United States Department of Agriculture

Importation of Grape (*Vitis vinifera* L.) from India into the Continental United States

A Qualitative, Pathway-Initiated Pest Risk Assessment

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Animal and Plant Health Inspection Service

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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 fruit of grape, *Vitis vinifera* (Vitaceae), for consumption from India into the continental United States. Based on the market access request submitted by India, we considered the pathway to include the following processes and conditions: hand harvesting, sorting, sizing, and cooling for shipment.

Based on the scientific literature, port-of-entry pest interception data, and information from the government of India, we developed a list of all potential pests with actionable regulatory status for the continental United States that are known to occur in India (on any host) and to be associated with the commodity plant species (anywhere in the world). Of these, we found 22 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 eight are *not* candidates for risk management, either because there is no endangered area within the continental United States, they were not likely to 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: *Icerya seychellarum* (Hemiptera: Margarodidae), *Maconellicoccus hirsutus, Nipaecoccus viridis, Pseudococcus cryptus, Rastrococcus iceryoides* (Hemiptera: Pseudococcidae), *Retithrips syriacus, Rhipiphorothrips cruentatus,* and *Thrips palmi* (Thysanoptera: Thripidae).

The remaining 14 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
Arthropods	Acari: Tenuipalpidae	*Tenuipalpus granati* Taher Sayed	Medium
	Diptera: Tephritidae	*Bactrocera correcta* (Bezzi)	Medium
		Bactrocera dorsalis Hendel	Medium
	Lepidoptera: Crambidae	*Conogethes punctiferalis* (Guenée)	Medium
	Lepidoptera: Noctuidae	*Helicoverpa armigera* (Hübner)	Medium
		Spodoptera litura (Fabricius)	Medium
	Lepidoptera: Oecophoridae	*Stathmopoda auriferella* (Walker)	Medium
	Lepidoptera: Pterophoridae	*Nippoptilia vitis* (Sasaki)	Medium
		Oxyptilus regulus Meyrick	Medium
		Platyptilia ignifera Meyrick	Medium
	Lepidoptera: Pyralidae	*Cryptoblabes gnidiella* Millière	Medium
	Thysanoptera: Thripidae	*Scirtothrips dorsalis* Hood	High
Fungi	Ascomycetes: Helotiales	*Monilinia fructigena* Honey ex Whetzel	Medium

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Pest type	Taxonomy	Scientific name	Likelihood of Introduction overall rating
Bacteria		*Xanthomonas campestris* pv. *viticola* (Nayuda) Dye	Low

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 of grapes (*Vitis vinifera*) for consumption from India 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" (IPPC, 2013). The use of biological and phytosanitary terms is consistent with ISPM No. 5, "Glossary of Phytosanitary Terms" (IPPC, 2016).

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, Part 319.56 of the Code of Federal Regulations (7 CFR § 319.56, 2012). Currently, under this regulation, the entry of grapes from India into the continental United States is not authorized. This commodity risk assessment was initiated due to a request by Pankaj Kumar, Ministry of Agriculture, India, to change the Federal Regulation to allow entry (MOA-India, 2008).

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 grapes because grapes are widely cultivated in the United States (Tordsen, 2015).

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1.4. Description of the pathway

A pathway is "any means that allows the entry or spread of a pest" (IPPC, 2016). 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 of grape (*Vitis vinifera* L.) for consumption from India into the continental United States; the movement of this commodity provides a potential pathway for the introduction and 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 India through importation and distribution in the continental United States. These conditions provided the basis for creating the pest list and assessing the likelihood of introduction of the pests selected for further analysis.

1.4.1. Description of the commodity

The commodity consists of fresh fruit of grapes (*Vitis vinifera*) for consumption. Potential varieties include Thompson Seedless, Muscat, Bangalore Blue, Flame, Sonaka, Black Seedless, Anabe-shahi, and Perlette.

1.4.2. Production and harvest procedures in the exporting area

Grapes will be grown in the field and allowed to fully ripen on the vine since they do not ripen post-harvest.

1.4.3. Post-harvest procedures in the exporting area

Grapes will be hand harvested, sorted, sized, and cleaned by hand to remove any broken, decayed, deformed, undersized, or discolored berries. Fruit is pre-cooled to less than 4 °C by forced air as soon as possible after packing and within 6-8 hours of sea shipment.

Prior to shipment, grapes are inspected at the packinghouse facilities by plant quarantine officers of Directorate of Plant Protection, Quarantine & Storage (Dte of PPQS).

Below is the sampling scheme for inspection.

Total No. of Packages in the shipment	**No. of packages to be sampled**
< than 10	100% of packages
11-100	10% of packages subject to a minimum of five packages
101-1000	2% or a minimum of 10 packages
>1000	1% or a minimum of 20 packages

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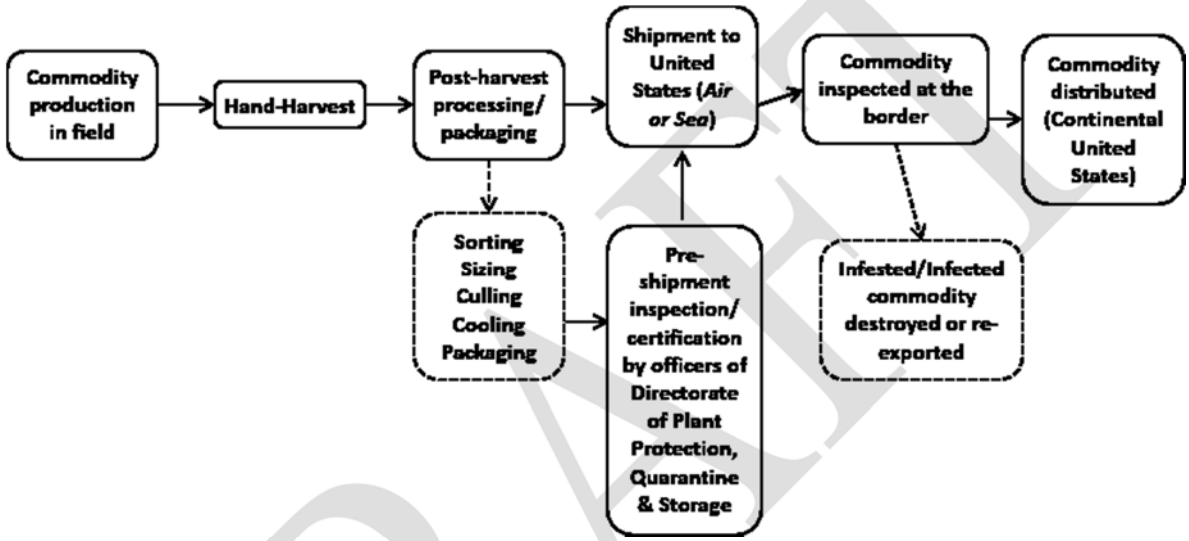
1.4.4. Shipping and storage conditions

Grapes are stored at 0-2 °C until shipment. Humidity levels are 90-95 percent throughout storage and transport. With air shipment, there is no pre-cooling; fruits are immediately loaded into a refrigerated truck or van and transported to the airport for loading into an aircraft.

1.4.5. Summary of the pathway

Figure 1 summarizes the pathway of concern: the importation of fresh grape (*Vitis vinifera*) fruit for consumption from India into the continental United States.

Figure 1. Pathway diagram for imports of grapes from India 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 India (on any host) and associated with *Vitis vinifera* (anywhere in the world). Species on the pest list with a reasonable likelihood of being present on grapes 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

2.1.1. Pests with weak evidence for association with the commodity or for presence in the export area

Archips machlopis (Meyrick) was reported on grape once in 1961 (Puttarudriah et al., 1961), but has not been reported on grape in any other areas of the world where it occurs. This pest was included in the Australian table grape import analysis; however, the association with grape was based on the Puttarudriah reference and the biology was all based on *Archips micaceana* on grape in China. Based on the lack of any additional past or current association with grape, we consider its association with grape to be doubtful.

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Eupoecilia ambiguella Hübner is occasionally listed as present in India (e.g., Byun and Li, 2006), but the EPPO PQR Database indicates that such reports are incorrect (EPPO, 2016). Without confirmation of detection of this species in India, we consider its presence there to be doubtful.

Homona coffearia (Nietner) (Lepidoptera: Tortricidae) is present in India (CABI, 2016; Shiraki, 1952b), but we think the host association with grapes (Shiraki, 1952b) is doubtful.

We did not list the insect, *Icerya aegyptiaca* (Douglas) (Hemiptera: Margarodidae), because, although it is present in India (Ben-Dov et al., 2009; CABI, 2016), its association with grapes is dubious.

We found a single reference from 1969 for *Heliothis peltigera* Denis & Schiffermüller infesting grapevine (Avidov and Harpaz, 1969). However, the number of larvae present, plant parts attacked, and degree of damage were not reported, indicating that caterpillars could have simply wandered onto the plant. We found no other sources corroborating that grapevine is a host for *H. peltigera*. Based on this information, we concluded there was not enough evidence that *Vitis vinifera* is a host for *H. peltigera*, and we did not include it in the pest list.

The fungus *Periconia saraswatipurensis* Bilgrami is reported from *Vitis vinifera* in India (Bilgrami et al., 1981); however, very little information has been published about *P. saraswatipurensis*. Most *Periconia* species are saprophytic on plant substrates (Cantrell et al., 2007). This species has been associated with a wide range of plants (Kew Gardens Herbarium, 2015). There is a 1971 report of it causing a leaf spot disease on coconut palm (Gupta and Ram, 1971) and a 1995 report of it causing a leaf spot on sugarcane (Rao and Sing, 1995). No subsequent reports of this activity on these hosts were found. On grapes, *P. saraswatipurensis* is reported as a post-harvest rot (Fatima et al., 2006). Proper storage and handling prevents incidence of this fungus (Fatima et al., 2006). It is not anticipated that commercially produced and stored grapes will be afflicted with this fungus.

The pest *Perissopneumon ferox* Newstead (Hemiptera: Margarodidae) is also present in India (CABI, 2016). We found no evidence for a host association with grapes besides a non-sourced reference in CABI (CABI, 2016).

Phakopsora cronartiiformis Dietel was reported on *Vitis* by Bilgrami Jamaluddin and Rizwi (1981), but a later report by Ono et al. (1990) stated that *P. cronartiiformis* only occurs on *Parthenocissus semicordata* (= *Vitis himalayana* Brandis var. *semicordata* Lawson, *V. semicordata* Roxb.) and is endemic to the Himalayas. Ono et al. (1990) also stated that *P. cronartiiformis* is easily differentiated from the "grape rust fungus," *P. ampelopsidis*. The rust is primarily a leaf pathogen, and is only occasionally reported from stem, young shoots, or rachises of *Vitis* (Pearson and Goheen, 1988) and not the fruit. We found very little information in the literature about this fungus or its economic impacts. Due to the uncertainty of the host association and pest status, we did not list this pest.

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There is a single record of *Phoma ampelocarpa* Pass. on *Vitis* in India (Mathur, 1979); however, no other information about this record or the behavior of this species on *Vitis* or other crops was found except for the original description from Italy in 1890 (Caruel, 1890). There is not enough substantiating evidence that this fungus is acting as a pest in current production systems. If new information arises, the risk will be evaluated.

Deuterocopus alopecodes Meyrick is cited as present in India (Gielis, 2003), which is confirmed in other sources; however, its association with *Vitis* is unclear. Most records are taxonomic in nature, without information about the host. Matthews and Lott (2005) cited Fletcher (1920) who described the moth as being collected on a vine where the larvae may have fed. We considered the pest unlikely to follow the pathway of commercial grapes because association with the host is not confirmed.

According to PestID (PestID, 2016) Ad hoc 309 records, *Coccus discrepans* (Green) has not been intercepted entering the United States from India, or from anywhere else, on any commodity. It is not listed in the CABI Crop Protection Compendium or the CABI Invasive Species Compendium. The association with grapes comes from two outdated pest lists of grapes in India that either place *C. discrepans* in a long list of other pests that "infest grape vine" (no further details provided) (Nair, 1975) or note that it is a "less important" and "minor" pest in one restricted geographic area (the Punjab, a small state in northwest India) (Pruthi and Batra, 1960). In general, soft scales are rarely of economic importance to grape production in India and modern Indian extension texts do not list *C. discrepans* as a pest of this industry (e.g., Mani et al., 2014; Korlapati and Singh, 2014). A comprehensive review of Indian coccids does not associate *C. discrepans* with grape (Varshney, 1985). One author lists it from India as a "soft scale recorded from citrus…of little or no importance" (Ben-Dov and Hodgson, 1997). The scale *is* said by Nair (1975, p. 222) to "infest grape vine" in India. Should this information be ignored?

2.1.2. Organisms with non-actionable regulatory status

We found evidence of the organisms listed in the appendix being associated with grapes and being present in India; however, because these organisms have non-actionable regulatory status for the continental United States, we did not include them in Table 1 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 species 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

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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 judgment.

