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	Medium	N/A	
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment	Medium	N/A	

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

Assessment of the consequences of introduction of *Neoleucinodes elegantalis* into the continental United States (i.e., the PRA area)

Criteria	Meets criteria? (Yes/No)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Direct Impacts			
Risk Element C1: Damage potential in the endangered area	Yes	MC	Infestations of *N. elegantalis* in tomato production caused up to 60 percent losses in Colombia, 76-90 percent losses in Brazil, and 40 percent losses in Venezuela (during the rainy season) (Blackmer et al., 2001; EPPO, 2015a; Carneiro et al., 1998; Picanço et al., 2007). Researchers estimate that 10-15 percent of the cost of tomato production in Rio de Janeiro, Brazil, is due to chemical control measures used against four major insect pests, one of which is *N. elegantalis* (Blackmer et al., 2001).
Risk Element C2: Spread potential	Yes	MU	Adults of *N. elegantalis* can fly and the larva is an internal fruit borer, indicating that it could move in harvested fruits (Anteparra et al., 2010; EPPO, 2015a; Gallegos et al., 2003; Picanço et al., 2007).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	N/A	
Trade Impacts			
Risk Element D1: Export markets at risk	N/A	N/A	
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	N/A	N/A	
Risk Element D: Pest is likely to cause significant trade impacts	N/A	N/A	
Conclusion			
Is the pest likely to cause unacceptable consequences in the PRA area?	Yes	N/A	

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

3.2.3. *Neosilba glaberrima*

We determined the overall likelihood of introduction of *N. glaberrima* to be Medium. However, because of a general lack of information on this species, our overall uncertainty in that rating was high. Also, because *Neosilba* spp., including *N. glaberrima*, are typically considered secondary invaders that take advantage of oviposition sites created by tephritid fruit flies (Korytkowski and Ojeda, 1971; McAlpine and Steyskal, 1982), the likelihood of this fly being introduced may be greatly influenced by the prevalence and activity levels of *Anastrepha fraterculus* in the field before harvest, analyzed in section 3.2.2. We present the results of this assessment in the following table.

We determined that establishment of *N. glaberrima* in the continental United States is likely to cause unacceptable impacts. As before, we had high uncertainty about that rating. We present the results of this assessment in the table below.

Determination of the portion of the continental United States endangered by *Neosilba glaberrima*

Climatic suitability	*Neosilba glaberrima* occurs in many Caribbean Islands and from Mexico through northern Chile and southern Brazil (Gonzalez, 1989; McAlpine and Steyskal, 1982). Specifically the pest occurs in Chile (Region I, which is in the north), Colombia, Costa Rica, Brazil, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Peru, Trinidad, the U.S. Virgin Islands (St. Croix), and the West Indies (Galeano-Olaya and Canal, 2012; Gonzalez, 1989; Korytkowski and Ojeda, 1971; Uchôa and Nicácio, 2010; McAlpine and Steyskal, 1982). While one report places this species in Florida (Stone et al., 1965), a more recent revision of the genus does not include Florida in its distribution (McAlpine and Steyskal, 1982). We found no other evidence of this species occurring in the United States; the report in Florida is not supported by any physical specimens (Steck, 2015), and no specimens from the United States exist in the National Museum of Natural History collection (Norrbom, 2015). A comparison of global Plant Hardiness Zones (Magarey et al., 2008; PERAL/CIPM, 2008) indicates that potential establishment in the continental United States would be in Plant Hardiness Zones 9-11, and possibly Zone 8 as well. These zones cover much of the west coast and all of the southern states.
Potential hosts at risk in PRA Area	*Neosilba glaberrima* has been reared from numerous fruits and vegetables (McAlpine and Steyskal, 1982). Hosts that occur in Plant Hardiness Zones 8-11 in the continental United States (CIPM, 2014; Kartesz, 2015; NRCS, 2015) include Anacardiaceae: *Mangifera indica* (mango) (McAlpine and Steyskal, 1982); Annonaceae: *Annona* (Maes, 2015); Caricaceae: *Carica papaya* (papaya) (Yepes and Velez, 1989); Euphorbiaceae: *Manihot* (Maes, 2015); Moraceae: *Ficus indica* (Gonzalez, 1989); Myrtaceae: *Psidium guajava* (guava) (Souza-Filho et al., 2009); Poaceae: *Zea* spp. (Maes, 2015); Rosaceae: *Prunus persica* (peach) (Souza-Filho et al., 2009); Rutaceae: *Citrus* spp. (Maes, 2015),

	C. reticulata (tangerine) (Lopes et al., 2008); and Solanaceae: *Capsicum annuum* (pepper) (Gonzalez, 1989; McAlpine and Steyskal, 1982).
Economically important hosts at risk[a]	Economically important hosts present in the area of concern include citrus, fig, guava, mango, peach, and pepper (CABI, 2015; CIPM, 2014; FASS and NASS, 2011).
Pest potential on economically important hosts at risk	Gonzalez (1989) states *N. glaberrima* attacks mature fruit or fruit previously attacked by other insects, and historically, the genus has been considered a secondary invader of most hosts (e.g., Korytkowski and Ojeda, 1971; McAlpine and Steyskal, 1982). Some reports, however, indicate that *Neosilba* flies may be primary invaders of some hosts (e.g., Lopes et al., 2008; Raga et al., 2004; Souza-Filho et al., 2009; Uchôa-Fernandes et al., 2003). For example, in a study in Brazil *Neosilba* spp. were obtained directly from peach, guava, and loquat fruit not previously attacked by other fruit flies (Souza-Filho et al., 2009). Hence, it remains unclear to what extent, if any, *N. glaberrima* behaves as a primary pest. In Chile, *N. glaberrima* has occasional economic importance (Gonzalez, 1989), and in Peru, the species has been an important fruit pest (Korytkowski and Ojeda, 1971; McAlpine and Steyskal, 1982). We found no other information on specific impacts by *N. glaberrima*.
Defined Endangered Area	The area endangered by *N. glaberrima* includes the southern states and those along the west coast (Plant Hardiness Zones 8-11). Potential hosts include citrus, fig, guava, mango, peach, pepper, and others.

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2013).

Assessment of the likelihood of introduction of *Neosilba glaberrima* into the endangered area via the importation of naranjilla fruit from Colombia

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Likelihood of Entry			
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	Medium	MU	*Neosilba* spp., including *N. glaberrima*, are typically considered secondary invaders that take advantage of oviposition sites created by tephritid fruit flies (Korytkowski and Ojeda, 1971; McAlpine and Steyskal, 1982) (discussed above in pest potential on economically important hosts at risk). For this analysis, we considered *N. glaberrima* to be an occasional secondary pest of naranjilla and we did not consider any field practices that would reduce the prevalence of tephritids or *N. glaberrima* in the field. Because we found only one report of *N.*

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
			glaberrima associated with naranjilla in Colombia (Yepes and Velez, 1989), we had moderate uncertainty for the prevalence of this insect on the harvested commodity.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MC	The larvae feed inside of the fruit of their hosts (Korytkowski and Ojeda, 1971; McAlpine and Steyskal, 1982) and would therefore be unaffected by post-harvest processing and highly likely to escape detection during culling. We did not change the previous rating.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	U	We found no evidence that this species would be affected by transport and storage conditions, so we did not change the previous rating.
Risk Element A: Overall risk rating for likelihood of entry	Medium	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	Medium	U	*Neosilba* spp. can fly, as demonstrated by numerous captures of adults in McPhail traps in orange groves (Uchôa-Fernandes et al., 2003), but the distance they can travel is unknown. Suitable hosts for *N. glaberrima* occur throughout the endangered area (CIPM, 2014; Kartesz, 2015; NRCS, 2015). As secondary invaders, their likelihood of successfully infesting host material in new areas would be lower if primary invaders (i.e., tephritid fruit flies) are not present.
Risk Element B2: Likelihood of arriving in the endangered area	High	C	More than 25 percent of the U.S. population lives within the endangered area (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	Medium	N/A	
Overall Likelihood of Introduction			

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Combined likelihoods of entry and establishment	Medium	N/A	

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

Assessment of the consequences of introduction of *Neosilba glaberrima* into the continental United States (i.e., the PRA area)

Criteria	Meets criteria? (Yes/No)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Direct Impacts			
Risk Element C1: Damage potential in the endangered area	Yes	U	Only a few species of *Neosilba* occur in the United States (e.g., *N. batesi*, *N. perezi*, and *N. nigrocaerulea*) (Ahlmark and Steck, 1997; McAlpine and Steyskal, 1982), and those species are not primary pests in any major economic crop grown here. U.S. growers do not currently control any *Neosilba* spp. in crops currently at risk (e.g., citrus). Therefore, production practices may change should *N. glaberrima* become established. Its introduction into the continental United States may result in significant increases in costs of production beyond normal fluctuations. The economic impact of *Neosilba* species in Brazil is hypothesized to be underestimated (Raga et al., 2004), and in Colombia large populations of *Neosilba* larvae can inflict economic damage on fruits (Galeano-Olaya and Canal, 2012). Because *N. glaberrima* occurs in both Brazil and Colombia and is considered one of the most widespread, most commonly collected, and most polyphagous species of *Neosilba* in the Neotropical Region (McAlpine and Steyskal, 1982), we assume that these statements likely apply to *N. glaberrima* (in addition to other species). Also, other species of *Neosilba* can cause serious damage to hosts (Uchôa-Fernandes et al., 2003). For example, *N. zadolicha* infestations were cited as limiting the cultivation of tangerines in Brazil (Lopes et al., 2008). However, we not find any additional information about control measures for *Neosilba* spp.

Criteria	Meets criteria? (Yes/No)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			Because we found evidence that the economic importance of *Neosilba* fruit flies in general have been underestimated (Raga et al., 2004), but there was very little information about the impacts of *N. glaberrima* specifically, but we answered yes but with high uncertainty.
Risk Element C2: Spread potential	Yes	MU	We could not identify any factors that would limit the spread potential of *N. glaberrima* if it were to be introduced into the continental United States.
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	N/A	
Trade Impacts			
Risk Element D1: Export markets at risk	N/A	N/A	
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	N/A	N/A	
Risk Element D: Pest is likely to cause significant trade impacts	N/A	N/A	
Conclusion			
Is the pest likely to cause unacceptable consequences in the PRA area?	Yes	N/A	Because of a lack of specific information on the direct impacts of *N. glaberrima*, we had overall high uncertainty for this determination.