For this risk assessment, we identified the following organisms identified only to the genus level that are reported on *Vitis vinifera* in India: *Oligonychus* spp. (Acari: Tetranychidae) (Hill, 1983), *Myllocerus* sp. (Coleoptera: Curculionidae) (Hill, 1983; Nair, 1975), *Adoretus* sp. (Coleoptera: Scarabaeidae) (Atwal, 1976; Hill, 1983; Matthews and Lott, 2005), *Anomala* spp. (Coleoptera: Scarabaeidae) (Hill, 1983), *Phyllophaga* sp. (Coleoptera: Scarabaeidae) (CABI, 2016), *Aleyrodes* sp. (Hemiptera: Aleyrodidae) (Matthews and Lott, 2005; CABI, 2016), *Brachycaudus* sp. (Hemiptera: Aphididae) (Cree, 2005), *Eulecanium* sp. (Syn: *Lecanium* sp.) (Hemiptera: Coccidae) (Hill, 1983), *Aspidiotus* sp. (Hemiptera: Diaspididae) (Hill, 1983), *Pseudococcus* sp. (Hemiptera: Pseudococcidae) (Varshney, 1992), *Odontotermes* sp. (Isoptera: Termitidae) (Nair, 1975), *Euproctis* spp. (Lepidoptera: Lymantriidae) (Hill, 1983), *Stathmopoda* sp. (Lepidoptera: Oecophoridae) (Matthews and Lott, 2005), *Acherontia* spp. (Lepidoptera: Sphingidae) (Hill, 2008), *Theretra* spp. (Lepidoptera: Sphingidae) (Hill, 2008), *Cryptophlebia* sp. (Lepidoptera: Tortricidae) (Cree, 2005), *Thyrassia* sp. (Lepidoptera: Zygaenidae) (Borror et al., 1989; Robinson et al., 2010), *Macrophoma* sp. (Ascomycetes: Botryosphaeriaceae) (Bilgrami et al., 1981; Farr and Rossman, 2015), *Microxyphiella* sp.[1] (Ascomycetes: Incertae sedis) (Butani and Lele, 1976; Farr and Rossman, 2015), *Oidium* sp. (Ascomycetes: Erysiphaceae) (CABI, 2016; Bilgrami et al., 1981), and *Phoma* sp. (Ascomycetes: Incertae sedis) (Farr and Rossman, 2015; Bilgrami et al., 1981).

2.2. Pest list

In Table 1, we list the actionable pests associated with grapes that occur in India. The list comprises those actionable pests that occur in India on any host and are associated with grapes whether in India 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 India. 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 2).

[1] This fungus is a sooty mold that grows on insect honeydew (secretions), and currently no action is taken on sooty molds (McKemy, 2010).

Table 1. Actionable pests associated with *Vitis vinifera* (in any country) and present in India (any host).

Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
ARTHROPODS					
Acari: Tenuipalpidae					
Tenuipalpus granati Taher Sayed	Thakur et al., 2004	Gentry, 1965; Hatzinikolis, 1986	Br, F, L (Hatzinikolis, 1986)	Yes	
Acari: Tetranychidae					
Eotetranychus kankitus Ehara	Bolland et al., 1998; Dhooria et al., 2005	Bolland et al., 1998	L (Jeppson et al., 1975)	No	
Eotetranychus truncatus Estebanes and Baker	Bolland et al., 1998; Prasad, 1974; Rather, 2008	Bolland et al., 1998; Prasad, 1974; Rather, 2008	L (Dhooria and Sandhu, 1975)	No	
Eutetranychus africanus (Tucker)	Migeon and Dorkeld, 2009	Migeon and Dorkeld, 2009	L (Jeppson et al., 1975)	No	
Eutetranychus orientalis (Klein)	Bolland et al., 1998; Hill, 1983; Rather, 2008	Bolland et al., 1998; Hill, 1983; Rather, 2008	L (Hill, 1983), F (van den Berg et al., 2001)	No	Fruit damage and association for *E. orientalis* has been reported for citrus, but not for grape. Leaves are the only reported portion to be damaged.
Oligonychus biharensis (Hirst)	Bolland et al., 1998	Bolland et al., 1998	L (McDonald, n.d.)	No	

[2] If warranted, the host type (i.e., Type 1, Type 2, or Type 4 host) may be indicated for a pest. Host types are explained in *Guidelines for Plant Pest Risk Assessment of Imported Fruit and Vegetable Commodities, Version 6.0* (PPQ, 2012).

[3] The plant part(s) listed are those for the plant species under analysis. S=stem, L=leaf, F=fruit, Br=branch, I= inflorescence, R=root, Sd=seed, Sh=shoot, Tr=trunk. If the information has been extrapolated, such as from plant part association on other plant species, we note that.

[4] "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).

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Oligonychus mangiferus (Rahman & Sapra)	Nair, 1975; Prasad, 1974; Rather, 2008	Bolland et al., 1998; Nair, 1975; Prasad, 1974; Rather, 2008	L (Nair, 1975)	No	
Oligonychus vitis Zaher & Shehata	Bolland et al., 1998; Rather, 2008	Bolland et al., 1998; Koch and Waterhouse, 2000; Rather, 2008	L, Sh (Gonzalez, 1983)	No	
Coleoptera: Bostrichidae					
Sinoxylon anale Lesne	Atwal, 1976	Atwal, 1976; Gupta et al., 2005	S (Gupta et al., 2005)	No	
Coleoptera: Cerambycidae					
Celosterna scabrator (Fabricius)	CABI, 2016; NHB, 2009	CABI, 2016; NHB, 2009	Br, S, Tr (NHB, 2009)[5]	No	
Chlorophorus annularis (Fabricius)	IN (CABI, 2016; Hua, 2002), US (HI) (CABI, 2016)	CABI, 2016; Hua, 2002	S (CABI, 2016)	No	
Chlorophorus quatuordecimmaculatus (Chevrolat)	Hua, 2002	Hua, 2002	S (CABI, 2016)	No	
Pterolophia annulata (Chevrolat)	Dubey et al., 1976	Tayutivutikul and Kusigemati, 1992	S (Tayutivutikul and Kusigemati, 1992)	No	
Sthenias grisator Fabricius	Atwal, 1976; Hill, 1983; Nair, 1975	Atwal, 1976; Gupta et al., 2005; Hill, 1983; Nair, 1975	S, Wood (Atwal, 1976; Hill, 1983)	No	

[5] Larvae bore directly into trunks, stems, and branches of host plants immediately after hatching (NHB, 2009). Eggs are unlikely to be laid on the rachis within fruit bunches.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Coleoptera: Chrysomelidae					
Altica coerulea Olivier	Hua, 2002	Hua, 2002	L (Borror et al., 1989)	No	
Basilepta subcostatum (Jacoby) (Syn: *Nodostoma subcostatum* Jac.)	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Borror et al., 1989)	No	
Mimastra cyanea Hope	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Borror et al., 1989)	No	
Monolepta erthrocephala Linnaeus	Matthews and Lott, 2005	Matthews and Lott, 2005	L (Hill, 2008)	No	
Monolepta signata Olivier	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Hill, 2008)	No	
Oides decempunctata (Billberg)	Hill, 1983	Hill, 1983; Lee and Cho, 2006	L (Hill, 1983)	No	
Oides maculata (Olivier)	Hua, 2002	Hua, 2002	L (Borror et al., 1989)	No	
Scelodonta strigicollis Motschulsky	Atwal, 1976; Nair, 1975; Matthews and Lott, 2005	Atwal, 1976; Gupta et al., 2005; Nair, 1975; Matthews and Lott, 2005	F, L (Matthews and Lott, 2005), R (Pimentel, 2007)	No[6]	
Coleoptera: Coccinellidae					
Henosepilachna elaterii (Rossi) (Syn: *Epilachna chrysomelina* [F.])	CABI, 2016	Avidov and Harpaz, 1969	L (Avidov and Harpaz, 1969)	No	

[6] Flea beetles may feed on the fruit, leaves, or roots of host plants. They are highly active and usually jump when disturbed (Cranshaw, 2006). They are highly unlikely to remain with the commodity through harvest and packing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Coleoptera: Dermestidae					
Trogoderma granarium Everts	PPQ, 2002	PPQ, 2002	Raisins (PPQ, 2002)	No	
Coleoptera: Scarabaeidae					
Adoretus bengalensis Brenske	Nair, 1975	Nair, 1975	L (Nair, 1975)	No	
Adoretus duvauceli Blanchard	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Nair, 1975)	No	
Adoretus horticola Arrow	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Nair, 1975)	No	
Adoretus lasiopygus Burmeister	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Nair, 1975)	No	
Adoretus nitidus Arrow	Atwal, 1976	(Atwal, 1976	L (Atwal, 1976)	No	
Adoretus pallens Arrow	Atwal, 1976	(Atwal, 1976	L (Atwal, 1976)	No	
Adoretus punctipennis Fahraeus	Flaherty, 1992; Pimentel, 2007	Flaherty, 1992; Le Pelley, 1959; Pimentel, 2007	L (Flaherty, 1992; Pimentel, 2007)	No	
Adoretus versutus Harold	CABI, 2016; Nair, 1975; Matthews and Lott, 2005	CABI, 2016; Nair, 1975; Matthews and Lott, 2005	I, L (CABI, 2016), L (Nair, 1975)	No	

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Anomala dimidiata Hope	Atwal, 1976; Nair, 1975; Matthews and Lott, 2005	Atwal, 1976; Gupta et al., 2005; Nair, 1975; Matthews and Lott, 2005	F (Matthews and Lott, 2005), L (Nair, 1975)	No[7]	
Brahmina coriacea Hope [Syn: *Lachnosterna coriacea* (Hope)]	Hill, 1983; Nair, 1975; Matthews and Lott, 2005	Hill, 1983; Nair, 1975; Matthews and Lott, 2005	L (Nair, 1975)	No	
Holotrichia longipennis (Blanchard)	Hill, 1983	Hill, 1983	L, R (Hill, 1983)	No	
Melolontha melolontha Linnaeus	CABI, 2016	CABI, 2016; Pimentel, 2007	F, L, R (CABI, 2016)	No[7]	
Popillia mutans Newman	Hua, 2002	Hua, 2002	F, I, L, R[8] (CABI, 2016)	No[9]	
Coleoptera: Curculionidae					
Ambrosiodmus apicalis Wood & Bright	Wood, 1992a	Wood and Bright, 1992b	Br, S (Borror et al., 1989)	No	
Xylosandrus discolor (Blandford)	CABI, 2016; Wood, 1992a	Wood and Bright, 1992b	S (CABI, 2016)	No	

[7] Adult scarab beetles may feed on fruits and leaves of host plants, but larvae feed on plant roots (Borror et al., 1989). Adults are relatively large and conspicuous, and are highly unlikely to remain with grape bunches through harvest and packing.

[8] We found little biological information about *P. mutans*. This information is based on *P. japonica*, which aggregates and feeds on flowers, fruits, and leaves of host plants (CABI, 2016).

[9] *Popillia mutans* is highly unlikely to follow the pathway of grapes. *Popillia* species generally feed in large, active groups and are more frequently found on leaves (CABI, 2016). As mobile insects, they are highly unlikely to remain with grape clusters through harvest and post-harvest processing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Coleoptera: Tenebrionidae					
Gonocephalum depressum Fabricius	Nair, 1975	Nair, 1975	F, R (Nair, 1975)	No[10]	
Gonocephalum hoffmannseggii (Steven) (Syn: *Dasus hoffmannseggi* [Steven])	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	F, S (Nair, 1975)	No[10]	
Diptera: Tephritidae					
Bactrocera correcta (Bezzi)	Mani, 1992	Mani, 1992	F (Mani, 1992)	Yes	
Bactrocera dorsalis (Hendel)	IN (Kapoor, 1993), US (HI) (CABI, 2016)	Kapoor, 1993	F (CABI, 2016)	Yes	
Hemiptera: Aleyrodidae					
Aleurocanthus citriperdus (Quaintance & Baker)	Hua, 2000	Hua, 2000	L (Borror et al., 1989)	No	
Aleurocanthus spiniferus (Quaintance)	IN, US (HI) (CABI, 2016; Evans, 2008)	CABI, 2016; Evans, 2008; Hill, 1983	L (CABI, 2016; Hill, 1983)	No	
Aleurocanthus woglumi Ashby	IN (Hill, 1983), US (FL, HI, TX) (CABI, 2016)	CABI, 2016; Hill, 1983	L, S (CABI, 2016)	No	
Aleurolobus taonabae (Kuwana)	Dubey and Ko, 2009; Evans, 2008	Dubey and Ko, 2009; Evans, 2008	L (Dubey and Ko, 2009)	No	

[10] Larvae of *Gonocephalum* species feed on roots, while adults may feed on fruits, leaves, and other host plant parts. Adults are relatively large and can fly (CABI, 2016). They are highly unlikely to remain with the commodity through harvest and packing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Bemisia capitata Regu & David	Evans, 2008	Evans, 2008	L (CABI, 2016)	No	
Hemiptera: Cicadellidae					
Arboridia viniferata Sohi and Sandhu	NHB, 2009	Gupta et al., 2005; NHB, 2009	L (NHB, 2009)	No	
Bothrogonia ferruginea (Fabricius) [Syn: *Cicadella ferruginea* (Fabricius)]	Hua, 2000; Shiraki, 1952b	Hua, 2000; Shiraki, 1952b; Tayutivutikul and Kusigemati, 1992	L (Chanthy et al., 2010)	No	
Empoasca flavescens (Fabricius)	Hua, 2000	Hua, 2000; Pimentel, 2007	L (Pimentel, 2007)	No	
Empoasca minor Singh-Pruthi	Nair, 1975	Nair, 1975	L (Nair, 1975)	No	
Empoasca notata Melichar	Hua, 2000	Hua, 2000	L (Borror et al., 1989)	No	
Empoasca rufa Melichar	Hua, 2000	Hua, 2000	L (Borror et al., 1989)	No	
Empoasca sp.	NHB, 2009	NHB, 2009	L (NHB, 2009)	No	
Empoasca vitis (Gothe)	CABI, 2016	Bournier, 1976; CABI, 2016	L (Böll and Herrmann, 2004; CABI, 2016)	No	
Erythroneura sp.	Atwal, 1976	Atwal, 1976	L (Atwal, 1976)	No	
Jacobiasca lybica (Bergevin & Zanon) (Syn: *Chlorita lybica* Bergevin & Zanon*; Empoasca lybica* [De Bergevin])	CABI, 2016; NHB, 2009; Pimentel, 2007	CABI, 2016; NHB, 2009; Pimentel, 2007	L (Pimentel, 2007)	No	

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Orosius orientalis (Matsumura) (Syn: *O. albicinctus* Distant)	CABI, 2016; Hua, 2000	Hua, 2000	L (CABI, 2016)	No	
Typhalocyba sp.	NHB, 2009	NHB, 2009	L (NHB, 2009)	No	
Hemiptera: Coccidae					
Ceroplastes actiniformis Green	Nair, 1975	Nair, 1975	L, S (CABI, 2016)	No	
Ceroplastes rusci (Linnaeus)	IN, US (FL) (CABI, 2016)	CABI, 2016; Hamon and Mason, 2006	L, S (Hamon and Mason, 2006)	No	
Megapulvinaria maxima (Green) [Syn: *Macropulvinaria maxima* (Green); *Pulvinaria maxima* Green]	Nair, 1975; Varshney, 1992	Nair, 1975; Varshney, 1992	L,S (Ben-Dov and Hodgson, 1997)	No	
Paralecanium expansum (Green)	Hua, 2000	Hua, 2000	L (Chanthy et al., 2010)	No	
Hemiptera: Coreidae					
Anoplocnemis phasiana Fabricius	Nair, 1975; Schaefer and Panizzi, 2000	Nair, 1975; Schaefer and Panizzi, 2000	Sh (Nair, 1975), F, L (Schaefer and Panizzi, 2000)	No[11]	
Leptocorisa acuta Thunberg	CABI, 2016; Hua, 2000	Hua, 2000	L, Sd (CABI, 2016)	No	
Hemiptera: Diaspididae					

[11] *Anoplocnemis* species are relatively large and mobile insects; when disturbed, they jump to the ground (Schaefer and Panizzi, 2000). Therefore, they are highly unlikely to remain with the commodity through harvest and packing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Aonidiella comperei McKenzie	Ben-Dov et al., 2009	Ben-Dov et al., 2009	Br, L (Ben-Dov et al., 2009), F[12]	Yes	Section 2.3
Aonidiella inornata McKenzie	IN (Suresh and Mohanasundaram, 1996), US (TX) (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Watson, 2005	Br, F, L (Atwal, 1976)	Yes	Section 2.3
Aulacaspis vitis Green [Syn: *Chionaspis vitis* (Green)]	Hua, 2000; Watson, 2005	Hua, 2000; Watson, 2005	L (Watson, 2005)	No	
Chlidaspis asiatica Archangelskaya	Ben-Dov et al., 2009; Watson, 2005	Ben-Dov et al., 2009; Watson, 2005	Br, F, L (Watson, 2005)	Yes	Section 2.3
Chrysomphalus pinnulifer (Maskell)	Ben-Dov et al., 2009	Ben-Dov et al., 2009	L (Ben-Dov et al., 2009)	No	
Parlatoria cinerea Hadden	Ben-Dov et al., 2009; Watson, 2005	Ben-Dov et al., 2009; Watson, 2005	F, L, S (Watson, 2005)	Yes	Section 2.3
Pseudaonidia trilobitiformis (Green)	IN, US (FL) (Watson, 2005)	Watson, 2005	F, L (Peña et al., 2002)	Yes	Section 2.3
Hemiptera: Flatidae					
Flata ferrugata (Fabricius)	Bournier, 1976; Pimentel, 2007	Bournier, 1976; Pimentel, 2007	L (Pimentel, 2007)	No	
Geisha distinctissima (Walker)	Hua, 2000	Hua, 2000	L, S (Song and Liang, 2009)	No	

[12] A similar species, *A. aurantii*, infests all above-ground portions of host plants, including leaves, branches, and fruit (Atwal, 1976).

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Unnata intracta Walker	Bournier, 1976; Pimentel, 2007	Bournier, 1976; Pimentel, 2007	L (Pimentel, 2007)	No	
Hemiptera: Fulgoridae					
Lycorma delicatula (White)	Hua, 2000	Han et al., 2008; Hua, 2000	S (Han et al., 2008)	No	
Hemiptera: Kerriidae					
Kerria communis (Mahdihassan) (Syn: *Laccifer communis* Mahdihassan)	Atwal, 1976; Varshney, 1992	Atwal, 1976; Gupta et al., 2005; Varshney, 1992	L, S [13]	No	
Kerria lacca Kerr	Butani and Lele, 1976; Hill, 1983	Butani and Lele, 1976; Hill, 1983	L (Butani and Lele, 1976), S (Hill, 1983)	No	
Hemiptera: Lygaeidae					
Oxycarenus hyalinipennis Costa	PPQ, 2002	Avidov and Harpaz, 1969; PPQ, 2002	L, S (PERAL, 2006)	No	
Spilostethus pandurus (Scopoli) (Syn: *Lygaeus pandurus* Scopoli)	Nair, 1975; Matthews and Lott, 2005; Schaefer and Panizzi, 2000	Gentry, 1965; Nair, 1975; Matthews and Lott, 2005; Schaefer and Panizzi, 2000	F, I, L, S (Schaefer and Panizzi, 2000)	No[14]	
Hemiptera: Margarodidae					

[13] A similar species, *Kerria lacca*, infests the leaves, stems, and twigs of grapevines (Mani, 2014)

[14] *Spilostethus pandurus* are large, conspicuous insects (Schaefer and Panizzi, 2000), and are highly unlikely to remain with the commodity through harvest and packing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Drosicha stebbingii (Stebbing) [Syn: *D. mangiferae* (Gr.)]	Matthews and Lott, 2005; Varshney, 1992	Matthews and Lott, 2005; Varshney, 1992	L (Hill, 2008), Sh (Peña et al., 2002)	No	
Icerya seychellarum (Westwood)	CABI, 2016; PPQ, 2002	CABI, 2016; PPQ, 2002	L, S, petiole of I, and F (PPQ, 2002)	Yes	
Hemiptera: Miridae					
Helopeltis antonii Signoret	Nair, 1975; Schaefer and Panizzi, 2000	Nair, 1975; Schaefer and Panizzi, 2000	F (Nair, 1975)	No[15]	
Hemiptera: Scutelleridae					
Scutellera nobilis Fabricius	Nair, 1975	Nair, 1975	F (Nair, 1975)	No[16]	
Hemiptera: Rhizoecidae					
Geococcus coffeae Green	IN, US (FL) (Ben-Dov, 1994)	Ben-Dov, 1994	R (Dekle, 1965)	No	
Hemiptera: Pseudococcidae					
Formicococcus robustus (Ezzat & McConnell) (Syn: *Planococcoides robustus* Ezzat & McConnell)	Ben-Dov, 1994; Ben-Dov et al., 2009	Ben-Dov, 1994; Ben-Dov et al., 2009	R (Bigger, 2009)	No	

[15] *Helopeltis antonii* are very mobile insects (Siswanto et al., 2008), and therefore are highly unlikely to remain with the commodity through harvest and packing.

[16] Adults may injure fruits (Nair, 1975); however, scutellerids are large, mobile insects, and highly unlikely to remain with the commodity through harvest and processing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Maconellicoccus hirsutus (Green) (Syn: *Phenacoccus hirsutus* Green)	IN (CABI, 2016; Nair, 1975), US (CA, FL, HI) (CABI, 2016)	Ben-Dov, 1994; Gupta et al., 2005; Nair, 1975	F, L, S (CABI, 2016)	Yes	
Nipaecoccus viridis (Newstead) (Syn: *N. vastator* (Maskell);[17]	IN (Nair, 1975; Varshney, 1992), US [HI (Ben-Dov, 1994), FL (Stocks and Hodges, 2010)]	Ben-Dov, 1994; Nair, 1975; Varshney, 1992	F, L, S (Ben-Dov, 1994; CABI, 2016)	Yes	
Planococcus lilacinus (Cockerell)	IN (CABI, 2016; Cox, 1989)	CABI, 2016; Cox, 1989	R (Thuy et al., 2011)	No	
Pseudococcus cryptus Hempel	IN, US (HI) (Ben-Dov et al., 2009)	Ben-Dov et al., 2009	F, I, L, S (Han et al., 2008)	Yes	
Rastrococcus iceryoides (Green)	CABI, 2016	CABI, 2016	F, L, S (CABI, 2016)	Yes	
Xenococcus acropygae Williams	Ben-Dov et al., 2009	Ben-Dov et al., 2009	R (Rajagopal et al., 1997)[18]	No	
Xenococcus annandalei Silvestri	Rajagopal et al., 1997	Rajagopal et al., 1997	R (Rajagopal et al., 1997)	No	
Hemiptera: Pyrrhocoridae					
Physopelta cincticollis Stal	Hua, 2000	Hua, 2000	F (Voigt, 2006)	No[19]	
Hymenoptera: Vespidae					

[17] Nair (1975) also describes *P. filamentosus* Ckll. infesting grape vine in India, but apparently this is a mis-identification of *Nipaecoccus viridis* in Southeast Asia (Williams and Miller, 2010).
[18] A similar species, *X. annandalei*, sucks sap from rootlets (Rajagopal et al., 1997).
[19] *Physopelta* species feed on host plants in the family Euphorbiaceae. Nymphs and adults feed on the tri-lobed fruit in the evening and at night (Voigt, 2006). They may shelter on grapes, but are highly unlikely to follow the pathway.

Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Vespa orientalis (Linnaeus)	Atwal, 1976; Nair, 1975	Atwal, 1976; Gupta et al., 2005; Nair, 1975	F (Nair, 1975)	No	Ripe fruit may be fed upon by adult wasps (Ross and Matthews, 1991), but it is unlikely that the highly mobile wasp would remain with the fruit upon harvest.
Vespa xanthoptera Cameron	Shiraki, 1952a	Shiraki, 1952a	F (Hill, 1987)	No	Ripe fruit may be fed upon by adult wasps (Ross and Matthews, 1991), but it is unlikely that the highly mobile wasp would remain with the fruit upon harvest.
Isoptera: Termitidae					
Microtermes obesi Holmgren (Syn: *Odontotermes obesus* Rambur)	Hill, 1983	Hill, 1983	R (Hill, 1983)	No	
Lepidoptera: Arctiidae					
Aglaomorpha plagiata (Walker) (Syn: *Callimorpha plagiata* [Walker])	Kirti and Sodhi, 2003	Gentry, 1965	Adults on vines (Gentry, 1965)	No	
Arctia caja (Linnaeus)	Dubatolov, 2010	Pimentel, 2007	Buds, Sh (Pimentel, 2007)	No	
Lepidoptera: Cossidae					
Cossus cossus Linnaeus	CABI, 2016	Bournier, 1976; CABI, 2016; Robinson et al., 2010	L, R, S (CABI, 2016), Tr (Pimentel, 2007)	No	
Zeuzera coffeae Nietner	CABI, 2016	CABI, 2016; Wongsiri, 1991	S (CABI, 2016)	No	
Lepidoptera: Crambidae					