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

3.2.4 *Thrips palmi*

A full pest analysis is not needed for *T. palmi* because we determined that no endangered area exists in the United States. We present the results of this assessment in the table below.

Determination of the portion of the continental United States endangered by *Thrips palmi*

Climatic suitability	*Thrips palmi* is distributed throughout tropical regions in Asia, Africa, South America, Oceania, and the Caribbean (CABI, 2015), as well as Hawaii and southern Florida (Capinera, 2013; Seal, 2001). While *T. palmi* is an important greenhouse pest and there is some concern that it may infest protected environments anywhere, it is estimated that outdoor establishment of permanent populations would be restricted to tropical regions (Capinera, 2013). Permanent populations have only been documented in Florida south of Orlando (Capinera, 2013). Initially detected in 1990 (Capinera, 2013), it is not under official control. Surveys conducted over the last 20 years indicate that *T. palmi* is likely established throughout the climate zone appropriate for population development. The possibility of *T. palmi* populations overwintering in greenhouses and then moving outdoors in summer (e.g., Kawai, 1990; McDonald et al., 1999) has not been realized.
Defined Endangered Area	*Thrips palmi* appears to be established throughout its potential range in the United States, so there is no endangered area.

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2013).

3.2.5. Solanum quitoense machorreo phytoplasma

We determined the overall likelihood of introduction of the Solanum quitoense machorreo phytoplasma (group 16SrIII-J) to be Negligible. We present the results of this assessment in the table below. Because the likelihood of introduction was negligible, we did not need to analyze the likelihood of introduction or consequences of introduction.

Determination of the portion of the continental United States endangered by Solanum quitoense machorreo phytoplasma

Climatic suitability	Solanum quitoense machorreo phytoplasma (group 16SrIII-J) is known to occur in Colombia (Alvarez et al., 2003; Álvarez et al., 2005; Galvis et al., 2007). Based on a comparison of this distribution of this phytoplasma with a global map of USDA Plant Hardiness Zones (Magarey et al., 2008; PERAL/CIPM, 2008), we estimate that it could establish in areas of the continental United States corresponding to USDA Plant Hardiness Zones 9-11.
Potential hosts at risk in PRA Area	Solanum quitoense machorreo phytoplasma infects *Solanum quitoense* (naranjilla) (Alvarez et al., 2003; Álvarez et al., 2005) and possibly *Coffea arabica* (Arabian coffee) (Galvis et al., 2007). Within Zones 9-11 of the continental United States, naranjilla and coffee are grown on a very limited extent by hobbyists (Crane et al., 2006; Morton, 1987).
Economically important hosts at risk[a]	In the continental United States, naranjilla and coffee have economic value to the hobbyists who grow these plants (Crane et al., 2006; Morton, 1987).
Pest potential on economically important hosts at risk	Solanum quitoense machorreo phytoplasma infects naranjilla, causing stunting, phyllody (floral structures that abnormally develop into leaves), and aborted flowers (Alvarez et al., 2003; Álvarez et al., 2005). This disease can result in up to 80 percent losses (Alvarez et al., 2003;

	Álvarez et al., 2005). Infected coffee plants exhibit dwarfing, aborted flowers, and reduced yield (Galvis et al., 2007).
Defined Endangered Area	The area endangered by Solanum quitoense machorreo phytoplasma includes coffee and naranjilla in the continental United States in Plant Hardiness Zones 9-11.

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2013).

Assessment of the likelihood of introduction of Solanum quitoense machorreo phytoplasma into the endangered area via the importation of naranjilla fruit from Colombia

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
Likelihood of Entry			
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	N/A	N/A	
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	N/A	N/A	
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	N/A	N/A	
Risk Element A: Overall risk rating for likelihood of entry	N/A	N/A	

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	Negligible	MC	Phytoplasmas are transmitted by phloem-feeding leafhoppers, planthoppers, and psyllids (Weintraub and Jones, 2010). These are sap-feeding insects that primarily feed on leaves (Triplehorn and Johnson, 2004). The adults are highly mobile, jumping or flying when disturbed (Purdue University, 2009; Wold-Burkness, 2011), so they are unlikely to remain with the harvested commodity. The nymphs are limited in mobility and are unlikely to move from imported naranjilla fruit to infest naranjilla or coffee plantings in the United States. Thus, Solanum quitoense machorreo phytoplasma has a negligible likelihood of being introduced into the United States in imported naranjilla fruit.
Risk Element B2: Likelihood of arriving in the endangered area	N/A	N/A	
Risk Element B: Combined likelihood of establishment	Negligible	N/A	
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment	Negligible	N/A	

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

3.2.6. *Tomato yellow mosaic begomovirus* (ToYMV)

We determined the overall likelihood of introduction of *Tomato yellow mosaic begomovirus* (ToYMV) to be Negligible. We present the results of this assessment in the table below. Because the likelihood of introduction was negligible, we did not need to analyze the likelihood of introduction or consequences of introduction.

Determination of the portion of the continental United States endangered by *Tomato yellow mosaic begomovirus* (ToYMV)

Climatic suitability	*Tomato yellow mosaic begomovirus* (ToYMV) occurs in the Caribbean, Panama, Venezuela (Morales et al., 2001; Piven et al., 1995), and Colombia (Morales et al., 2002). Based on a comparison of this distribution of this phytoplasma with a global map of USDA Plant Hardiness Zones (Magarey et al., 2008; PERAL/CIPM, 2008), we estimate that it could establish in areas of the continental United States corresponding to USDA Plant Hardiness Zones 9-11.
Potential hosts at risk in PRA Area	ToYMV infects *Solanum lycopersicum* (tomato) and *S. tuberosum* (potato) (Morales et al., 2001). These crops are grown in Zones 9-11 of the continental United States.
Economically important hosts at risk[a]	Tomato and potato are economically important crops (NASS, 2015).
Pest potential on economically important hosts at risk	ToYMV has caused millions of dollars in losses to the tomato industry in Venezuela (Piven et al., 1995); it causes yield losses of 30 to 40 percent (Morales et al., 2001).
Defined Endangered Area	The area endangered by ToYMV includes the areas in Plant Hardiness Zones 9-11 where tomato and potato are grown.

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2013).

Assessment of the likelihood of introduction of *Tomato yellow mosaic begomovirus* (ToYMV) into the endangered area via the importation of naranjilla fruit from Colombia

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Likelihood of Entry			
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	N/A	N/A	
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	N/A	N/A	
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	N/A	N/A	
Risk Element A: Overall risk rating for likelihood of entry	N/A	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with	Negligible	MC	ToYMV is not seed-transmitted; it is vectored by the whitefly *Bemisia*

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
host material in the endangered area			*tabaci* (Piven et al., 1995). *Bemisia tabaci* whiteflies primarily feed on leaves (Triplehorn and Johnson, 2004).The adults are highly mobile and fly when disturbed (Barrett, 2010; University of California, 2016), so they are unlikely to remain with the harvested commodity. The nymphs are limited in mobility and are unlikely to move from imported naranjilla fruit to field-grown crops in the United States. Additionally, there are no interception records of *B. tabaci* on naranjilla fruit imported into the United States between 1984 and 2015 in the Pest ID database out of 221 total interceptions involving naranjilla fruit (PestID, 2015). Thus, it is unlikely that whiteflies would transmit ToYMV from infected naranjilla fruit to host plants in the continental United States. We considered ToYMV to have a negligible likelihood of being introduced into the United States in imported naranjilla fruit.
Risk Element B2: Likelihood of arriving in the endangered area	N/A	N/A	
Risk Element B: Combined likelihood of establishment	Negligible	N/A	
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment	Negligible	N/A	

[a]C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

4. Summary and Conclusions of Risk Assessment

Of the organisms associated with naranjilla worldwide and present in Colombia, we identified organisms that are actionable pests for the continental United States and have a reasonable likelihood of being associated with the commodity following harvesting from the field and prior to any post-harvest processing. If warranted, we further evaluated these organisms for their likelihood of introduction (i.e., entry plus establishment) and their potential consequences of introduction. Pests that are likely to cause unacceptable consequences of introduction with an overall likelihood of introduction risk rating above Negligible 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. Production, post-harvesting, and shipping procedures in Colombia were not considered as part of this assessment.

Of the pests selected for further analysis, we determined that those identified in Table 4 are *not* candidates for risk management, either because no portion of the continental United States is likely to be endangered by the pest, they are unlikely to cause unacceptable consequences of introduction, and/or because they received a Negligible risk rating for likelihood of introduction into the endangered area via the import pathway. We summarize the results for each pest in Table 4.

All the other pests selected for further analysis are candidates for risk management, because they are likely to cause unacceptable consequences of introduction, and they received a likelihood of introduction risk rating above Negligible. We summarize the results for each pest in Table 5.

Detailed examination and choice of appropriate phytosanitary measures to mitigate pest risk are part of the pest risk management phase within APHIS and are not addressed in this document.

Table 4. Summary for pests selected for further evaluation and determined *not* to be candidates for risk management.

Pest	**Reason the pest is *not* a candidate for risk management**	**Uncertainty statement (optional)[a]**
Solanum quitoense machorreo phytoplasma (group16SrIII-J)	Negligible likelihood of establishment	This phytoplasma is closely related to several other phytoplasmas (Galvis et al., 2007; Gamarra et al., 2014). The taxonomy of this phytoplasma would be clearer if it was formally described as a species.
Thrips palmi	No endangered area exists within the PRA area	
Tomato yellow mosaic begomovirus (ToYMV)	Negligible likelihood of establishment	The exact distribution of this virus is unclear. This virus is reported in Brazil, but those reports are unreliable (CABI, 2015).

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

Table 5. Summary for pests selected for further evaluation and determined to be candidates for risk management. All of these pests meet the threshold for unacceptable consequences of introduction.

Pest	**Likelihood of Introduction overall rating**	**Uncertainty statement (optional)[a]**
Anastrepha fraterculus	High	We are uncertain in our overall risk rating because of the lack of information pertaining to *A. fraterculus*' potential pest status on naranjilla, as well as the population density of this pest in the naranjilla-growing areas of Colombia.
Neoleucinodes elegantalis	Medium	Our uncertainty in this rating is based on having no information pertaining to the stage at which the naranjilla fruit is harvested.
Neosilba glaberrima	Medium	We had overall high uncertainty for the assessment of *N. glaberrima* because of a general lack of information on the species, including its prevalence on naranjilla and its economic impacts. Also, the likelihood of introduction may be greatly influenced by the prevalence and activity levels in the field before harvest of the tephritid fruit fly, *Anastrepha fraterculus,* analyzed in this risk assessment.