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Conogethes punctiferalis (Guenée)	CABI, 2016; Gour and Sriramulu, 1992	CABI, 2016; Gour and Sriramulu, 1992	F (Gour and Sriramulu, 1992), L, S (CABI, 2016)	Yes	
Coptobasis lunalis Guenée	Robinson et al., 2010	Robinson et al., 2010	L (Robinson et al., 2010)	No	
Lepidoptera: Oecophoridae					
Odites ricinella Stainton	Ades and Kendrick, 2004; Shiraki, 1952b	Robinson et al., 2001; Shiraki, 1952b	L (Robinson et al., 2001)	No	
Lepidoptera: Geometridae					
Thinopteryx crocoptera Kollar	Robinson et al., 2010	Robinson et al., 2010	L (Borror et al., 1989)	No	
Lepidoptera: Gracillariidae					
Phyllocnistis toparcha Meyrick	Nair, 1975; Prins and Prins, 2005	Nair, 1975; Prins and Prins, 2005	L (Nair, 1975)	No	
Lepidoptera: Heliozelidae					
Antispila argostomia Meyrick	Nair, 1975	Nair, 1975; Robinson et al., 2001	L (Nair, 1975)	No	
Antispila aristarcha Meyrick	Robinson et al., 2010	Robinson et al., 2010	L (Robinson et al., 2010)	No	
Antispila isorrhythma Meyrick	Robinson et al., 2010	Robinson et al., 2001	L (Robinson et al., 2010)	No	
Lepidoptera: Hepialidae					
Endoclita signifer (Walker) (Syn: *Phassus signifer* Walker)	Shiraki, 1952b; Zhang, 1994	Shiraki, 1952b; Zhang, 1994	S (Tobi et al., 1993)	No	
Lepidoptera: Lymantridae					

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Dasychira feminula Hampson	Ades and Kendrick, 2004	Robinson et al., 2001	L (Common, 1990)	No	
Dasychira moerens Felder	(Robinson et al., 2010)	Robinson et al., 2001	L (Common, 1990)	No	
Dasychira tenebrosa Walker	(Robinson et al., 2010)	Robinson et al., 2001	L (Common, 1990)	No	
Euproctis flava Bremer	Nair, 1975; Matthews and Lott, 2005	Nair, 1975; Matthews and Lott, 2005	L (Nair, 1975)	No	
Euproctis fraterna (Moore)	Matthews and Lott, 2005	Matthews and Lott, 2005	L (Hill, 2008)	No	
Euproctis lunata (Walker)	Atwal, 1976	Atwal, 1976	L (Atwal, 1976)	No	
Orgyia postica (Walker)	CABI, 2016; Zhang, 1994	CABI, 2016; Robinson et al., 2001; Zhang, 1994	L (Wu, 1977a)	No	
Lepidoptera: Noctuidae					
Achaea janata Linnaeus	Hill, 1983; Nair, 1975	Hill, 1983; Nair, 1975	F (Nair, 1975), L (CABI, 2016)	No[20]	
Aegocera bimacula Walker	Robinson et al., 2010	Robinson et al., 2010	L (Robinson et al., 2001)	No	
Agrotis segetum Denis & Schiffermüller	CABI, 2016; Carter, 1984	CABI, 2016; Carter, 1984	L, R, S (CABI, 2016)	No	
Amphipyra pyramidea Linnaeus	Shiraki, 1952c	Shiraki, 1952c	L (Roslin and Salminen, 2009)	No	
Anomis mesogona Walker	Ades and Kendrick, 2004	Hattori, 1969; Robinson et al., 2001	F, L (Hattori, 1969)	No[21]	
Arcte coerula Guenée	Ades and Kendrick, 2004	Hattori, 1969; Robinson et al., 2001	F, L (Hattori, 1969)	No[21]	

[20] Only adult fruit-piercing moths feed on fruits; larvae feed on leaves of nearby weeds (Atwal, 1976; CABI, 2016; Nair, 1975; Walker, 2007; Zhang, 1994). Because they are large, highly mobile insects, these fruit-piercing moths are highly unlikely to follow the pathway.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Artena dotata (Fabricius)	Robinson et al., 2010	Robinson et al., 2010; Zhang, 1994	F, L (Hattori, 1969)	No[21]	
Autographa gamma (Linnaeus)	CABI, 2016	Abdullagatov and Abdullagatov, 1986; CABI, 2016	I, L (Whittle, 1986), F[21] (Abdullagatov and Abdullagatov, 1986)	No	
Ercheia umbrosa Butler	Ades and Kendrick, 2004	Hattori, 1969	F, L (Hattori, 1969)	No[21]	
Eudocima fullonia Clerck (Syn: *Othreis fullonica* Linnaeus)	IN(Hill, 1983; Nair, 1975), US (HI) (CABI, 2016)	CABI, 2016; Hattori, 1969; Hill, 1983; Nair, 1975	F (CABI, 2016), L (Hattori, 1969)	No[21]	
Eudocima homaena Hübner [Syn: *Ophideres ancilla* (Cramer)]	Atwal, 1976; CABI, 2016	Atwal, 1976	F (Atwal, 1976)	No[21]	
Eudocima materna Linnaeus (Syn: *Ophideres materna*)	Atwal, 1976; Zhang, 1994	Atwal, 1976; Robinson et al., 2010	F (Atwal, 1976)	No[21]	
Eudocima tyrannus (Guenée)	Robinson et al., 2010	Zhang, 1994	F (Zhang, 1994)	No[21]	
Helicoverpa armigera (Hübner)	CABI, 2016; King et al., 1982	Annecke and Moran, 1982	F, I, L (CABI, 2016)	Yes[22]	
Mamestra brassicae (Linnaeus)	CABI, 2016	CABI, 2016	L, S (CABI, 2016)	No	
Ophiusa coronata (Fabricius) [Syn: *Anua coronata* (Fabricius)]	Nair, 1975	Nair, 1975	F (Nair, 1975)	No	

[21] While generally a leaf pest, larvae of *A. gamma* may scrape the skin off fruits of grapes and feed on the contents (Abdullagatov and Abdullagatov, 1986). Because it is a large and highly mobile external pest, however, it is highly unlikely to be associated with harvested grapes.

[22] Larvae of *H. armigera* feed internally on fruits of host plants. While they may be noticeable on the surface of the plants, they are also cryptic and may be hidden within grape fruit bunches (CABI, 2016).

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Pest name	**Evidence of presence in India**	**Association with *Vitis vinifera*[2]**	**Plant part(s) association[3]**	**On harvested plant part(s)?[4]**	**Remarks**
Ophiusa tirhaca Cramer	Ades and Kendrick, 2004	Robinson et al., 2001	F (Nair, 1975)	No[21]	
Oraesia emarginata Fabricius (Syn: *Calpe emarginata*)	Ades and Kendrick, 2004; Hattori, 1969	Annecke and Moran, 1982; Hattori, 1969; Robinson et al., 2001	F (Nair, 1975)	No[21]	
Oraesia excavata Butler	IN(Ades and Kendrick, 2004), US (HI) (Kumashiro, 2010)	Hattori, 1969; Shiraki, 1952c	F (Ohmasa et al., 1991)	No[21]	
Sarbanissa transiens Walker	Robinson et al., 2010	Robinson et al., 2010	L (Holloway, 1983)	No	
Scrobigera vulcanica Butler	Robinson et al., 2010	Robinson et al., 2010	L (Robinson et al., 2010)	No	
Serrodes campana Guenée	Ades and Kendrick, 2004	Hattori, 1969; Robinson et al., 2001	F (Walker, 2007)	No[21]	
Serrodes partita (Fabricius)	Robinson et al., 2010	Annecke and Moran, 1982; Bournier, 1976; Pimentel, 2007	F (Bournier, 1976; Pimentel, 2007)	No[21]	
Spirama retorta Clerck	Ades and Kendrick, 2004	Robinson et al., 2001	L (Nair, 2001)	No	
Spodoptera litura (Fabricius)	Hill, 1983	CABI, 2016; Hill, 1983; Robinson et al., 2001	F, L (CABI, 2016)	Yes	
Thyas juno Dalman	Ades and Kendrick, 2004	Robinson et al., 2001	F (Holloway, 1983)	No[21]	
Trichosea champa Moore	Ades and Kendrick, 2004	Robinson et al., 2001	L (Wu, 1977b	No	

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Lepidoptera: Oecophoridae					
Stathmopoda auriferella (Walker)	EPPO, 2010; Pathania et al., 2009	EPPO, 2010	F, I, L (EPPO, 2010)	Yes	
Lepidoptera: Psychidae					
Eumeta variegata Snellen	Ades and Kendrick, 2004	Robinson et al., 2001	L (Gries et al., 2006)	No	
Lepidoptera: Pterophoridae					
Nippoptilia vitis (Sasaki)	Gielis, 2003	Gielis, 2003; Zhang, 1994	F, L (Matthews and Lott, 2005)	Yes	
Oxyptilus regulus Meyrick	Nair, 1975; Subramaniam, 1940; Zhang, 1994	Nair, 1975; Subramaniam, 1940; Zhang, 1994	F (Nair, 1975; Subramaniam, 1940)	Yes	
Platyptilia ignifera Meyrick	Sidhu et al., 2010	Matthews and Lott, 2005; Shiraki, 1952c	F (Yuji and Shinji, 2003)	Yes	
Lepidoptera: Pyralidae					
Cryptoblabes gnidiella Millière	IN(Zhang, 1994), US (HI) (CABI, 2016)	CABI, 2016; Carter, 1984; Pimentel, 2007; Zhang, 1994	F, L, S (CABI, 2016), F (Pimentel, 2007)	Yes	
Sylepta luctuosalis Guenee	(Shiraki, 1952c)	Shiraki, 1952c	L (Nair, 1975)	No	
Sylepta lunalis Guenee	Atwal, 1976; Hill, 1983; Nair, 1975; Matthews and Lott, 2005	Atwal, 1976; Hill, 1983; Nair, 1975; Matthews and Lott, 2005	L (Nair, 1975)	No	
Sylepta ovalis Walker	Bentley et al., 2007	Bentley et al., 2007	L (Bentley et al., 2007)	No	
Lepidoptera: Saturniidae					

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Loepa katinka Westwood	Robinson et al., 2010	Robinson et al., 2010	L (Common, 1990)	No	
Lepidoptera: Sphingidae					
Acherontia styx (Westwood)	CABI, 2016	Gentry, 1965	L (CABI, 2016)	No	
Acosmeryx castanea Rothschild & Jordan	Danielsson, 2009	Shiraki, 1952b	I, L (Common, 1990)	No	
Acosmeryx naga Moore	Robinson et al., 2010; Shiraki, 1952b	Robinson et al., 2010; Shiraki, 1952b	I, L (Common, 1990)	No	
Acosmeryx shervillii Boisduval	Ades and Kendrick, 2004	Robinson et al., 2001	I, L (Common, 1990)	No	
Agrius convolvuli (Linnaeus) [Syn: *Herse convolvuli* (Linnaeus)]	Matthews and Lott, 2005; Shiraki, 1952b	Matthews and Lott, 2005; Shiraki, 1952b	L (Matthews and Lott, 2005)	No	
Ampelophaga khasiana Rothschild	Rothschild and Jordan, 1903	Robinson et al., 2001	I, L (Common, 1990)	No	
Ampelophaga rubiginosa Bremer & Grey	CABI, 2016	CABI, 2016; Robinson et al., 2001	L (CABI, 2016)	No	
Cechenena lineosa Walker	Robinson et al., 2010	Robinson et al., 2010	I, L (Common, 1990)	No	
Deilephila elpenor (Linnaeus)	CABI, 2016	CABI, 2016; Carter, 1984	I, L (CABI, 2016)	No	
Hippotion celerio Linnaeus	Atwal, 1976; Nair, 1975; Matthews and Lott, 2005	Atwal, 1976; Gupta et al., 2005; Nair, 1975; Matthews and Lott, 2005	L (Loch, 2007), S (CABI, 2016)	No	
Hyles lineata (Fabricius) (Syn: *Celerio lineata*)	IN, US (CABI, 2016)	Bournier, 1976; Hill, 1983	N/A	N/A	

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Pergesa acteus Cramer	Ades and Kendrick, 2004	Robinson et al., 2001	I, L (Common, 1990)	No	
Rhagastis albomarginatus Rothschild	Ades and Kendrick, 2004	Robinson et al., 2001	I, L (Common, 1990)	No	
Rhagastis olivacea Moore	Robinson et al., 2010	Robinson et al., 2010	I, L (Common, 1990)	No	
Rhyncholoba acteus Cr.	Nair, 1975	Nair, 1975	L (Nair, 1975)	No	
Theretra alecto Linnaeus	Atwal, 1976; Nair, 1975	Atwal, 1976; Gupta et al., 2005; Nair, 1975	L (Nair, 1975)	No	
Theretra boisduvalii Bugnion	Ades and Kendrick, 2004	Robinson et al., 2001	L (Hill, 2008)	No	
Theretra clotho (Drury)	CABI, 2016	CABI, 2016; Robinson et al., 2001; Wongsiri, 1991	L (CABI, 2016)	No	
Theretra gnoma Fabricius	Nair, 1975	Nair, 1975	L (Nair, 1975)	No	
Theretra latreillii Macleay	Ades and Kendrick, 2004	Robinson et al., 2001	L (Hill, 2008)	No	
Theretra oldenlandiae (Fabricius)	CABI, 2016	CABI, 2016; Robinson et al., 2001	L (Loch, 2007)	No	
Theretra pallicosta Walker	Ades and Kendrick, 2004; Nair, 1975	Nair, 1975; Robinson et al., 2001	L (Nair, 1975)	No	
Illiberis tenuis (Butler)	Kim et al., 2004; Shiraki, 1952b	Kim et al., 2004; Shiraki, 1952b	L (Kim et al., 2004)	No	
Orthoptera: Acrididae					

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Anacridium rubrispinum Bei-Bienko	CABI, 2016	CABI, 2016	L (Borror et al., 1989)	No	
Locusta migratoria (Linnaeus)	CABI, 2016	Bournier, 1976; Gentry, 1965; Pimentel, 2007	L (Grichanov, 2008)	No	
Poekilocerus pictus (Fabricius) [Syn: *Poecilocerus pictus* (Fabricius)]	Matthews and Lott, 2005	Matthews and Lott, 2005	L (Bhargava, 1975)	No	
Schistocerca gregaria (Forskål) (Syn: *S. peregrina* [Olivier])	CABI, 2016	Bournier, 1976; CABI, 2016; Pimentel, 2007	F, L, Sd, S (CABI, 2016)	No[23]	
Teratodus monticollis Cam.	Nair, 1975	Nair, 1975	L (Nair, 1975)	No	
Orthoptera: Gryllotalpidae					
Gryllotalpa africana Palisot de Beauvois (Syn: *G. orientalis* Burmeister)	Hua, 2000	Hua, 2000	R (Nickle and Castner, 1984)	No	
Thysanoptera: Aeolothripidae					
Streothrips arorai (Bhatti)	Verghese and Harish, 2010	Verghese and Harish, 2010	Fl (CSIRO, 2009)	No	
Thysanoptera: Phlaeothripidae					
Haplothrips tenuipennis Bagnall	(Verghese and Harish, 2010)	Verghese and Harish, 2010	I, L (NIIR NIIR, 2004)	No	
Thysanoptera: Thripidae					

[23] *Schistocerca gregaria* are large, externally-feeding, highly mobile locusts (CABI, 2016). They are highly unlikely to remain with the commodity through standard harvest and post-harvest procedures.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Megalurothrips distalis (Karny)	Tayutivutikul and Kusigemati, 1992	Tayutivutikul and Kusigemati, 1992	I (Tayutivutikul and Kusigemati, 1992)	No	
Retithrips syriacus (Mayet)	IN (Hill, 1983), US (FL) (CABI, 2016)	CABI, 2016; Hill, 1983; Lewis, 1997	F (Pimentel, 2007)	Yes	
Rhipiphorothrips cruentatus Hood	Atwal, 1976; Nair, 1975	Atwal, 1976; Gupta et al., 2005; Lewis, 1997; Nair, 1975	L (Atwal, 1976), F (Pimentel, 2007)	Yes	
Scirtothrips dorsalis Hood	IN (Hill, 1983), US (FL, HI) (CABI, 2016)	Gupta et al., 2005; Hill, 1983; Lewis, 1997	L (CABI, 2016), F (Pimentel, 2007)	Yes	
Thrips coloratus Schmutz	Tayutivutikul and Kusigemati, 1992	Tayutivutikul and Kusigemati, 1992	I (Tayutivutikul and Kusigemati, 1992)	No	
Thrips palmi Karny	IN (Ranganath et al., 2008; Sunitha and Jagginavar, 2010), US (FL, HI) (Capinera, 2010)	Ranganath et al., 2008; Sunitha and Jagginavar, 2010	F, L, I (Ranganath et al., 2008)	Yes	
MOLLUSKS					

Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Lissachatina fulica (Bowdich) (Syn: *Achatina fulica* Bowdich)	IN (CABI, 2016; Mavinkurve et al., 2004), US (HI, CABI, 2016; APHIS, 2011)	Jayashankar et al., 2013	Whole plant (CABI, 2016)	No[24]	
NEMATODES					
Hemicriconemoides mangiferae Sidd.	IN (MacGowan, 1984), US (CA, FL, MacGowan, 1984), (PA, USDA-ARS, 2010)	CABI, 2016; MacGowan, 1984	R (CABI, 2016)	No	
Hoplolaimus seinhorsti Luc	IN (CABI, 2016; CABI/EPPO, 2008), US (FL, USDA-ARS, 2010; Lehman, 2002), GA (USDA-ARS, 2010)	CABI, 2016	R (CABI, 2016)	No	
Scutellonema clathricaudatum Whitehead	CABI, 2016; CABI/EPPO, 2006; Gunasekaran, 1979	CABI, 2016	R (CABI, 2016)	No	
FUNGI					
Achaetomium globosum J.N. Rai & J.P. Tewari	Bilgrami et al., 1981	Bilgrami et al., 1981	L (Bilgrami et al., 1981), R (Cannon, 1986)	No	

[24] *Achatina fulica* is a large and conspicuous pest that is highly likely to be detected at the time of harvest (CABI, 2016). The genus has not been intercepted on grape (PestID, 2016). It is highly unlikely to follow the pathway after standard harvest and post-harvest processing.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Acrospermum viticola Ikata [Anamorph: *Gonatophragmium mori* (Sawada) Deighton, Synanamorph: *Ormathodium fici* Tims & Olive]	Farr and Rossman, 2015	Farr and Rossman, 2015; Kata and Hitomi, 1931	L (Farr and Rossman, 2015; Kata and Hitomi, 1931)	No	
Alternaria vitis (Cav.) Sacc.	Bilgrami et al., 1981; Sarbhoy et al., 1975; Suhag et al., 1982	Bilgrami et al., 1981; Sarbhoy et al., 1975; Suhag et al., 1982	L (Mehta and Yadav, 1987; Suhag et al., 1982)	No	
Bartalinia robillardoides Tassi[25]	Bilgrami et al., 1981; Bilgrami et al., 1979	Bilgrami et al., 1981; Bilgrami et al., 1979	Bark, L (Bilgrami et al., 1979)	No	
Bipolaris papendorfii (Aa) Alcorn [Syn: *Drechslera papendorfii* (Aa) M.B. Ellis (CABI, 2010)]	Bilgrami et al., 1981	Bilgrami et al., 1981	L (Khanna and Chandra, 1977)	No	
Cephalosporium vitis Rifai	Bilgrami et al., 1979; Mehdi and Pillay, 1968	Bilgrami et al., 1979; Mehdi and Pillay, 1968	R (Bilgrami et al., 1979; Mehdi and Pillay, 1968)	No	
Helicobasidium mompa Tanaka	CABI, 2016; Cree, 2005; Gangwar and Thangavelu, 1991	Cree, 2005	R (Cree, 2005; Farr and Rossman, 2015)	No	

[25] Spelled "*robillardes*" by Bilgrami et al., 1981.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Monilinia fructigena Honey ex Whetzel	Chang, 1986; MOA-India, 2008; CABI, 2016	Batra, 1991; Farr and Rossman, 2015; Chang, 1986	F, S (Batra, 1991; CABI, 2016; Chang, 1986; Farr and Rossman, 2015)	Yes	
Passalora dissiliens (Duby) U. Braun & Crous [Syn: *Phaeoramularia dissiliens* (Duby) Deighton]	Farr and Rossman, 2015	Pearson and Goheen, 1988	L (Pearson and Goheen, 1988)	No	
Phellinus noxius (Corner) G. Cunn	Ann et al., 2002	Ann et al., 2002	R, S (Ann et al., 2002)[26]	No	
Pseudocercospora riachueli (Speg.) Deighton (Syn: *Cercospora riachueli* Speg.[27])	Bilgrami et al., 1981	Bilgrami et al., 1981	L (Farr and Rossman, 2015)	No	
Synchytrium viticola Lingappa	Bilgrami et al., 1981; Watson, 1971	Bilgrami et al., 1981	S, petioles, L (Watson, 1971)	No	
BACTERIA					
Clover phyllody phytoplasma	IN; US (FL) (CABI, 2016)	CABI, 2016 (minor host)	Plant phloem (CABI, 2016)	No[28]	

[26] Spelled "*robillardes*" by Bilgrami Jamaluddin and Rizwi (1981)
[27] Spelled as "*raichueli*" in Bilgrami Jamaluddin and Rizwi (1981).
[28] This phytoplasma is highly unlikely to follow the pathway on imported grapes because it is transmitted by leafhoppers that feed on leaves of the plant (CABI, 2016). A leafhopper is highly unlikely to attack imported fruit, follow the pathway, and subsequently spread the phytoplasma to plants in the United States.

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Pest name	Evidence of presence in India	Association with *Vitis vinifera*[2]	Plant part(s) association[3]	On harvested plant part(s)?[4]	Remarks
Xanthomonas campestris pv. *viticola* (Nayudu) Dye	Chand et al., 1999; MOA-India, 2008; Halfeld-Vieira and Nechet, 2006; NRC, 2008; Trindade et al., 2005	Chand et al., 1999; Halfeld-Vieira and Nechet, 2006; Trindade et al., 2005	L , S, petioles, rachis, F (Chand et al., 1999; Nascimento and Mariano, 2004)	Yes	
VIRUS					
Tomato black ring virus (TBRV)	IN (CABI, 2016; MOA-India, 2008), US (CABI/EPPO, 2002b)[29]	CABI, 2016; Singh et al., 1999	Whole plant (Brunt et al., 1996 onwards	No[30]	

2.3. Notes on pests identified in the pest list

The armored scales identified in this pest list (Hemiptera: Diaspididae: *Aonidiella comperei, A. inornata, Chlidaspis asiatica, Parlatoria cinerea,* and *Pseudaonidia trilobitiformis*) will not be further analyzed because, although armored scales may enter on commercial fruit for consumption, they are highly unlikely to become established, and therefore introduced, via this pathway (Miller, 1985; PERAL, 2007). A recent critical review of the literature, APHIS-PPQ operational data, and expert opinion concludes that, even assuming high quantities of imported fruit infested with armored scale species that could be parthenogenic, highly fecund, polyphagous, invasive, theoretically able to survive in most of the United States, and cause high level consequences, the specific pathway represented by commercially produced fruit shipped without leaves, significant stems or contaminants constitutes an extremely low risk (Hennessey et al., 2013). This low risk is explained by poor ability of armored scales to disperse to new host

[29] Brunt et al. (1996 onwards) report TBRV in the United States, probably referring to an interception record. We found no other reports to substantiate the occurrence of TBRV in the United States.

[30] Pathogen is moved between hosts via nematode, seed, or mechanical transmission (CABI, 2016; Frison and Ikin, 1991). Discarded fruit are highly unlikely to facilitate mechanical transmission to growing hosts nearby, and nematodes, which generally feed on the roots of host plants, are highly unlikely to acquire and transmit the virus from discarded fruits. Seed transmission can be high in some hosts; however, seed transmission of nepovirus-infected grapevines is considered erratic (Martelli, 1978). The FAO/IBPGR technical guidelines for the safe movement of grapevine germplasm do not mention seed transmission (Frison and Ikin, 1991). Furthermore, grapevine propagation is primarily done via cuttings or grafting; seeds are used for discovery of new traits or preservation of genetic material (Doijode, 2001). Grape seeds have a high rate of dormancy, which is broken with stratification or gibberlin applications (Doijode, 2001). Grapes imported for consumption are unlikely to be a pathway for introduction of this virus.

plants from fruits for consumption, and consequently, by their low probability of establishment (Hennessey et al., 2013). The following characteristics of armored scales contribute to their poor dispersal capabilities:

- Legs and wings are absent in females and in feeding immature forms. Males possess wings but are short-lived, do not feed, and tend to mate with nearby females.
- Self-dispersal of armored scales occurs by immature forms, or "crawlers." They are the most vulnerable life stage, survival of which decreases with long distance wind dispersal. Crawlers can be passively dispersed by wind from one plant to another only during a time period of approximately 24 hours. No further dispersal is possible after the crawlers start feeding as they lose their legs during the first molt and the mouth parts are deeply inserted in the host, anchoring them firmly to the substrate.

Dispersal from fruit discarded in the environment is considered very unlikely because of low wind speeds at ground level and low survival rate of crawlers on the ground or on decaying fruit or fruit peel. There is a low probability of active dispersal of crawlers by walking from their natural host since they are not capable of rapid movement over bare soil or rough surfaces (Hennessey et al., 2013).

2.4. Pests selected for further analysis

We identified 22 pests for further analysis (Table 2). 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 2. Pests selected for further analysis.

Pest type	Taxonomy	Scientific name
Arthropods	Acari: Tenuipalpidae	*Tenuipalpus granati*
	Diptera: Tephritidae	*Bactrocera correcta*
		Bactrocera dorsalis
	Hemiptera: Margarodidae	*Icerya seychellarum*
	Hemiptera: Pseudococcidae	*Maconellicoccus hirsutus*
		Nipaecoccus viridis
		Pseudococcus cryptus
		Rastrococcus iceryoides
	Lepidoptera: Crambidae	*Conogethes punctiferalis*
	Lepidoptera: Noctuidae	*Helicoverpa armigera*
		Spodoptera litura
	Lepidoptera: Oecophoridae	*Stathmopoda auriferella*
	Lepidoptera: Pterophoridae	*Nippoptilia vitis*
		Oxyptilus regulus
		Platyptilia ignifera
	Lepidoptera: Pyralidae	*Cryptoblabes gnidiella*
	Thysanoptera: Thripidae	*Retithrips syriacus*
		Rhipiphorothrips cruentatus
		Scirtothrips dorsalis

		Thrips palmi
Fungus	Ascomycetes: Helotiales	*Monilinia fructigena*
Bacterium		*Xanthomonas campestris* pv. *viticola*

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.