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

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6. Literature Cited

7 CFR § 319.56. 2016. U.S. Code of Federal Regulations, Title 7, Part 319 (7 CFR § 319.56 - Fruits and Vegetables).

Adamski, D., and J. W. Brown. 2002. A new species of *Frumenta* Busck (Lepidoptera: Gelechiidae: Gnorimoschemini) from Mexico: a potential biocontrol agent against *Solanum elaeagnifolium* (Solanaceae). Proceedings of the Entomological Society of Washington 104(4):1029-1035.

Aguilar, H., and P. Murillo. 2012. New hosts and records of plant feeding mites for Costa Rica: interval 2008-2012. Agronomía Costarricense 36(2):11-28.

Ahlmark, K., and G. J. Steck. 1997. A new U.S. record for a secondary fruit infester, *Neosilba batesi* (Curran) (Diptera: Lonchaeidae). Insecta Mundi 11(2):116.

Allen, C., P. Prior, and A. C. Hayward. 2005. Bacterial Wilt Disease and the *Ralstonia solanacearum* Species Complex. APS Press, St. Paul, MN. 528 pp.

Aluja, M., J. Rull, J. Sivinski, A. L. Norrbom, R. A. Wharton, R. Macias-Ordonez, F. Diaz-Fleischer, and M. Lopez. 2003. Fruit flies of the genus *Anastrepha* (Diptera: Tephritidae) and associated native parasitoids (Hymenoptera) in the tropical rainforest biosphere reserve of Montes Azules, Chiapas, Mexico. Environmental Entomology 32(6):1377-1385.

Alvarez, E., J. F. Mejía De Los Ríos, C. A. Huertas, and F. Varón de Agudelo. 2003. Detección y caracterización molecular de un fitoplasma, asociado con el "machorreo" del lulo (*Solanum quitoense* Lam.) en Colombia. Fitopatologia colombiana 27(2):71-76.

Álvarez, E., J. F. Mejía, C. Huertas, F. Varón, and J. Loke. 2005. Detection and molecular characterization of a phytoplasma associated with *machorreo* of lulo (*Solanum quitoense*) in Colombia. Poster International Center for Tropical Agriculture (CIAT) and Instituto Colombiano Agropecuario (ICA), Colombia. Available from http://ciat-library.ciat.cgiar.org/Articulos_ciat/poster_lulo_high_value_crops_2005.pdf.

Anteparra, M. E., K. Vargas, and L. B. Granados. 2010. First registry for Peru of cocona fruit borer *Neoleucinodes elegantalis* (Guenée) (Lepidoptera: Pyralidae). Rev. Aporte Santiaguino 3(2):171-176.

APHIS. 1984. Action Plan: South American Fruit Fly, *Anastrepha fraterculus* (Wiedemann). United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). 35 pp.

Aponte, A., E. Debrot, E. Arnal, R. Solórzano, and F. Ramos. 2005. Diagnóstico de las enfermedades del tomate de árbol en los Estados Aragua y Miranda, Venezuela. CENIAP HOY 9. http://sian.inia.gob.ve/repositorio/revistas_tec/ceniaphoy/articulos/n9/arti/aponte_a/arti/aponte_a.htm.

Arcila Aristizábal, I. M., E. P. González Jaimes, C. M. Zuluaga Amaya, M. A. Marín Montoya, and J. M. Cotes Torres. 2014. Effect of *Spongospora subterranea* f. sp. *subterranea* infection on alternate hosts. Revista - Facultad Nacional de Agronomía Medellín 67(2):7261-7269.

Arnett, R. H. J., M. C. Thomas, P. E. Skelley, and J. H. Frank. 2002. American Beetles Volume 2: Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press LCC, Boca Raton, Florida. 861 pp.

Arrieta-Guevara, M. A., B. L. Higuera-Mancipe, and S. T. Martínez-Peralta. 2010. Induction of phenylalanine ammonia lyase and variation in phenolic compounds content in lulo fruits (*Solanum quitoense* Lam) infected by *Colletotrichum acutatum*. Acta Biológica Colombiana 15(1):129-144.

Baeza, A. C. A. 1972. The golden nematode (*Heterodera rostochiensis* Woll.) in Colombia. Nematropica 21(1):15.

Barker, G. M. 2002. Molluscs as Crop Pests. CAB International, Wallingford, United Kingdom. 576 pp.

Barreto Gomez, M. I., and B. Polanco Bolanos. 1982. Diagnostico de las enfermedades fungosas en el cultivo del lulo (*Solanum quitoense* Lam.) en algunas zonas del departamento del Tolima. Tesis de Grado. Universidad del Tolima. Facultad de Ingeniería Agronómica. Ibagué. 22 pp.

Barrett, B. A. 2010. Managing whiteflies on indoor and outdoor plants. G7275. University of Missouri Extension, Columbia, Missouri. Available from http://extension.missouri.edu/publications/DisplayPrinterFriendlyPub.aspx?P=g7275.

Belalcazar, J. A. M. 2011. Análisis de la competitividad del sistema de producción de lulo (*Solanum quitoense* Lam.) en tres Municipios de Nariño, Universidad Nacional de Colombia, Bogotá, Colombia. 128 pp.

Betancourth García, C., C. Salazar González, and M. Rodriguez. 2011. Soil coverage evaluation with calendula (*Calendula officinalis* L.), crotalaria (*Crotalaria* sp. L.) and oat (*Avena* sp. L.) in *Meloidogyne* spp. control in quito orange (*Solanum quitoense* Lam.)/Evaluación de coberturas de suelo con caléndula (*Calendula officinalis* L.), crotalaria (*Crotalaria* sp. L.) yavena (*Avena* sp. L.) en el control de *Meloidogyne* spp. en lulo (*Solanum quitoense* Lam.). Revista de Ciencias Agrícolas 28(2):43-57.

Blackmer, J. L., A. E. Eiras, and C. L. M. de Souza. 2001. Oviposition preference of *Neoleucinodes elegantalis* (Guenée) (Lepidoptera: Crambidae) and rates of parasitism by *Trichogramma pretiosum* Riley (Hymenoptera: Trichogrammatidae) on *Lycopersicon esculentum* in São José de Ubá, RJ, Brazil. Neotropical Entomology 30(1):89-95.

Boerema, G. H., J. de Gruyter, M. E. Noordeloos, and M. E. C. Hamers. 2004. *Phoma* identification manual. Differentiation of specific and infra-specific taxa in culture. CABI Publishing. 470 pp.

Botha, J., D. Hardie, and A. Reeves. 2004. Exotic threat to Western Australia - South American fruit flies not present in Western Australia: *Anastrepha fraterculus* and related species (No. 9/2004). Factsheet. Government of Western Australia, Department of Agriculture. 2 pp.

Buriticá, P. 1999. Directorio Patógenos y Enfermedades de las Plantas de Importancia Económica en Colombia. Produmedios, Bogotá, Colombia. 329 pp.

Buriticá, P., J. Orjuela, and E. Bustamante. 1968. La roya de la papa en Colombia y sus implicaciones / Potato rust in Colombia and its implications. Agricultura Tropical (Colombia) 24:221-222.

Buritica, P., and V. M. Pardo Cardona. 1996. Flora Uredineana Colombiana. Revista de la Academia Colombiana de Ciencias Exactas 20:183-236.

Bustillo, A. E., R. A. Navarro, and G. J. Franco. 1988. Transmisión del virus del amarillamiento intervenal del lulo por el afido *Myzus persicae* (Suizer). Page 55 in Resumenes XV - Congreso de la Sociedad Colombiana de Entomología Manizales, Colombia.

CABI. 2015. Crop Protection Compendium. Commonwealth Agricultural Bureau International (CABI). http://www.cabi.org/cpc/.

Cabrera, A., A. E. Eiras, G. Gries, R. Gries, N. Urdaneta, B. Mirás, C. Badji, and K. Jaffe. 2001. Sex pheromone of tomato fruit borer, *Neoleucinodes elegantalis*. Journal of Chemical Ecology 27(10):2091-2107.

Capinera, J. L. 2013. Melon Thrips, *Thrips palmi* Karny (Insecta: Thysanoptera: Thripidae) (EENY-135). University of Florida, Institute of Food and Agricultural Sciences. Last accessed September 10, 2015, https://edis.ifas.ufl.edu/pdffiles/IN/IN29200.pdf.

Capinera, J. L., and J. White. 2014. Terrestrial snails affecting plants in Florida (Phylum Mollusca, Class Gastropoda) (EENY 497). University of Florida, Institute of Food and Agricultural Sciences, Florida Cooperative Extension Service, Entomology and Nematology Department. Last accessed September 10, 2015, http://edis.ifas.ufl.edu/pdffiles/IN/IN89300.pdf.

Cárdenas, M., J. Tabima, W. E. Fry, N. J. Grünwald, A. Bernal, and S. Restrepo. 2011. Letter to the Editor. Defining species boundaries in the genus *Phytophthora*: the case of *Phytophthora andina*. A response to '*Phytophthora andina* sp. nov., a newly identified heterothallic pathogen of solanaceous hosts in the Andean highlands' (Oliva et al., 2010). Plant Pathology 61:215–220.

Carneiro, J. d. S., F. N. P. Haji, and F. d. A. M. d. Santos. 1998. Bioecologia e controle da broca-pequena-do-tomateiro *Neoleucinodes elegantalis*. Pages 14 *in* Teresina: Embrapa Meio-Norte/Circular Técnica. Empresa Brasileira de Pesquisa Agropecuária.

Castaneda, R. d. R., A. F. Orsorio, N. A. Canal, and P. E. Galeano. 2010. Species, distribution and hosts of the genus *Anastrepha* Schiner in the Department of Tolima, Colombia. [Especies, distribución y hospederos del género *Anastrepha* Schiner en el departamento del Tolima, Colombia]. Agronomia Colombiana 28(2):265-271.

Castaño, O. 1996. Pests of the crop, lulo (*Solanum quitoense* Lam) and its management. [Plagas del cultivo del lulo (*Solanum quitoense* Lam) y su manejo]. Primer Seminario Futales de Clima Frío Moderado, Manizales. Octubre 10 -11, 1996.

CIPM. 2014. USDA Crop Profiles. North Carolina State University, Center for Integrated Pest Management (CIPM). http://www.ipmcenters.org/cropprofiles/CP_form.cfm. (Archived at PERAL).