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 factors, such as the physical damage the pest is likely to cause 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. *Bactrocera correcta*

We determined the overall likelihood of introduction of *B. correcta* to be medium We present the results of this assessment in the table below.

We determined that establishment of *B. correcta* 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 *Bactrocera correcta*

Climatic suitability	*Bactrocera correcta* is present in South, East, and Southeast Asia: India (central and southern portions), Pakistan, Nepal, Sri Lanka, China (Sichuan, Yunnan), Myanmar, Malaysia, Thailand,and Vietnam (Liu et al., 2013). The reported distribution of *B. correcta* encompasses Global Plant Hardiness Zones 8-12 as defined by Magarey et al. (2008). Based on this distribution, we estimate that *B. correcta* could become established in the areas corresponding to the USDA Plant Hardiness Zones 8b-11 (USDA, 2012). *Bactrocera correcta* has potential hosts occurring in these zones (NRCS, 2016).
Potential hosts at risk in PRA Area	*Bactrocera correcta* has a wide host range, including tropical and subtropical fruits (Allwood et al., 1999; Maynard et al., 2004; Liu and Ye, 2009). Seventy-three fruit-bearing plant species belonging to 50 genera in 35 families have been recorded as hosts of *B. correcta* (Liquido et al., 2015; Liquido and Marnell, 2016). The plant families with the highest number of genera, in descending order, are Cucurbitaceae (5), Anacardiaceae (4), and Sapotaceae (3). The plant families with the highest number of validated host plant species, in descending order, are Myrtaceae (8), Anacardiaceae (6), Cucurbitaceae (6), Rhamnaceae (4), Rosaceae (4), Capparaceae (3), Rutaceae (3), and Sapotaceae (3). The plant genera with the highest number of species with records of field infestation, in descending order, are *Syzygium* (7), *Prunus* (4), *Ziziphus* (4), *Artocarpus* (2), *Bouea* (2), *Capparis* (2), *Careya* (2), *Citrus* (2), *Flacourtia* (2), *Garcinia* (2), *Malpighia* (2), *Spondias* (2), *Terminalia* (2), and *Trichosanthes* (2) (Liquido et al., 2015). The above families and most of the above genera occur in the continental United States (NRCS, 2016). Potential hosts at risk in the PRA area were determined by identifying zones within the United States that have both suitable climate and hosts for *B. correcta* through literature, national and state online databases, and national and state websites. The suitable climates are in Zone 8b/9a and Zone 10b/11a. Potential hosts at risk in the PRA area include cashew (*Anacardium occidentale* L.), carambola (*Averrhoa carambola* L.), gourd [*Benincasa*

	hispada (Thunb.) Cogn.], papaya (*Carica papaya* L.), citrus [pomelo, *Citrus maxima* (Burm.) Merr.; tangerine, *C. reticulata* Blanco], wampi [*Clausena lansium* (Lour.) Skeels], melon (*Cucumis melo* L.), governor's plum [*Flacourtia indica* (Burm. F.) Merr.], common bushweed [*Flueggea virosa* (Roxb. Ex Willd.)], egg tree [*Garcinia dulcis* (Roxb.) Kurz], sponge gourd (*Luffa aegyptiaca* Mill.), Barbados cherry (*Malpighia emarginata* DC.), acerola (*Malpighia glabra* L.), mango (*Mangifera indica* L.), sapote [*Manilkara zapota* (L.) P. Royen], calabur tree (*Muntingia calabura* L.), banana (*Musa* × *paradisiaca* L.), dropping prickly pear (*Opuntia monacantha* Haw.), gooseberry tree [*Phyllanthus acidus* (L.) Skeels], sweet cherry [*Prunus avium* (L.) L.], peach [*Prunus persica* (L.) Batsch], guava (*Psidium guajava* L.), *Syzygium* spp. [*S. cumini* (L.) Skeels; *S. jambos* (L.) Alston; *S. nervosum* DC.; *S. samarangense* (Blume) Merr. & L. M. Perry], tropical almond (*Terminalia catappa* L.), snake gourd (*Trichosanthes cucumerina* L.), grape (*Vitis vinifera* L.), jujube (*Ziziphus jujube* Mill.) (Mossler and Crane, 2012; Extension, 2012; NRCS, 2016; RIPM, 2015; NASS, 2012), and Chinese date (*Ziziphus mauritiana* Lam.).
Economically important hosts at risk	The economically important hosts of *B. correcta* in the PRA areas include cashew nut (*Anacardium occidentale* L.), carambola (*Averrhoa carambola* L.), gourd [*Benincasa hispada* (Thunb.) Cogn.], papaya (*Carica papaya* L.), citrus [*Citrus maxima* (Burm.) Merr.; *C. reticulata* Blanco], wampi [*Clausena lansium* (Lour.) Skeels], melon (*Cucumis melo* L.), sponge gourd (*Luffa aegyptiaca* Mill.), Barbados cherry (*Malpighia emarginata* DC.), acerola (*Malpighia glabra* L.), mango (*Mangifera indica* L.), sapote [*Manilkara zapota* (L.) P. Royen], banana (*Musa* × *paradisiaca* L.), sweet cherry [*Prunus avium* (L.) L.], peach [*Prunus persica* (L.) Batsch], guava (*Psidium guajava* L.), *Syzygium* spp. [*S. cumini* (L.) Skeels; *S. jambos* (L.) Alston; *S. nervosum* DC.; *S. samarangense* (Blume) Merr. & L. M. Perry], tropical almond [*Terminalia bellirica* (Gaertn.) Roxb.], orange gourd (*Trichosanthes costata* Blume), snake gourd (*Trichosanthes cucumerina* L.), and grape (*Vitis vinifera* L.) (Mossler and Crane, 2012; Weems and Fajardo, 2001; NRCS, 2016; RIPM, 2015; NASS, 2012).
Pest potential on economically important hosts at risk	Papaya is grown commercially in Florida. It is worth approximately $1.9 million (Weems and Fajardo, 2001; RIPM, 2015). In Vietnam Nguyen et al. (2000) reported "low" infestations. Melons are major crops in Arizona and California, the latter of which ranks number one in the nation for cantaloupe and honeydew melon production (RIPM, 2015). In Vietnam, Nguyen et al. (2000) reported "low" infestations. Mango is grown primarily in south Florida (RIPM, 2015). In Vietnam, Nguyen et al. (2000) reported "moderate" infestations. In Chiang Mai, Thailand, *B. correcta* was collected from 862 wild and cultivated *M. indica* with an infestation rate of 13.12 flies/kg of infested fruit (Clarke et al., 2001).

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	In Vietnam, Nguyen et al. (2000) reported "serious" infestations of *B. correcta* in guava. In Chiang Mai, Thailand, *B. correcta* was reared from 1,996 infested guajava fruit, with an infestation rate of 15.96 flies/kg of infested fruit, and in Bangkok, Thailand, *B. correcta* was reared from 1,995 infested fruit with an infestation rate of 23.21 flies/kg (Clarke et al., 2001). It was intercepted from passenger luggage originating in Thailand and destined for Japan. From the 318 confiscated fruit, five *B. correcta* emerged for an infestation rate of 0.0157 fly/fruit. Additional economic hosts include the following: *Manilkara zapota* – Along with mamey sapote, *Manilkara zapota* are grown exclusively in southern Florida in Miami-Dade County (RIPM, 2015). Sapote was intercepted and collected from passenger baggage originating from Thailand and arriving in Narita, Japan. Nine *B. correcta* were reared from 288 *M. zapota* fruits with an overall infestation rate of 0.0313 flies/fruit (Takeishi, 1992). *Syzygium jambos* – In Chiang Mai, Thailand, *B. correcta* emerged from 1,649 *S. jambos* fruit with an infestation rate of 7.77 flies/kg of infested fruit (Clarke et al., 2001). *Syzygium samarangense* – In Chiang Mai, Thailand, *B. correcta* was reared from 3,781 *S. samarangense* fruit for an infestation rate of 77.42 flies/kg of infested fruit and in Bangkok, Thailand, from 2,972 fruit for an infestation rate of 50.25 flies/kg of infested fruit (Clarke et al., 2001). *Bactrocera correcta* were also reared from fruit intercepted from passenger baggage originating in Thailand and destined for Japan. Thirteen *B. correcta* emerged from 173 *S. samarangense* fruit for an infestation rate of 0.0751 flies/fruit (Takeishi, 1992). Non-economic hosts may sustain *B. correcta* populations and may serve as refugia. These plants may be wild-growing or planted in dooryards, community gardens, and parks. These potential hosts include Governors plum [*Flacourtia indica* (Burm. F.) Merr.], common bushweed [*Flueggea virosa* (Roxb. Ex Willd.)], eggtree [*Garcinis dulcis* (Roxb.) Kurz], calabur tree (*Muntingia calabura* L.), dropping prickly pear (*Opuntia monacantha* Haw.), gooseberry tree [*Phyllanthus acidus* (L.) Skeels], tropical almond (*Terminalia catappa* L.), jujube (*Ziziphus jujube* Mill.), and Chinese date (*Ziziphus mauritiana* Lam.)
Defined Endangered Area	Regions that are climatically suitable for the continued survival of *B. correcta* include Portland, OR, the northernmost location (Zone 8b/9a), followed by California, Nevada, Arizona, Texas, Louisiana, and Florida, with Miami, FL (Zone 10b/11a), being the southernmost location (USDA, 2012).

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	The following wild hosts are of environmental importance due to their ability to sustain populations of *B. correcta*: *Anacardium occidentale* (Nguyen et al., 2000); *Ziziphus jujube* (Clarke et al., 2001); and *Terminalia catappa* (Nguyen et al., 2000).

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

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Assessment of the likelihood of introduction of *Bactrocera correcta* into the endangered area via the importation of grapes from India

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	MC	*Bactrocera correcta* is normally not associated with grapes (Liquido et al., 2015), but was found infesting grapes in India in 1992 (Mani, 1992).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MC	This analysis assumes that the grapes have not undergone any post-harvest quarantine treatment. The grapes are sorted, cleaned, and inspected prior to packing. Eggs and larvae of *B. correcta* are expected to be associated with the commodity entering the packinghouses. Developing eggs and internally feeding larvae may remain undetected during packing and visual inspections, and adults would successfully emerge from these infested fruits. For this reason, the previous rating remains unchanged.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	MC	The grapes will be refrigerated at 0-2 °C during storage and transport via either sea or air, significantly varying the amount of time the grapes may be refrigerated. While cold treatment of commodities in refrigerated containers with constant temperature ranging from 0-2 °C is an accepted quarantine treatment for several *Bactrocera* species in host commodities, the treatment efficacy and expected probit mortality of treatment schedules are dependent on specific constant treatment temperature and the duration (days) of refrigeration. At present, there is no evidence to conclude that the risk of *B. correcta* in grapes is reduced during storage and transport in refrigerated containers. The risk rating therefore remains the same.
Risk Element A: Overall risk rating for likelihood of entry	Medium	N/A	

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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	MC	*Bactrocera correcta* has a wide host range and is likely to find suitable hosts in the endangered area (Liquido et al., 2015). Congeneric species of *B. correcta* can fly over long distances and disperse to forage for suitable hosts (Liu et al., 2013). *Bactrocera correcta* is expected to have similar dispersal behavior and host resource foraging capability. Even if *B. correcta* were to be introduced during winter months in Zone 11 where some suitable hosts are likely to be available, the prevailing temperatures would allow survival and development.
Risk Element B2: Likelihood of arriving in the endangered area	High	MC	*Bactrocera correcta* may have optimum survival in Zone 11. More than 25 percent of the U.S. population lives in the endangered area, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	High	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

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

Criteria	Meets criteria? (Y/N)	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	C	High economic value commodities, including grapes, stone fruits, citrus, and cucurbits, are grown in the endangered area. In addition to costly quarantine and eradication programs, the introduction of *B. correcta* will result in significant yield losses, increase in costs of production beyond normal fluctuations, and potential loss of domestic and international markets. A recent examination of costs for an eradication of *B. dorsalis* in the Miami-Dade area estimated impacts for three scenarios from $4-23 million dollars (Alvarez et al., 2016).
Risk Element C2: Spread potential	Yes	C	Adult *Bactrocera* may live for several months and during that time they have the capacityto disperse over relatively long distances to locate hosts (FDACS, 2016). These biological parameters and their ability to feed and oviposit on a wide range of host plants assure successful spread of introduced populations of *B. correcta*. Furthermore, *B. correcta* can spread in trade or infested commodity (Liu et al., 2013)
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	

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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. *Bactrocera dorsalis*

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

We determined that establishment of *B. dorsalis* 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 *Bactrocera dorsalis*

Climatic suitability	*Bactrocera dorsalis*, or Oriental fruit fly, found in mainland Asia and western Malaysia, and has been introduced into Hawaii and the Mariana Islands (Drew and Hancock, 1994), recently *B. dorsalis* has spread to many countries in Africa, described as *B. invadens* (Drew et al., 2005), however recent molecular analysis has determined it to be a complex of *B. dorsalis* (Schutze et al., 2014). Its distribution corresponds to U.S. Plant Hardiness Zones 9-12 (CABI, 2016; Magarey et al., 2008).
Potential hosts at risk in PRA Area	Oriental fruit fly has a wide host range. In the Kunming area of China, the principal agricultural host fruits of *B. dorsalis* include pear, apple, orange, grape, and capsicum (Ye and Liu, 2005). These hosts are distributed throughout the fly's potential U.S. climatic range.
Economically important hosts at risk[a]	Economically important hosts at risk include pear, apple, orange, grape, capsicum, peach, plum, and watermelon (Ye and Liu, 2005; Ye, 2001).
Pest potential on economically important hosts at risk	*Bactrocera dorsalis* directly damages fruit, laying eggs under the skin of fruit, larvae feed on pulp, which can result in fruit destruction (Ye and Liu, 2005). *Bactrocera dorsalis* is an economically important pest categorized as a widespread invasive polyphagous species that has established outside of its native range (Vargas et al., 2015)

Defined Endangered Area	Pear, apple, orange, grape, capsicum, peach, plum, and watermelon, wild hosts? in Hardiness Zones 9-11 are at risk. This does not include Hawaii or the Mariana Islands, where *B. dorsalis* is already established.