Cladera, J. L., J. C. Vilardi, M. Juri, L. E. Paulin, M. C. Giardini, P. V. G. Cendra, D. F. Segura, and S. B. Lanzavecchia. 2014. Genetics and biology of *Anastrepha fraterculus*: research supporting the use of the sterile insect technique (SIT) to control this pest in Argentina. BMC Genetics 15(Suppl. 2):1-14.

Clark, S. M., D. G. LeDoux, T. N. Seeno, E. G. Riley, A. J. Gilbert, and J. M. Sullivan. 2004. Host plants of leaf beetle species occuring in the United States and Canada (Coleoptera: Megalopodidae, Orsodacnidae, Chrysomelidae, excluding Bruchinae). The Coleopterists Society, Sacramento, CA. 481 pp.

Clark, W. E., and H. R. Burke. 1996. The species of *Anthonomus* Germar (Coleoptera: Curculionidae) associated with plants in the family Solanaceae. Southwestern Entomological Society. 114 pp.

Coplin, D. L. 1980. *Erwinia carotovora* var. *carotovora* on bell peppers in Ohio. Plant Disease 64:191-194.

Cordoba, V., and S. Pineda. 1986. Reconocimiento e Identificación de Organismos Fungosos en el Lulo *Solanum quitoense* Lamark en el Municipio de Venecia (Cundinamarca) Tesis de Grado Universidad Pedagógica y Tecnológica de Tunja. Facultad de Ciencias Agropecuarias. Tunja, Colombia.

Corrales, S. P., V. D. Francia, and B. M. Nancy. 1999. Survey and effect of *Meloidogyne* spp. in lulo crop *Solanum quitoense* Lam. Acta Agronómica, Universidad Nacional de Colombia 49(3/4):43-47.

Correa, E. M., O. J. Marsiglia, and C. R. Fernández. 2012. Susceptibility of *Corythaica cyathicollis* Costa to a native isolation of *Beauveria bassiana* (Vuillemin). Agronomía Colombiana 30(2):236-241.

Couturier, G. 1988. Alguns insetos do Cubiu (*Solanum sessiliflorum* Dunal var. *sessiliflorum* Dunal, Solanaceae) na regiao de Manaus - Am. Acta Amazónica 18(3-4):93-103.

CPHST. 2011. New Pest Response Guidelines: *Tomato Leafminer* (Tuta absoluta). *in*. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (PERAL), New Pest Reponse Guidelines (NPRG), Raleigh, NC. 176 pp.

Crane, J. H., C. F. Balerdi, and G. Joyner. 2006. Coffee growing in the Florida home landscape. Document HS1056. University of Florida (UF), Institute of Food and Agricultural Sciences (IFAS) Extension, Homestead, Florida. 5 pp.

Crozzoli, R., Y. Aguirre, and L. Angel. 2012. Pathogenicity of the root-knot nematode, *Meloidogyne enterolobii,* on naranjilla (*Solanum quitoense* Lam.) in pots. Nematologia Mediterranea 40(2):153-156.

Davis, D. R. 1996. Neotropical Tineidae, VI: *Prosetomorpha falcata*, a new genus and species of Setomorphinae (Lepidoptera: Tineoidea) from Colombia associated with Curculionid galleries in stems of *Solanum*. Proceedings of the Entomological Society of Washington 98(2):173-187.

de Flutter, H. J., and J. J. Mulholland. 1941. Gegevens, verkregen bij net onder-zoek naar de waardplanten van *Tylenchus coffeae*. Berg cultures 15(47):1588-1593.

Denmark, H. A. 2014. Cyclamen Mite, *Phytonemus pallidus* (Banks) (Arachnida: Acari: Tarsonemidae) (EENY-178). *in*. University of Florida, Institute of Food and Agricultural Sciences, Florida Cooperative Extension Service.

Dias de Almeida, G., G. Santos Andrade, V. B. Vicentini, W. Faria Barbosa, F. Moreira Sobreira, and D. Pratissoli. 2009. Occurrence of *Faustinus* sp. (Coleoptera: Curculionidae) in Southeastern Brazil tomato crops. Agronomía Colombiana 27(3):417-419.

Díaz-Montilla, A. E., H. G. Suárez-Baron, G. Gallego-Sánchez, C. I. Saldamando-Benjumea, and J. Tohme. 2013. Geographic differentiation of Colombian *Neoleucinodes elegantalis* (Lepidoptera: Crambidae) haplotypes: Evidence for Solanaceae host plant association and Holdridge life zones for genetic differentiation. Annals of the Entomological Society of America 106(5):586-597.

Diaz, A. E., and S. M. Alma. 2007. A new species and species distribution records of *Neoleucinodes* (Lepidoptera: Crambidae: Spolomelinae) from Colombia feeding on *Solanum* sp. Proceedings of the Entomological Society of Washington 109(4):897-908.

Dickstein, E. R., and L. H. Purdy. 1995. Resistance to a solanaceous strain of *Crinipellis perniciosa* in the tomato mutant monstrosa. Phytopathology 85(10):1192.

Diener, T. O. 1979. Viroids and viroid diseases. Wiley-Interscience, New York, New York. 252 pp.

Durán, I. C., N. C. Mesa, and E. I. Estrada. 1999. Life cycle of *Thrips palmi* (Thysanoptera: Thripidae) and host plant registered in the Cauca Valley [Abstract]. Revista Colombiana de Entomología 25(3-4):109-120.

EDA. 2007. Boletín Técnico de Producción: Identificación, Daño y Control del barrenador en el fruto del tomato/berenjena (Neoleucinodes elegantalis: Pyralidae - Lepidóptera). Honduras Entrenamiento y Desarrollo de Agricultores (EDA). 3 pp.

EFSA PLH Panel. 2011. Scientific opinion on the assessment of the risk of solanaceous pospiviroids for the EU territory and the identification and evaluation of risk management options. EFSA Panel on Plant Health (PLH). No. 2330. EFSA Journal 9(8):1-133.

Eiras, A. E., and J. L. Blackmer. 2003. Eclosion time and larval behavior of the tomato fruit borer, *Neoleucinodes elegantalis* (Guenée) (Lepidoptera: Crambidae). Scientia Agricola 60(1):195-197.

EPPO. 2005. Data sheets on quarantine pests - *Tuta absoluta*. Bulletin OEPP/EPPO 35:434–435.

EPPO. 2015a. EPPO Datasheet on pests recommended for regulation: *Neolucinodes elegantalis*. EPPO Bulletin 45(1):9-13.

EPPO. 2015b. PQR - EPPO's Plant Quarantine Data Retrieval System Version 5.0. European and Mediterranean Plant Protection Organization (EPPO), Paris, France. http://www.eppo.int/DATABASES/pqr/pqr.htm.

Esquivel, R. E. 1975. Fruit rot of tomato caused by *Helminthosporium carposaprum* Pollack in Panama. Fitopatologia 10(1):45-46.

Evans, K., J. Franco, and M. M. De Scurrah. 1975. Distribution of species of potato cyst-nematodes in South America. Nematologica 21(3):365-369.

Fabhawk. 2006. Solanum quitoense. Sliced and whole naranjillas or lulos, accompanied by a U.S. dime for scale. Transferred from French Wikipedia to Commons by Fabhawk. Wikimedia Commons. Last accessed March 22, 2016, https://commons.wikimedia.org/w/index.php?curid=3548340.

Farr, D. F., A. Y. Rossman, M. E. Palm, and E. B. McCray. 2015. Fungal Databases. United States Department of Agriculture, Agricultural Research Service, Systematic Mycology and Microbiology Laboratory. Last accessed October 6, 2015, http://nt.ars-grin.gov/fungaldatabases/.

FASS and NASS. 2011. Florida Citrus Statistics 2009-2010. Florida Department of Agriculture and Consumer Services, Florida Agricultural Statistics Service (FASS) in coorperation with the United States Department of Agriculture, Agricultural Marketing Service, National Agricultural Statistics Service (NASS), Tallahassee, Florida. 118 pp.

Ferrucho, R. L., J. M. Cifuentes, P. Ceresini, and C. García-Domínguez. 2012. *Rhizoctonia solani* AG-3PT is the major pathogen associated with potato stem canker and black scurf in Colombia / *Rhizoctonia solani* GA-3PT es el principal patógeno asociado con el chancro del tallo y la sarna negra de la papa en Colombia. Agronomía Colombiana 30(2):204-213.

Figueroa, A. 1977. Insectos y acarinos de Colombia. Universidad Nacional de Colombia. 685 pp.

Foote, R. H., F. L. Blanc, and A. L. Norrobom. 1993. Handbook of the Fruit Flies (Diptera: Tephritidae) of America North of Mexico. Comstock Publishing Associates, Ithaca, NY. 571 pp.

Franco, G., J. Bernal, M. Giraldo, P. Tamayo, O. Castaño, A. Tamayo, J. Gallego, M. Botero, J. Rodríguez, N. Guevara, J. Morales, M. Londoño, G. Ríos, J. Rodríguez, A. Cardona, J. Zuleta, J. Castaño, and M. Ramírez. 2002. El Cultivo del Lulo. Manual Técnico Corporación Colombiana de Investigación Agropecuaria. Corpoica Manizales, Colombia. 103 pp.

Freytag, P. H., and M. J. Sharkey. 2002. A preliminary list of the leafhoppers (Homoptera: Cicadellidae) of Colombia. Biota Colombiana 3(2):235-283.

Galeano-Olaya, P. E., and N. A. Canal. 2012. New species of *Neosilba Mcalpine* (Diptera: Lonchaeidae) and new records from Colombia. Papeis Avulsos de Zoologia (Sao Paulo) 52(31):361-385.

Gallego, F., and R. Velez. 1992. Lista de insectos que afectan los principales cultivos, plantas forestales, animales domésticos y al hombre en Colombia. Pages 1-193 Universidad Nacional de Colombia, Facultad de Ciencias, Departamento de Biología, Area de Entomología, Medellín, Colombia.

Gallegos, P., C. Asaquibay, L. Shiki, and R. Williams. 2003. Integrated pest management methodologies to control (*Neoleucinodes elegantalis*) "barrenador del fruto" in fruits of naranjilla (*Solanum quitoense*). Tenth Annual Report of the Integrated Pest Management Collaborative Research Support Program (IPM CRSP). 597 pp.

Galvis, C. A., J. E. Leguizamón, Á. L. Gaitán, J. F. Mejía, E. Álvarez, and J. Arroyave. 2007. Detection and identification of a group 16SrIII-related phytoplasma associated with coffee crispiness disease in Colombia. Plant Disease 91(3):248-252.

Gamarra, D., W. Cuellar, E. Mayta, A. Olortegui, P. Lozada, R. Ramírez, C. Chuquillanqui, I. Bartolini, G. Torres, and E. Durigon. 2014. Molecular identification of virus co-infecting with phytoplasma in carrot crops in Peru/Identificación molecular de virus que infectan con fitoplasma en cultivos de zanahoría en Perú. Convicciones 1(1):18-27.

García, M., B. Denno, D. R. Miller, G. L. Miller, Y. Ben-Dov, and N. B. Hardy. 2015. ScaleNet: A Literature-based model of scale insect biology and systematics. . Last accessed September 10, 2015, http://scalenet.info.

Gibbs, A. J., E. Hecht-Poinar, R. D. Woods, and R. K. McKee. 1966. Some properties of three related viruses: Andean potato latent, dulcamara mottle, and Ononis yellow mosaic. Journal of General Microbiology 44(2):177-193.

Gomez, J. 1990. Incidencia de enfermedades del lulo *Solanum quitoense* en el departamento del Cauca. Sanidad Vegetal. Instituto Colombiano Agropecuario ICA. Popayán, Colombia. ASCOLFI-Informa. 1990, 16.

Gomez, L. E. 1997. Enfermedades del Cultivo del Lulo en Tolima y Huila: Guía de Reconocimiento y Control. Boletín Técnico CORPOICA, Regional No. 6 Centro de Investigación Nataima. El Espinal Tolima, Colombia. 36 pp.

Gonzalez, R. H. 1989. Insectos y Acaros de Importancia Agricola y Cuarentenaria en Chile. BASF Chile S.A., Santiago, Chile. 310 pp.

Goodey, J. B., M. T. Franklin, and D. J. Hooper. 1965. T. Goodey's The Nematode Parasites of Plants Catalogued Under Their Hosts. Commonwealth Agricultural Bureau, Farnham Royal, UK. 179 pp.

Gordon, R. D. 1975. A Revision of the Epilachninae of the Western Hemisphere (Coleoptera: Coccinellidae). Technical Bulletin No. 1493. USDA-ARS Washington D.C. 409 pp.

Gould, W. P., and A. Raga. 2002. Pests of guava. Pages 295-313 *in* J. L. S. J. E. Peña and M. Wysoki, (eds.). Tropical fruit pests and pollinators: biology, economic importance, natural enemies and control. CABI Publishing, Wallingford, United Kingdom.

Gregoric, D. E. G., A. A. Beltramino, R. E. Vogler, M. G. Cuezzo, V. Núñez, S. R. Gomes, M. Virgillito, and S. E. Miquel. 2013. First records of four exotic slugs in Argentina. American Malacological Bulletin 31(2):245-256.

Guillen, D., and R. Sanchez. 2007. Expansion of the national fruit fly control programme in Argentina. Pages 653-660 *in* A. S. R. M. J. B. Vreysen and J. Hendrichs, (eds.). Area wide control of insect pests: from research to field implementation. Springer, Dordrecht, Netherlands.

Hausdorf, B. 2002. Introduced land snails and slugs in Colombia. Journal of Molluscan Studies 68:127-131.

Hausdorf, B. 2003. Systematic position and taxonomy of the genus *Hirtudiscus* from Colombia (Gastropoda: Scolodontidae). Journal of Molluscan Studies 69:179-186.

Hausdorf, B., and C. I. M. Bermúdez. 2006. Two new *Hirtudiscus* species from Colombia (Gastropoda: Scolodontidae). Malacologia 49(1):211-215.

Horst, R. K. 2001. Wescott's Plant Disease Handbook (6th). Kluwer Academic Publishers, Boston, Massachusetts. 1007 pp.

Horvath, J. 1987. Reaction of wild *Solanum* species to different viruses. Journal of the Indian Potato Association 14(3&4):104-108.

ICA. 2002. Market access request to import Columbia naranjilla into the United States. Ministerio de Agricultura y Desarrollo Rural, Instituto Colombiano Agropecuario (ICA), Bogota, Colombia. 1 pp.

ICTV. 2016. Virus Taxonomy: 2014 Release. International Committee on Taxonomy of Viruses (ICTV). Last accessed March 22, 2016, http://ictvonline.org/virusTaxonomy.asp.

Infante, D., N. Piven, and R. de Uzcategui. 1996. Resistance to tomato yellow mosaic geminivirus and presence of viral DNA in some species of Solanaceae. Journal of Phytopathology-Phytopathologische Zeitschrift 144(3):163-165.

IPPC. 2012. International Standards For Phytosanitary Measures, Publication No. 5: Glossary of Phytosanitary Terms. Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention (IPPC), Rome, Italy. 38 pp.

IPPC. 2013. International Standards For Phytosanitary Measures, Publication No. 11: Pest Risk Analysis for Quarantine Pests. Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention (IPPC), Rome, Italy. 36 pp.

Jadwiszczak, A. S., and P. Wegrzynowicz. 2003. World catalogue of Coccinellidae. Part I - Epilachninae. MANTIS, Poland.

Johnson, M. W., E. R. Oatman, N. C. Toscano, S. C. Welter, and J. T. Trumble. 1984. The vegetable leafminer on fresh market tomatoes in southern California. California Agriculture January-February:10-11.

Kartesz, J. T. 2015. North American Plant Atlas [maps generated from Kartesz, J.T. 2010. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP)]. The Biota of North America Program, Chapel Hill, N.C. Last accessed May 7, 2015, http://www.bonap.org/MapSwitchboard.html.

Kawai, A. 1990. Life cycle and population dynamics of *Thrips palmi* Karny. Japan Agricultural Research Quarterly 23(4):282-288.

Kennedy, B. W., and S. M. Alcorn. 1980. Estimates of U.S. crop losses to procaryote plant pathogens. Plant Disease 64(7):674-676.

Koenning, S. R., C. Overstreet, J. W. Noling, P. A. Donald, J. O. Becker, and B. A. Fortnum. 1999. Survey of crop losses in response to phytoparasitic nematodes in the United States for 1994. Journal of Nematology 31(4S):587-618.

Kondo, T. 2001. The Scale Insects of Colombia (Hemiptera: Coccoidea). Biota Colombiana 2(1):31-48.

Korytkowski, C. A., and P. D. Ojeda. 1971. Revision de las especies de la familia Lonchaeidae en el Peru (Diptera: Acalyptratae). Revista Peruana de Entomologia 14(1):87-116.

Kovaleski, A., R. L. Sugayama, and A. Malavasi. 1999. Movement of *Anastrepha fraterculus* from native breeding sites into apple orchards in Southern Brazil. Entomologia Experimentalis et Applicata 91(3):457-463.

Lehman, P. S. 2002. Phyoparasitic nematodes reported from Florida. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Bureau of Entomology, Nematology, and Plant Pathology. Available from http://freshfromflorida.s3.amazonaws.com/phyotnema.pdf.

Lincango, P., and G. Morales. 2005. Análisis de riesgo de plagas para la importación de productos vegetales a las Islas Galápagos. Charles Darwin Foundation and Ecuadorian Agricultural Health Service (SESA), Galapagos Inspection and Quarantine System (SICGAL), Ecuador. 522 pp.

Lobo Arias, M., and E. Girard. 1977. El cultivo del Lulo. Curso sobre Frutales. Pages 161-180 in Instituto Colombiano Agropecuario ICA. Programa de Frutales Regional No. 4. Bogotá D.C., Colombia.

Lopes, E. B., I. C. de Albuquerque, C. H. de Brito, and J. L. Batista. 2008. Frugivorous flies (Tephritidae and Lonchaeidae): Occurrence in commercials tangerine orchards (*Citrus reticulata* Blanco) in Matinhas, state of Paraíba, Brazil. Acta Scientiarum - Agronomy 30(5S):639-644.

Maes, J.-M. 2015. Fauna entomologica de Nicaragua, catalogo de insectos y artropodos terrestres de Nicaragua: Familia Lonchaeidae. Last accessed May 12, 2015, http://www.bio-nica.info/Ento/Diptera/LONCHAEIDAE.htm.

Magarey, R. D., D. M. Borchert, and J. W. Schlegel. 2008. Global plant hardiness zones for phytosanitary risk analysis. Scientia Agricola (Piracicaba, Brazil) 65:54-59.

Marelli, J.-P., S. N. Maximova, K. P. Gramacho, S. Kang, and M. J. Guiltinan. 2009. Infection biology of *Moniliophthora perniciosa* on *Theobroma cacao* and alternate solanaceous hosts. Tropical Plant Biology 2(3-4):149-160.

Martínez Córdoba, H. E., J. M. Montes Rodríguez, and F. C. Yepes Rodríguez. 2010. Evaluation of management practices of the moth of lulo flower *Symmetrischema insertum* Povolny (Lepidoptera: Gelechiidae). Revista - Facultad Nacional de Agronomía Medellín 63(1):5275-5283.

McAlpine, J. F., and G. C. Steyskal. 1982. A revision of *Neosilba* McAlpine with a key to the world genera of Lonchaeidae (Diptera). Canadian Entomologist 114(2):105-137.

McDonald, J. R., J. S. Bale, and K. F. A. Walters. 1999. Temperature, development and establishment potential of *Thrips palmi* (Thysanoptera: Thripidae) in the United Kingdom. European Journal of Entomology 96:169-173.

McKamey, S. H. 2000. Checklist of Leafhopper Species 1758-1955 (Hemiptera: Membracoidea: Cicadellidae and Myserslopiidae) with Synonymy and Distribution [Catalogue of the Homoptera, Fascicle 6, Abridged]. United States Department of Agriculture, Agricultural Research Service, Systematic Entomology Laboratory, Washington, D.C. 516 pp.

Mejia, J. F. 2014. Identification and genetic diversity in phytoplasmas associated with diseases of cassava and other agronomic relevant crops in South-east Asia and Latin America. Ecologia microbica e patologia vegetale. Dottorato di Ricerca in Scienzie agrarie, Università di Bologna. 139 pp.

Montemayor, S., and M. C. Coscaron. 2005. List of Argentinian Tingidae Laporte (Heteroptera) with their host plants. Zootaxa 1065:29-50.

Montes Rojas, C., L. A. Muñoz, V. F. Terán G., F. A. Prado C., and M. A. Quiñónez. 2010. Evaluación de patógenos en clones de lulo (*Solanum quitoense* Lam.). Acta agronómica 59(2):144-154.