[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 *Bactrocera dorsalis* into the endangered area via the importation of grapes from India

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	MC	We had no evidence that conditions or production practices would limit pest prevalence. Eggs are laid in fruit (Ye and Liu, 2005).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	High	MC	Grapes are sorted, cleaned, and inspected prior to packing (MOA-India, 2008). However, due to the internal feeding of the larvae in the bunches of fruit, detection and removal are difficult. For this reason, the previous rating remains unchanged.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	High	MU	The grapes will be refrigerated at 0-2 °C (MOA-India, 2008), though grapes may be shipped either via sea or air, significantly altering the amount of time the grapes may be refrigerated. While *Bactrocera* species are frequently impacted by refrigeration (e.g., De Lima et al., 2011), we do not have enough evidence at this time to conclude whether the risk may be reduced for this species on grapes, and the risk rating therefore remains the same.
Risk Element A: Overall risk rating for likelihood of entry	High	N/A	

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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	MC	If infested grapes were composted or disposed in the natural environment, fruit fly larvae could survive to adulthood. In India, grapes are harvested in the main production area of Anab-e-Shahi from March to April (Shikhanany, 2005), meaning that the grapes would arrive in the United States in the spring and summer, when more host fruits likely would be available.
Risk Element B2: Likelihood of arriving in the endangered area	High	MC	More than 25 percent of the U.S. population lives in the endangered area, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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	

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

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

Criteria	Meets criteria? (Y/N)	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	C	*Bactrocera dorsalis* is a serious pest of a wide variety of fruits and vegetables. It can damage up to 100 percent of unprotected fruit (CABI, 2016).

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element C2: Spread potential	Yes	C	*Bactrocera dorsalis* can move from 2-11 kilometers in Hawaii (Froerer et al., 2010). The species has invaded areas of China, Africa, and many other areas of the world recently (Ye and Liu, 2005; Ye, 2001; Goergen et al., 2011).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	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. *Conogethes punctiferalis*

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

We determined that establishment of *C. punctiferalis* 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 *Conogethes punctiferalis*

Climatic suitability	*Conogethes punctiferalis* has been reported from Australia, Bangladesh, Burma, China, India, Indonesia, Japan, Malaysia, Sri Lanka (Gour and Sriramulu, 1992), and China (CABI, 2016), areas which correspond to U.S. Plant Hardiness Zones 9-12 (Magarey et al., 2008).
Potential hosts at risk in PRA Area	*Conogethes punctiferalis* feeds on cardamom, castor, and *Vitus vinifera* in India (Gour and Sriramulu, 1992), and has been reported on apricot, citrus, ginger, guava, jack fruit, mango, mulberry, peach, pear, plum, tamarind (Butani, 1979), and maize (CABI, 2016). Many of these hosts occur in the United States throughout the climatic range of *C. punctiferalis* (NRCS, 2016).
Economically important hosts at risk[a]	Apricot, citrus, maize, mulberry, peach, pear, and plum are crops grown in the suitable climatic zone for *C. punctiferalis*.

Pest potential on economically important hosts at risk	*Conogethes punctiferalis* is described as an economic pest in India (Gour and Sriramulu, 1992). This insect contributed to significant losses of maize in southern China (CABI, 2016). In Australia there are reports of each larva destroying 1 g of grain (DAF, 2016).
Defined Endangered Area	The endangered area includes crops such as maize and stone fruits in Zones 9-12, which includes most of California, Florida, and the Gulf Coast and mid-Atlantic states.

[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 *Conogethes punctiferalis* into the endangered area via the importation of grapes from India

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	MU	The species has been reported feeding on grapes (Gour and Sriramulu, 1992). We do not have evidence of standard industry practices that may reduce pest prevalence in the field.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MU	*Conogethes punctiferalis* larvae web the berries together to feed on them (Gour and Sriramulu, 1992), so damaged bunches would be highly visible to pickers and sorters (see section 1.4.3). Grapes are sorted, cleaned, and inspected prior to packing (MOA-India, 2008). For these reasons, we reduced the previous risk rating by one level.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	MU	Grapes are refrigerated during transport (MOA-India, 2008), but we found no evidence that this pest is susceptible to chilling mortality.
Risk Element A: Overall risk rating for likelihood of entry	Medium	N/A	

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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	Medium	MU	The physical conditions necessary for the pest's transmission to the host are seldom met. Only lightly infested grape bunches would be expected to escape detection at harvest, so few larvae would be available in any one place to start a new population. For larvae to persist on hosts through a generation, the grapes would have to be discarded outside and female larvae would have to develop to adulthood, find mates, and lay eggs on a host.
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, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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

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

Criteria	Meets criteria? (Y/N)	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 introduction of this pest would likely result in significant increases in costs of production beyond normal annual fluctuations. *Conogethes punctiferalis* is a major pest of chestnut and maize in China (Li et al., 2015 ;Lu et al., 2010) and a serious pest of castor in India, (Gour and Sriramulu, 1992), causing considerable yield loss by attacking the shoots, inflorescences and capsules (from Singh et al. 1992 in Rao et al., 2012) Most commercial growers likely have integrated pest management programs in place for tortricid leafrollers, but a crambid larvae that bores into fruit is not easily controlled with insecticides (CABI, 2016).
Risk Element C2: Spread potential	Yes	MC	The pest is widely distributed in Asia and Australia (CABI, 2016), indicating an ability to move and establish populations over relatively long distances.
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	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

3.2.4. *Cryptoblabes gnidiella*

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

We determined that establishment of *C. gnidiella* 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 *Cryptoblabes gnidiella*

Climatic suitability	*Cryptoblabes gnidiella* does best in warm climates and cannot survive winters in cooler temperate areas (CABI, 2016). *Cryptoblabes gnidiella* is found in Europe (Austria, Cyprus, France, Greece, Italy, Malta, Portugal, and Spain), Asia (India, Israel, Lebanon, Pakistan, Thailand, and Turkey), Africa (Egypt, Liberia, Morocco, Nigeria, Sierra Leone, and South Africa), the Atlantic islands (Bermuda), Pacific islands (Hawaii), South America (Argentina, Uruguay), and Oceania (New Zealand) (CABI, 2016). The reported distribution indicates that *C. gnidiella* could establish in U.S. Plant Hardiness Zones 6-11 (USDA, 2012).
Potential hosts at risk in PRA Area	*Cryptoblabes gnidiella* is polyphagous and feeds on several species from many families including; *Albizia saman* (Leguminosae), *Allium* (Alliaceae), *Annona muricata* (Annonaceae), *Cyaneae procera* (Campanulaceae), *Ficus carica, Ficus macrophylla,* (Moraceae) *Lantana* (Verbenaceae), *Macadamia* (Proteaceae), *Magnifera indica* (Anacardiaceae) (for more complete list see : Robinson et al., 2010).
Economically important hosts at risk[a]	Examples of economically important hosts of *C. gnidiella* include *Citrus*, *Gossypium* (cotton), *Persea americana* (avocado), *Phaseolus* (beans), *Zea mays* (corn), and *Vitis* (grape). Larvae feed on more than sixty plants in more than thirty families (Bagnoli and Lucchi, 2001).
Pest potential on economically important hosts at risk	In citrus, it is an internal feeder that punctures fruit and causes premature ripening, blotches, and early fruit drop (Silva and Mexia, 1999; CABI, 2016; Moore, 2003). This type of damage can cause substantial losses to citrus crops (Moore, 2003; Silva and Mexia, 1999). In grapes, *C. gnidiella* feeds on grape clusters, causing them to wilt and consequently fall (Bisotto-de-Oliveira et al., 2007; Ringenberg et al., 2005). On fruit close to harvest, feeding causes the disruption of the berries, resulting in leakage of juice, which reduces the quality of wines or depreciates the value of fruits (Ringenberg et al., 2005). In addition, feeding increases the incidence of fungal and bacteria diseases that cause fruit rot (Bisotto-de-Oliveira et al., 2007; Ringenberg et al., 2005).
Defined Endangered Area	The area endangered by *C. gnidiella* comprises Plant Hardiness Zones 6-11, as this area is both climatically suitable and has the economically important and wild hosts mentioned above.

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

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Assessment of the likelihood of introduction of *Cryptoblabes gnidiella* into the endangered area via the importation of grapes from India

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	MC	Larval populations can be high, especially when associated with mealybugs, as *C. gnidiella* seems attracted to the honeydew of coccids (Sullivan et al., 2008). In order to lower *C. gnidiella* populations below economic thresholds in table grapes, 12-17 chemical applications per season may be required. Effective control has also been obtained when using mating disruption pheromones (Harari et al., 2007).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MC	Hand-harvesting and grading (see section 1.4.3) are highly likely to remove most damaged grapes from the pathway. Presence of larvae are obvious, as they produce silk and frass that are clearly visible, and may roll leaves for refuge (Carter, 1984; Zimmerman, 1958). Damage to fruits by larvae is both direct, caused by feeding, and indirect, caused by the spread of fungus from damaged fruit to undamaged fruit (Harari et al., 2007). In Europe, eggs are laid on fruit or foliage, in clusters or dispersed singly, and hatch in 4-7 days. (Carter, 1984). Eggs may not be detected and hatch in transit. The baseline risk rating does not change: The pest is not eliminated from the commodity and the population does not increase.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	MC	More than 450 interceptions of *C. gnidiella* live larvae have been intercepted, indicating that they can survive transport (PestID, 2016). Due to the potential variability in shipping time (air or sea transport) and the high numbers of intercepted live *C. gnidiella* larvae, the risk factor was not changed as the risk rating does not change as populations are not likely to increase or decrease during shipping.
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	As mentioned above, *C. gnidiella* has a wide host range, and those hosts are widely and regularly distributed throughout the entire endangered area (CABI, 2016; Kartesz, 2015). Eggs are laid at the base of fruits, and larvae can feed internally (de Morais Oliveira et al., 2014); eggs and larvae are the most likely forms to follow the pathway. In order for establishment to occur, the pest must successfully develop, find hosts, and mate. We rated this risk element to be Medium due to the likelihood of these required conditions being met for development.
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, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (PERAL, 2015).

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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

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

Criteria	Meets criteria? (Y/N)	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	MU	*Cryptoblabes gnidiella* is a secondary pest of citrus, and may cause 5-7 percent reductions in yield and up to 50 percent in fruit damage (Moore, 2003; Silva and Mexia, 1999). In Israel, *C. gnidiella* is a major pest of grapevines (Harari et al., 2007), but its co-occurrence with other important pests means that determining the amount of yield loss attributed to it is difficult. In pomegranate in Turkey, *C. gnidiella* has been reported to cause between 6.4 and 41.2 percent fruit damage (Öztürk and Ulusoy, 2011a). Several countries actively control *C. gnidiella* populations [e.g., Turkey (Öztürk and Ulusoy, 2011a) and Israel (Harari et al., 2007)]. Control programs currently in place for other Lepidoptera pests are unlikely to be sufficient for managing this pest. In order to lower *C. gnidiella* populations below economic thresholds in table grapes, 12-17 chemical applications per season may be required. Effective control has also been obtained when using mating disruption pheromones (Harari et al., 2007).
Risk Element C2: Spread potential	Yes	MU	*Cryptoblabes gnidiella* adults can naturally disperse by flying (Öztürk and Ulusoy, 2011b; CABI, 2016). Recent population expansions in Africa have been documented (Moore, 2003).