Montilla, A. E. D., M. A. Solis, and T. Kondo. 2013. The tomato fruit borer, *Neoleucinodes elegantalis* (Guenée) (Lepidoptera: Crambidae), an insect pest of Neotropical solanaceous fruits. Pages 137-159 *in* J. Peña, (ed.). Potential invasive pests of agricultural crops. CAB International.

Morales, F. J., R. Lastra, R. C. de Uzcátegui, and L. Calvert. 2001. Potato yellow mosaic virus: a synonym of *Tomato yellow mosaic virus*. Archives of Virology 146:2249–2253.

Morales, F. J., A. K. Martinez, and A. C. Velasco. 2002. Nuevos brotes de begomovirus en Colombia. Fitopatologia colombiana 26(2):75-79.

Morton, J. F. 1987. Naranjilla. Pages 425-428 Fruits of warm climates. Julia F. Morton, Miami, Florida.

Múnera Uribe, G. E. 2008. Biodiversity of phytoparasitic nematodes associated with Musaceae and fruit crops in Colombia. Doctor in Science (Biology) Thesis, University of Ghent. 209 pp.

Muriel, S. B., J. Montoya, A. Restrepo, and J. Muñoz. 2011. New host plant records and resource availability to Ithomiini butterflies (Lepidoptera: Nymphalidae: Danainae), in Colombian coffee agroecosystems. Actual Biol 33(95):275-285.

NASS. 2015. Quick Stats 2.0. United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). Last accessed April 16, 2015, http://www.nass.usda.gov/Quick_Stats/.

Navarro Alzate, R., and M. Lobo Arias. 1989. Some studies on *Phoma andina* var *crystalliniformis* on the tomato *Lycopersicon esculentum* Mill. Fitopatologia colombiana 13(2):47-55.

Nieto Paez, L. E. 1972. Control químico de nemátodo dorado de la papa (*Heterodera rostochiensis* Woll). Resumen de los trabajos expuestos. 2. Reunión Nacional de Fitopatología y Sanidad Vegetal. Ibagué (Colombia). 17-19 Jul 1972. p. 14.

Norrbom, A. L. 2015. RE: *Neosilba glaberrima*: question regarding whether it is present in the United States. Personal communication to L. Millar on January 30, 2015, from A. Norrbom (Systematic Entomology Lab, USDA). Archived at the PERAL Library, Raleigh, NC.

Norrbom, A. L., and K. C. Kim. 1988. A list of the reported host plants of the species of *Anastrepha* (Diptera: Tephritidae). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. 114 pp.

NRCS. 2015. The PLANTS Database. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), The National Plant Data Center. http://plants.usda.gov.

Nuñez Bueno, L. 1996. The South American fruit fly, *Anastrepha fraterculus* (Diptera: Tephritidae) in Colombia. Proceedings of the South American fruit fly, Anastrepha fraterculus (Wied.); advances in artificial rearing, taxonomic status and biological studies:163-171.

Ochoa, J., M. Ellis, D. I. Jarvis, R. Sevilla-Panizo, J. L. Chávez-Servia, and T. Hodgkin. 2005. Seed transmission of *Fusarium oxysporum* f. sp. *quitoense* appears an important cause of naranjilla collapse in Ecuador. Pages 122-125 *in* Seed Systems and Crop Genetic Diversity On-Farm, Pucallpa, Peru.

Ochoa, J. B., B. F. Yangari, M. A. Ellis, and R. N. Williams. 2004. Two new formae specialis of *Fusarium oxysporum*, causing vascular wilt on babaco (*Carica heilbornii* var. *pentagona*) and vascular wilt on naranjilla (*Solanum quitoense*) in Ecuador. Fitopatologia 39(1):10-17.

Olckers, T., J. C. Medal, and D. E. Gandolfo. 2002. Insect herbivores associated with species of *Solanum* (Solanaceae) in Northeastern Argentina and Southeastern Paraguay, with reference to the biological control of weeds in South Africa and the United States of America. Florida Entomologist 85(1):254-260.

Oliva, R. F., L. P. N. M. Kroon, G. Chacón, W. G. Flier, J. B. Ristaino, and G. A. Forbes. 2010. *Phytophthora andina* sp. nov., a newly identified heterothallic pathogen of solanaceous hosts in the Andean highlands. Plant Pathology 59(4):613-625.

Osorio-Solano, C., C. A. Orozco-Castaño, G. A. López-Gartner, and F. A. Rivera-Páez. 2012. Genetic variability of *Moniliophthora perniciosa* (Stahel) Aime & Phillips-Mora, comb. nov. (Agaricales – Marasmiaceae) in varieties of cocoa (*Theobroma cacao* L.). Acta agronómica 61(2):85-93.

Parrella, G., P. Gognalons, K. Gebre-Selassiè, C. Vovlas, and G. Marchoux. 2003. An update on the host range of tomato spotted wilt virus. Journal of Plant Pathology 85(4):227-264.

Patiño, M. L. M. 2002. Identificaión y caracterización de moscas de las frutas en los departamentos del Valle del Cauca, Tolima y Quindío. Universidad de Caldas, Facultad de Ciencias Agropecuarias, Programa de Agronomia. 27 pp.

Paull, R. E., and O. Duarte. 2011. Tropical fruits. Volume 2. 2nd edition. CAB International, Wallingford, United Kingdom. 371 pp.

Peck, S. B., M. C. Thomas, and R. H. Turnbow, Jr. 2014. The diversity and distributions of the beetles (Insecta: Coleoptera) of the Guadeloupe Archipelago (Grande-Terre, Basse-Terre, La Désirade, Marie-Galante, Les Saintes, and Petite-Terre), Lesser Antilles. Insecta Mundi 0352:1-156.

PERAL. 2009. NPAG Report: *Tuta absoluta* (Meyrick), Tomato Leafminer. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (PERAL), New Pest Advisory Group (NPAG), Raleigh, NC. 15 pp.

PERAL. 2011. Risk of introduction of *Ralstonia solanacearum* Race 3 Biovar 2 to the United States associated with imported commodities for consumption originating in infested regions. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (PERAL), Raleigh, NC. 27 pp.

PERAL. 2012. NPAG Report: *Neoleucinodes elegantalis*, Tomato fruit borer. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (PERAL), New Pest Advisory Group (NPAG), Raleigh, NC. 7 pp.

PERAL. 2015. Plant Hardiness Zones of the United States: Area and Population Analysis (Rev.Original). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and

Technology, Plant Epidemiology and Risk Analysis Laboratory (PERAL), Raleigh, NC. 8 pp.

PERAL/CIPM. 2008. Weather based disease probability maps generated using NAPPFAST system. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (PERAL) and North Carolina State University, Center for Integrated Pest Management (CIPM), Raleigh, North Carolina.

Perry, R. N., M. Moens, and J. L. Starr (eds.). 2009. Root-knot nematodes. CAB International, Wallingford, United Kingdom. 488 pp.

PestID. 2015. Pest Identification Database (PestID). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. https://aqas.aphis.usda.gov/aqas/.

Picanço, M. C., L. Bacci, A. L. B. Crespo, M. M. M. Miranda, and J. C. Martins. 2007. Effect of integrated pest management practices on tomato production and conservation of natural enemies. Agricultural and Forest Entomology 9(4):327-335.

Piven, N. M., R. C. de Uzcátegui, and D. Infante H. 1995. Resistance to tomato yellow mosaic virus in species of *Lycopersicon*. Plant Disease 79(6):590-594.

Posada, O. 1989. Lista de insectos dañinos y otras plagas en Colombia. Boletín Técnico No. 43. Instituto Colombiano Agropecuario, Bogota, Colombia. 660 pp.

Povolny, D. 1975. On three neotropical species of *Gnorimoschemini* (Lepidoptera, Gelechiidae) mining *Solanaccae*. Acta Universitatis Agriculturae 23(2):379-393.

PPQ. 2002. Electronic files for arthropods from pests not known to occur in the United States or of limited distribution and insects not known to occur in the United States. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Policy and Program Development, Risk Analysis Systems. 941 pp.

PPQ. 2012. Guidelines for Plant Pest Risk Assessment of Imported Fruit and Vegetable Commodities, Version 6.0. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ), Raleigh, NC.

PPQ. 2015. Fruits and Vegetables Import Requirements (FAVIR). United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ). https://epermits.aphis.usda.gov/manual/index.cfm?action=pubHome.

Purdue University. 2009. Potato Leafhopper. *Empoasca fabae* Harris. Purdue University Field Crops Intergrated Pest Management (IPM), West Lafayette, Indiana. Last accessed March 22, 2016, https://extension.entm.purdue.edu/fieldcropsipm/insects/soybean-potato-leafhopper.php.

Raga, A., D. A. Prestes, M. F. Souza, M. E. Sato, R. C. Siloto, J. A. Guimaraes, and R. A. Zucchi. 2004. Fruit fly (Diptera: Tephritoidea) infestation in citrus in the state of Sao Paulo, Brazil. Neotropical Entomology 33(1):85-89.

Robbins, R. T., R. D. Riggs, and D. von Steen. 1989. Phytoparasitic nematode surveys of Arkansas cotton fields, 1986-88. Journal of Nematology 21(4S):619-623.

Roberts, P. A., and A. R. Stone. 1979. Invasion and development of *Globodera* in four non-host *Solanum* species. Nematropica 9(2):106-107.

Roberts, P. A., and A. R. Stone. 1983. Comparisons of invasion and development of *Globodera* spp. and European potato cyst nematode pathotypes in roots of resistant *Solanum* subgenus *Leptostemonus*. Nematologica 29(1):95-108.

Rodríguez-Kabana, R., and P. King. 1987. Passion fruit and naranjilla as hosts for soybean nematodes. Nematropica 17(2):171-177.

Rogg, H. W. 2000. Manual manejo integrado de plagas en cultivos de la Amazonia Ecuatoriana. Imprenta MOSSAICO, Quito, Ecuador. 236 pp.

Rotta, C. D., and V. H. Muñoz. 1987. Wilt and death of *Solanum quitoense* plants. Ascolfi informa 13(1):4.

Rubiano, J. F. G., and M. P. Morera. 2006. Manual técnico del cultivo de lulo (*Solanum quitoense* L.) en el Departmento del Huila, Gobernación del Huila, Secretaria de Agricultura y Minería, Neiva.

Salazar G., C., C. Betancourth G., and A. Castillo M. 2012. Effect of biological control in nematode *Meloiogyne* spp. in lulo (*Solanum quitoense* Lam). Revista de Ciencias Agrícolas 29(2):81-92.

Salazar, L. F., G. Müller, M. Querci, J. L. Zapata, and R. A. Owens. 2000. *Potato yellow vein virus*: its host range, distribution in South America and identification as a crinivirus transmitted by *Trialeurodes vaporariorum*. Annals of Applied Biology 137:7-19.

Salazar Pineda, H., and J. Castaño Zapata. 1996. Principales enfermedades del Manzano (*Malus* sp. b.), Lulo (*Solanum quitoense* Lam.) y Mora (*Rubus glaucus* Benth) en Caldas. Pages 136-149 in Memorias. Primer Seminario frutales de clima frio moderado Manizales, Colombia.

Sanchez Ortiz, E., and R. U. Tello Duran. 1985. Identificación del agente causal de la pudrición suave del fruto del lulo (*Solanum quitoense* Lam.) y evaluación de algunos métodos de control. Tesis de Grado Universidad del Tolima. Facultad de Ingeniería Agronómica Ibagué. Colombia.

Sasser, J. N., and C. C. Carter (eds.). 1985. An advanced treatise on *Meloidogyne*: Volume I. Biology and control. North Carolina State Unviersity Graphics, Raleigh, North Carolina. 422 pp.

Scholte, K. 2000. Screening of non-tuber bearing Solanaceae for resistance to and induction of juvenile hatch of potato cyst nematodes and their potential for trap cropping. Annals of Applied Biology 136(3):239-246.

Seal, D. R. 2001. Seasonal abundance and distribution of *Thrips palmi* Karny (Thysanoptera: Thripidae) in southern Florida. Proceedings of the Floria State Horticultural Society 114:337-342.

Seal, D. R. 2004. Management of melon thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae): An integrated approach using chemical, cultural, and biological agents. Proceedings of the Florida State Horticultural Society 117:63-68.

Sequeira, R. A., L. M. Millar, and D. Bartels. 2001. Identification of susceptible areas for the establishment of *Anastrepha* spp. fruit flies in the United States and analysis of selected pathways. USDA-APHIS-PPQ Center for Plant Health Science and Technology, Raleigh, NC.

Souza-Filho, M. F., A. Raga, J. A. Azevedo-Filho, P. C. Strikis, J. A. Guimarães, and R. A. Zucchi. 2009. Diversity and seasonality of fruit flies (Diptera: Tephritidae and Lonchaeidae) and their parasitoids (Hymenoptera: Braconidae and Figitidae) in orchards of guava, loquat and peach. Brazilian Journal of Biology 69(1):31-40.

Spencer, K. A. 1990. Host Specialization in the World Agromyzidae (Diptera). Kluwer Academic Publishers, Dordrecht, The Netherlands. 444 pp.

Steck, G. 2015. RE: *Neosilba glaberrima*: question regarding whether it is present in the United States. Personal communication to L. Millar on January 30, 2015, from G. Steck (Florida Department of Agriculture & Consumer Services, Division of Plant Industry). Archived at the PERAL Library, Raleigh, NC.

Steck, G. J. 2001. Concerning the occurrence of *Anastrepha obliqua* (Diptera: Tephritidae,) in Florida. Florida Entomologist 84(2):320-321.

Stevenson, W. R. 2001. Compendium of Potato Diseases (Second Edition). American Phytopathological Society. 106 pp.

Stone, A. 1942. The fruit flies of the genus *Anastrepha*. United States Department of Agriculture Miscellaneous Publication (No. 439):112.

Stone, A., C. W. Sabrosky, W. W. Wirth, R. H. Foote, and J. R. Coulson. 1965. A catalog of the Diptera of America north of Mexico (Agriculture Handbook No. 276). United States Department of Agriculture, Washington, D.C. 1669 pp.

Stonedahl, G. M., W. R. Dolling, and G. J. duHeaume. 1992. Identification guide to common tingid pests of the world (Heteroptera: Tingidae). Tropical Pest Management 38(4):438-449.

Subbotin, S. A., M. Mundo-Ocampo, and J. G. Baldwin. 2010. Systematics of the cyst nematodes (Nematoda: Heteroderinae). Nematology Monographs and Perspectives Volume 8A. Brill, Leiden, the Netherlands. 351 pp.

Sugayama, R. L., A. Malavasi, I. Nora, and E. S. Branco. 1996. Ovipositional responses to apple in a caged tree by *Anastrepha fraterculus* in southern Brazil. Pages 67-69 *in* B. A. McPheron and G. J. Steck, (eds.). Fruit fly pests: a world assessment of their biology and management. St. Lucie Press, Delray Beach, Florida. 608 pp.

Tamayo M., P. J., R. A. Navarro A., and M. Clemencia F. de La Rotta. 2001. Enfermedades del cultivo del lulo en Colombia: guía de diagnóstico y control. Boletín Técnico. Corporación Colombiana de Investigación Agropecuaria, Corpoica, Regional 4, Centro de Investigación "La Selva", Antioquia, Colombia.

Tamayo, M. P. 1992. Drying of stems and shoots of pepper caused by *Sclerotinia sclerotiorum*. Ascolfi informa 18(5):45-46.

Tapia B., C., J. Velásquez C., J. Eestrella E., and E. Cazar M. 1993. Recolección de naranjilla (*Solanum quitoense* Lam.) en Ecuador. Instituto Nacional de Investigaciones Agropecuarias (INIAP), Estación Experimental Santa Catalina, Departamento Nacional de Recursos Fitogenéticos, Quito, Ecuador. 36 pp.

Triplehorn, C. A., and N. F. Johnson. 2004. Borror and Delong's introduction to the study of insects. 7th edition. Thomson Brooks/Cole, Belmont, California. 864 pp.

Uchôa-Fernandes, M. A., I. de Oliveira, R. M. S. Molina, and R. A. Zucchi. 2003. Populational fluctuation of frugivorous flies (Diptera: Tephritoidea) in two orange groves in the State of Mato Grosso do Sul, Brazil. Neotropical Entomology 32(1):19-25.

Uchôa, M. A., and J. Nicácio. 2010. New records of Neotropical fruit flies (Tephritidae), lance flies (Lonchaeidae) (Diptera: Tephritoidea), and their host plants in the South Pantanal and Adjacent Areas, Brazil. Annals of the Entomological Society of America 103(5):723-733.

UGA. 2015. Widely prevalent viruses of the United States. University of Georgia (UGA), Center for Invasive Species and Ecosystem Health. Last accessed October 19, 2015, http://www.prevalentviruses.org/.

University of California. 2016. Controlling whiteflies in your garden. University of California, Master Gardeners of Ventura County. Last accessed March 22, 2016, http://ucanr.edu/sites/VCMG/Controlling_Whiteflies_in_Your_Garden/.

Urueta Sandino, E. J., and R. Navarro Alzate. 1978. The mite *Steneotarsonemus pallidus*, a new pest of strawberry in Colombia and a study on its chemical control and spread to other crops. Revista Colombiana de Entomología 4(3/4):70-75.

Vallejo, F., and M. A. Morón. 2008. Description of the immature stages and redescription of the adults of *Ancognatha scarabaeoides* Erichson (Coleoptera: Scarabaeidae: Dynastinae), a member of the soil white grub assemblage in Colombia. The Coleopterists Bulletin 62(1):154-164.

Vargas, A. M., L. M. Q. Ocampo, M. C. Céspedes, N. Carreño, A. González, A. Rojas, A. P. Zuluaga, K. Myers, W. E. Fry, P. Jiménez, A. J. Bernal, and S. Restrepo. 2009. Characterization of *Phytophthora infestans* populations in Colombia: First report of the A2 mating type. Phytopathology 99(1):82-88.

Vélez, R., and D. Povolny. 1988. Symmetrischema insertum sp. n. y *Scrobipalpula motasi* Povolny (Lepidoptera: Gelechiidae) affectando lulo (*Solanum quitoense*) en Colombia. Revista del I. C. N. E. 1(1):75-96.

Vera, T., S. Abraham, A. Oviedo, and E. Willink. 2007. Demographic and quality control parameters of *Anastrepha fraterculus* (Diptera: Tephritidae) maintained under artificial rearing. Florida Entomologist 90(1):53-57.

Volcy, C. 1998. Algunas especies de Criconematodos Criconematides en suelos cultivados en Antioquia, Colombia. Revista Facultad Nacional de Agronomía 51(2):215-234.

Weems, H. V., Jr. 2006. South American fruit fly, *Anastrepha fraterculus* (Wiedemann) (Insecta: Diptera: Tephritidae) (EENY-266). University of Florida, Gainsville, Florida. 6 pp.

Wehunt, E. J., A. M. Golden, and R. T. Robbins. 1989. Plant nematodes occurring in Arkansas. Journal of Nematology 21(4S):677-681.

Weintraub, P. G., and P. Jones (eds.). 2010. Phytoplasmas: Genomes, plant hosts and vectors. CAB International, Wallingford, United Kingdom. 331 pp.

Wellman, F. L. 1977. Dictionary of Tropical American Crops and Their Diseases. The Scarecrow Press, Metuchen, NJ. 1-495 pp.

Wheeler, B. E. J., and R. Mepsted. 1988. Pathogenic variability amongst isolates of *Crinipellis perniciosa* from cocoa (*Theobroma cacao*). Plant Pathology 37(4):475-488.

White, I. M., and M. M. Elson-Harris. 1994. Fruit Flies of Economic Significance: Their Identification and Bionomics. CAB International, Wallingford, UK. 1-608 pp.

Wold-Burkness, S. 2011. Leafhoppers. Department of Entomology, University of Minnesota, Minneapolis, Minnesota. Last accessed March 22, 2016, http://fruit.cfans.umn.edu/grapes/pest/grapeipmguide/insect/leafhoppers/.

Yepes, R. F., and A. R. Velez. 1989. Contribucion al conocimiento de las moscas de las frutas (Tephritidae) y sus parasitoides en el departmento de antioquia. [Contribution to the knowledge of fruit flies (Tephritidae) and their parasitoids in the Department of Antioquia]. Revista Facultad Nacional de Agronomia Medellin 42:73-98.

Zuluaga R., M. L. 1994. El cultivo del Lulo (*Solanum quitoense* Lam.). Pages 197-208 *in* ICA and Corpoica, (ed.). Memorias del Curso Regional de Actualización en Frutas Tropicales. Instituto Colombiano Agropecuario (ICA) and Corpoica, Espinal, Tolima, Colombia.

7. Appendix: Pests with non-actionable regulatory status

We found some evidence of the below listed organisms being associated with naranjilla and being present in Colombia. Because these organisms have non-actionable regulatory status for the continental United States, however, we did not list them in Table 1 of this risk assessment, and we did not evaluate the strength of the evidence for their association with naranjilla or their presence in Colombia. Because we did not evaluate the strength of the evidence, we consider the following pests to have only "potential" association with the commodity and presence in Colombia.

Below we list these organisms along with the references supporting their potential association with naranjilla, their potential presence in Colombia, their presence in the continental United States (if applicable), and their regulatory status for the continental United States. For organisms *not* present in the continental United States, we also provide justification for their non-actionable status.

Organism	Evidence and/or other notes
ARTHROPODS	
Acari: Tarsonemidae	
Phytonemus pallidus (Banks) [syn. *Phytodromus pallidus, Steneotarsonemus pallidus, Tarsonemus fragariae, Tarsonemus pallidus]*	Aguilar and Murillo, 2012; Denmark, 2014; PestID, 2015; Urueta Sandino and Navarro Alzate, 1978
Polyphagotarsonemus latus (Banks) [syn. *Hemitarsonemus latus, Hemitarsonemus translucens, Polyphagotarsonemus translucens, Tarsonemus latus,Tarsonemus phaseoli, Tarsonemus translucens*]	CABI, 2015; PestID, 2015; Rubiano and Morera, 2006
Acari: Tetranychidae	
Tetranychus cinnabarinus (Boisduval)	Castaño, 1996; PestID, 2015; Posada, 1989
Tetranychus desertorum Banks	PestID, 2015; Posada, 1989
Tetranychus ludeni Zacher	PestID, 2015; Posada, 1989
Tetranychus urticae Koch	Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Coleoptera: Chrysomelidae	
Leptinotarsa undecimlineata (Stål)	Castaño, 1996; Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Coleoptera: Curculionidae	
Phyrdenus muriceus Germar	Gallego and Velez, 1992; Arnett et al., 2002
Diptera: Lonchaeidae	
Neosilba batesi (Curran)	Ahlmark and Steck, 1997; PestID, 2015; Yepes and Velez, 1989
Hemiptera: Aleyrodidae	

Organism	Evidence and/or other notes
Bemisia tabaci (Gennadius)	Rubiano and Morera, 2006; PestID, 2015. Vector of *Tomato yellow mosaic begomovirus* (ToYMV) (Morales et al., 2001; Morales et al., 2002).
Hemiptera: Aphididae	
Aphis gossypii Glover	Castaño, 1996; Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Myzus ornatus Laing	Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Myzus persicae (Sulzer)	Castaño, 1996; Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Hemiptera: Diaspididae	
Pseudalacaspis pentagona (Targ.)	Castaño, 1996; Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Hemiptera: Pentatomidae	
Arvelius albopunctatus (DeGeer)	PestID, 2015; Posada, 1989
Hemiptera: Pseudococcidae	
Phenacoccus gossypii Townsend & Cockerell	Figueroa, 1977; García et al., 2015; Kondo, 2001; PestID, 2015
Planococcus citri(Risso)	Gallego and Velez, 1992; PestID, 2015; Posada, 1989
Lepidoptera: Noctuidae	
Agrotis ipsilon (Hufnagel)	CABI, 2015; Belalcazar, 2011
Feltia sp. Walker	PestID, 2015
Trichoplusia ni (Hübner)	Gallego and Velez, 1992; PestID, 2015
Lepidoptera: Pyralidae	
Pilemia periusalis Walker	Gallego and Velez, 1992; PestID, 2015
Lepidoptera: Sphingidae	
Manduca sexta (L.)	Gallego and Velez, 1992; PestID, 2015
MOLLUSKS	
Arion (Kobeltia) intermedius Normand	Gregoric et al., 2013; Hausdorf, 2002; PestID, 2015
Deroceras (Deroceras) laeve (Müller) [syn. *Limax andicolus*]	Hausdorf, 2002; PestID, 2015
Deroceras (Deroceras) reticulatum (Müller)	Hausdorf, 2002; PestID, 2015
Hawaiia minuscula (Binney)	Hausdorf, 2002; PestID, 2015
Lehmannia valentiana (Férussac)	Gregoric et al., 2013; Hausdorf, 2002; PestID, 2015
Milax gagates (Draparnaud)	Hausdorf, 2002; PestID, 2015
Oxychilus (Ortizius) alliarius (Miller)	Hausdorf, 2002; PestID, 2015
Paralaoma servilis (Shuttleworth) [syn. *Helix servilis*]	Hausdorf, 2002; PestID, 2015

Organism	Evidence and/or other notes
Vitrea (Crystallus) contracta (Westerlund)	Hausdorf, 2002; PestID, 2015
NEMATODES	
Aphelenchus sp.	PestID, 2015; Tamayo M. et al., 2001
Criconema longulum Gunhold	Lehman, 2002; Volcy, 1998
Globodera tabacum (Lownsbery & Lownsbery) Skarbilovich	CABI, 2015; Roberts and Stone, 1983; Subbotin et al., 2010. *Solanum quitoense* is a poor host for this nematode (Roberts and Stone, 1983).
Heterodera glycines Ichinohe	EPPO, 2015b. *Solanum quitoense* is not a host for this nematode (Rodríguez-Kabana and King, 1987).
Meloidogyne arenaria (Neal) Chitwood	Corrales et al., 1999; Betancourth García et al., 2011; Koenning et al., 1999; Múnera Uribe, 2008; Rodríguez-Kabana and King, 1987
Meloidogyne hapla Chitwood	Betancourth García et al., 2011; Koenning et al., 1999; Múnera Uribe, 2008; Sasser and Carter, 1985
Meloidogyne javanica (Treub) Chitwood	Corrales et al., 1999; Buriticá, 1999; Múnera Uribe, 2008; Salazar Pineda and Castaño Zapata, 1996; Sasser and Carter, 1985
Meloidogyne incognita (Kofoid & White) Chitwood [syn. *M. acrita* Chitwood]	Betancourth García et al., 2011; Corrales et al., 1999; Buriticá, 1999; Múnera Uribe, 2008; Salazar Pineda and Castaño Zapata, 1996; Sasser and Carter, 1985
Pratylenchus brachyurus (Godfrey) Filipjevi & Schuurmans Stekhoven	CABI, 2015; Lehman, 2002; Robbins et al., 1989; Rodríguez-Kabana and King, 1987
Pratylenchus coffeae (Zimmermann) Filipjevi & Schuurmans Stekhoven [syn. *Tylenchus coffeae* Zimmermann]	CABI, 2015; Goodey et al., 1965; Lehman, 2002; Wehunt et al., 1989. *Solanum quitoense* is a poor host for this nematode (de Flutter and Mulholland, 1941).
Tylenchus sp.	Buriticá, 1999; PestID, 2015; Tamayo M. et al., 2001
FUNGI and CHROMISTA	
Athelia rolfsii (Curzi) Tu & Kimbr. [syn. *Sclerotium rolfsii* Sacc.]	Buriticá, 1999; Farr et al., 2015; Franco et al., 2002
Colletotrichum acutatum J.H. Simmonds	Arrieta-Guevara et al., 2010; Farr et al., 2015
Clonostachys rosea f. *rosea* (Link : Fr.) Schroers et. al. [syn. *Gliocladium roseum* Bainier]	Barreto Gomez and Polanco Bolanos, 1982; Farr et al., 2015
Colletotrichum gloeosporioides (Penz.) Penz. & Sacc.	Buriticá, 1999; Farr et al., 2015; Gomez, 1990; Paull and Duarte, 2011; Salazar Pineda and Castaño Zapata, 1996
Fusarium oxysporum Schltdl. : Fr.	Buriticá, 1999; Farr et al., 2015; Franco et al., 2002; Rotta and Muñoz, 1987

Organism	Evidence and/or other notes
Mycena citricolor (Berk. & M.A. Curtis) Sacc.	CABI, 2015; PestID, 2015; Wellman, 1977
Phytophthora infestans (Mont.) de Bary	Farr et al., 2015; Vargas et al., 2009
Rhizoctonia solani J.G. Kühn [syn. *Thanatephorus cucumeris* (A.B. Frank) Donk]	Buriticá, 1999; Farr et al., 2015; Ferrucho et al., 2012; Paull and Duarte, 2011
Rhizoctonia sp.	Cordoba and Pineda, 1986; Farr et al., 2015
Sclerotinia sclerotiorum (Lib.) de Bary	Buriticá, 1999; Salazar Pineda and Castaño Zapata, 1996; Tamayo, 1992
Spongospora subterranea (Wallr.) Lagerh. [syn. *S. subterranea* f. sp. *subterranea* J.A. Toml.]	Arcila Aristizábal et al., 2014; Farr et al., 2015. *Solanum quitoense* is considered a trap crop for this pathogen (Arcila Aristizábal et al., 2014).
Verticillium albo-atrum Reinke & Berthold	Buriticá, 1999; Farr et al., 2015; Franco et al., 2002
BACTERIA	
Clavibacter michiganensis (Smith) Davis et al. [syn. *Corynebacterium michiganense* (Smith) Jensen]	CABI, 2015; Horst, 2001; Salazar Pineda and Castaño Zapata, 1996
Dickeya chrysanthemi (Burkholder et al.) Samson et al. [syn. *Erwinia chrysanthemi* Burkholder et al.]	Horst, 2001; Tamayo M. et al., 2001
Pectobacterium carotovorum (Jones) Waldee emend. Gardan et al. [syn. *Erwinia carotovora* (Jones) Bergey et al.]	Gomez, 1997; Kennedy and Alcorn, 1980
Pectobacterium carotovorum subsp. carotovorum (Jones) Hauben et al. emend. Gardan et al. [syn. *Erwinia carotovora* subsp. *carotovora* (Jones) Bergey et al.]	Coplin, 1980; Sanchez Ortiz and Tello Duran, 1985; Stevenson, 2001
Xanthomonas vesicatoria (ex Doidge) Vauterin et al.	Horst, 2001; EPPO, 2015b
VIRUSES and VIROIDS	
Alfalfa mosaic alfamovirus (AMV)	Horvath, 1987; CABI, 2015; UGA, 2015
Citrus exocortis pospiviroid (CEVd)	Diener, 1979; EFSA PLH Panel, 2011; UGA, 2015

Organism	Evidence and/or other notes
Potato leafroll polerovirus (PLRV)	Buriticá, 1999; UGA, 2015
Potato potyvirus Y (PVY)	CABI, 2015; Horvath, 1987; UGA, 2015
Tomato spotted wilt tospovirus (TSWV)	EPPO, 2015b; Parrella et al., 2003; UGA, 2015