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Criteria	Meets criteria? (Y/N)	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	
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

3.2.5. *Helicoverpa armigera*

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

We determined that the establishment of *H. armigera* 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 *Helicoverpa armigera*

Climatic suitability	This insect is widely distributed, and occurs throughout Europe, the Middle East, Central and South Asia, the Far East, Africa, Australia, and Oceania, as well as recently in South America (CABI, 2016). Based on this distribution, we estimate establishment is possible in USDA Plant Hardiness Zones 5-11 (PERAL, 2015).
Potential hosts at risk in PRA Area	Numerous suitable hosts are grown throughout Zones 5-11 (see below).
Economically important hosts at risk	Economically important hosts in Zones 5-11 include cotton, tomato, okra, pea, soybean, tobacco, potato, citrus, and corn (NASS, 2012; PERAL, 2015).
Pest potential on economically important hosts at risk[a]	*Helicoverpa armigera* is a serious economic pest. Annual economic damage from the pest in India is estimated at $1 billion (Subramanian and Mohankumar, 2006). The recent introduction of *H. armigera* into Brazil has resulted in high levels of damage to soybean (Pomari-Fernandes et al., 2015).
Defined Endangered Area	Cotton, tomato, okra, pea, soybean, tobacco, potato, corn, citrus, and other crops in Plant Hardiness Zones 5 to 11 in the continental United States are at risk for *H. armigera* 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 *Helicoverpa armigera* into the endangered area via the importation of grapes from India

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	MC	*Helicoverpa armigera* is widespread in India (CABI, 2016). Presence and damage on grape in South Africa is most severe during periods of population outbreaks (Swart et al., 1976). Grape has been reported in Hungary to be a marginal host for *H. armigera*, and survival of larvae may be reduced (Vörös, 1996).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MC	Culling of damaged grapes as described in the management plan would reduce the likelihood of the larvae being present in the commodity, but not eliminate the pest. We did not reduce the rating as a result.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	C	We found no evidence that the standard shipping and storage conditions would lead to a decrease of the pest population, so we did not adjust the 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	Low	MC	The anticipated fate of imported grapes is consumption. Probably only a small fraction will be discarded. The life stage of the pest associated with grape would be larvae, which would have to complete development before they could disperse to a host plant. Grapes will start decomposing as soon as they are discarded, so larval development would have to be completed in a short time. Then, pupal development needs to occur successfully. After a female emerges, she would have to find an adult male, mate successfully, and

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			then find a host plant. Finally, suitability of climate and availability of hosts would be limited to part of the year in most parts of the endangered area.
Risk Element B2: Likelihood of arriving in the endangered area	High	MC	More than 25 percent of the U.S. population lives in the endangered area, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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 *Helicoverpa armigera* into the continental United States

Criteria	Meets criteria ? (Y/N)	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	As discussed above (Endangered Area table), this pest can be a serious economic pest.
Risk Element C2: Spread potential	Yes	C	In South Africa, *H. armigera* lays an average of 730 eggs over an oviposition period of 10-23 days; females may produce up to 11 generations per year in tropical climates. Larvae have limited mobility, but adults can fly long distances (CABI, 2016).This pest has spread rapidly in the western hemisphere in South America and into the Caribbean (Kriticos et al., 2015).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	N/A	

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Criteria	Meets criteria ? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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

3.2.6. *Icerya seychellarum*

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

We determined that establishment of *I. seychellarum* in the PRA area is unlikely to cause unacceptable impacts. We present the results of this assessment in the table below.

Determination of the portion of the United States of America endangered by *Icerya seychellarum*

Climatic suitability	*Icerya seychellarum* occurs in southeast Asia, eastern and southern Africa, Australia, the Caribbean (Guadeloupe and Martinique), Colombia, France (Corsica), French Guiana, Portugal (Madeira), and Oceania (CABI, 2016). Using Plant Hardiness Zone matching (Magarey et al., 2008), we determined that these regions roughly correspond to Zones 9-13. This pest is present but under effective control in American Samoa, indicating it could establish on similar islands, such as Puerto Rico (Schmaedick, 2007).
Potential hosts at risk in PRA Area	The highly polyphagous *Icerya seychellarum* feeds on a diverse suite of taxa, especially woody non-graminaceous plants (Beardsley, 1966; CABI, 2016). Although it seems capable of feeding on nearly any plant it encounters, major host genera reported include *Acacia, Acalypha, Artocarpus, Casuarina, Ceasalpinia, Citrus, Cocculus, Cocos, Crotolaria, Cynodon, Croton, Cassia, Dodona, Eugenia, Euphorbia, Ficus, Grevillea, Hibiscus, Malus, Morus, Mangifera, Magnolia, Morus, Olla, Persea, Prunus, Psidium, Pyrus, Pterospermum, Rosa, Saccharum,* and *Scaevola*, as well as members of the Arecaceae (palm family) (Bedford, 1965; Newbery, 1980; Varshney, 1992; Sharaf El-Den et al., 2011; Sayed et al., 2013; CABI, 2016). See also Williams and Watson (1990) for additional commercial crops and wild plants on which the scale has been recorded. Reports from sugar cane were probably erroneous and due to incorrect taxonomic designations (Mamet, 1958; Beardsley, 1966). Natural and conditional hosts of this extremely polyphagous species include temperate-zone and/or widely cultivated plants that should be present throughout the potential U.S. range (CABI, 2016; NRCS, 2016).

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Economically important hosts at risk[a]	Any woody (tropical, subtropical, or temperate) species under commercial cultivation in the endangered area could be at risk. Genera of possible concern include *Artocarpus*, *Citrus, Cocos, Coffea, Cynodon, Ficus, Malus, Morus, Mangifera, Persea, Prunus, Psidium, Pyrus, Rosa, Solanum*, and *Vitis* The pest is known to infest wild hosts, and possibly caused significant damage and population death to wild hosts in the Seychelles islands (Hill, 1980). Of possible concern are threatened or endangered members of *Avicennia, Ceasalpinia, Crotolaria, Eugenia, Euphorbia, Hibiscus, Magnolia, Prunus, Scaevola*, *Solanum*, and Arecaceae (palm family).
Pest potential on economically important hosts at risk	By sucking sap from plants, the scale impacts plant vigor by reducing leaf and root growth (PNKTO, 1982b). High scale numbers producing copious honeydew can result in the growth of sooty mold, which, if present at flowering, can reduce fruit set (Astridge, 2006). It can cause serious damage or host mortality in severe infestations; however, these infestations are rare and seemingly limited to certain hosts (Morales, 1991; Schmaedick, 2007). For instance, some trees suffer no apparent damage even with heavy infestations (Bedford, 1965). The biology of the species indicates that it only becomes a pest, in any environment, when it is tended by ants, as otherwise naturally occurring predators and parasitoids keep it under control (Beardsley, 1966; PNKTO, 1982b; Hill, 1980). The only specific losses reported on a commercial host, *Mangifera indica* (mango), were 1.47-2.64 percent (Salman and Bakry, 2012). It was listed in one instance as "killing trees" of *Citrus* sp. in Vanuatu (Williams and Butcher, 1987). It can cause serious damage to breadfruit (*Artocarpus* spp.) in the absence of predators (Beardsley, 1966). It has been reported from plants under cultivation in greenhouses, but no associated damage was reported (Gerlach, 2010). The potential exists for *I. seychellarum* to reach the status of a minor pest of environmental concern in areas not subject to routine pest monitoring. However, major damage caused by this species to environmentally important hosts is rare. Experimental removal of the pest from wild hosts indicated that it reduced the rate of leaf growth by 52 percent on *Euphorbia pyrifolia* and 39 percent on *Scaevola taccada* (Newbery, 1980). Most host records are from taxonomic occurrence surveys, not damage records. Although it is highly polyphagous, it is almost always a minor pest where it occurs (PNKTO, 1982b). The pest potential on economically important hosts at risk is low.
Defined Endangered Area	Because of its high polyphagy, the pest risk of *I. seychellarum* is non-negligible. It poses a low potential threat to cultivated and wild hosts in

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	Plant Hardiness Zones 9-11 in the United States, Zones which cover Alabama (coastal), Arizona, California (coastal and southern), Florida, Georgia (southern), Louisiana, Mississippi (coastal), South Carolina (southern coast), and Texas (southern). Due to current control of its congener, *Icerya purchasi* Maskell, and other ecological homologues, which have similar host ranges and are widely distributed in areas where *I. seychellarum* could establish, it is unlikely to become a pest of economic importance in the endangered area. If it was to become a pest of cultivated hosts, the most likely hosts in Zones 9-11 are *Citrus* spp., *Ficus* spp., *Malus* spp., *Mangifera* spp., *Persea* spp., *Pyrus* spp., and *Rosa* spp. (NASS, 2012). Major damage has been documented in wild species of *Euphorbia* and *Scaevola* in the Seychelles islands. Endangered members of these genera are found in Hawaii. *Euphorbia telephioides* is native to Florida and listed as threatened. Of possible concern (based on pest association with congeners, no major damage reported) are threatened or endangered members of *Asplenium*, *Avicennia, Ceasalpinia, Crotolaria, Eugenia, Hibiscus, Magnolia, Prunus, Solanum*, and Arecaceae (palm family) (USFWS, 2016).

[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 *Icerya seychellarum* into the endangered area via the importation of grapes from India

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)	Low	C	In the available published literature, online databases, and industry blogs, this pest has been been reported on *Vitis vinifera* in the Cook Islands and French Polynesia (no indication of plant part) (Williams and Watson, 1990). Related taxa have been reported from roots of grapevine (Gonzalez, 1983). It was not found during a large-scale study (58,017 samples covering 19,994 hectares) of the phytosanitary risk of scale insects from table grapes in South Africa, where it occurs on roses, ficus, and

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			palms (Walton et al., 2009). Even though grapes and vines are inspected for mealybug infestations during harvest in India, and *Cryptolaemus montrozieri* ladybird beetle predators are released to control mealybug infestations (once grapes begin softening on the vine), no modern Indian viticulture texts report *Icerya seychellarum* or congeners associated with grapes or vineyards (e.g., Pruthi and Batra, 1960; Nair, 1975; Varshney, 1985; Varshney, 1992; Shikhamany, 2001; Bostanian et al., 2012; Mani et al., 2014;Satyagopal, 2014)[31]. On all plants, immatures and adult females are found feeding mostly on the undersurfaces of leaves, usually along the main veins, but they can infest twigs, smaller branches, and even petioles of flowers and fruits in heavy infestations (PNKTO, 1982b). Because it is not reported from Indian vineyards, we can infer that infestations rarely (if ever) occur, and heavy infestations do not occur, so the likelihood of it being present in harvested grape bunches is very low. Based on this, the rating for this risk element is Low. A source of uncertainty is the lack of experimental evidence documenting *I. seychellarum* feeding locations on *Vitis* spp.

[31]This absence might be explained by the fact that *I. seychellarum*'s ideal host has thick, evergreen, and hairless leaves, and grape leaves have trichomes; additionally, *I. seychellarum* inserts its stylet 520 µm into the leaf to reach phloem, and grape leaves are only about 100 µm thick (Newbery et al., 1983; Boso et al., 2010).

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MC	The adult female is 7-10 mm long, large, covered in cottony white wax, often attached to an egg sac twice its own size, and thus unlikely to be overlooked during post-harvest processing (PNKTO, 1982b). The female continuously lays eggs into a waxy ovisac attached to her body and they hatch into crawlers within one day, emerging in the morning, so egg transport in the commodity is unlikely (Hill, 1980). Crawlers (mobile larvae) can disperse locally by walking or being blown by wind (Schmaedick, 2007), and might drift onto fruit during harvest or packing. However, only 16 percent of crawlers are dispersed by wind, and crawler dispersal peaks in the afternoon after emergence before they settle into a feeding site by evening (typically on the underside of leaves) (Hill, 1980). The remaining larvae exhibit natal philopatry and will settle into a feeding site on the parent plant. Because of copious honeydew production by this species during infestation, and subsequent growth of sooty mold on fruit, and the tendency of larvae to stay in the vicinity honeydew producing and egg-laying adult females, the visual inspection and culling of damaged grapes during post-harvest processing would likely eliminate most bunches that crawlers would be present on. Additionally, younger, less physically established larvae may be easily dislodged by fruit handling.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			Based on this evidence, and the fact that no explicit processing efficacy data exist, we did not reduce or increase the previous risk rating (A1). A source of uncertainty is consistency of detection across processing personnel.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	MU	Although populations of this tropical species can overwinter in Japan as mature females, grapes are harvested in March/April in India (Bostanian et al., 2012; CABI, 2016). Whether females would survive a rapid change from warm, near-summer temperatures to pre-cooling (< 4 °C) and/or refrigerated storage and transport (0-2 °C) is unknown. No accounts document overwintering by crawlers; the biology of the species and lack of documentation indicate crawler overwintering is unlikely. How that would affect crawler survival during refrigerated transport is unknown. Given crawlers' high surface area to body volume ratio, they probably would desiccate readily in the cold, dry air under refrigeration. Based on this evidence, and the fact that limited cold tolerance data exist, we did not reduce or increase the previous risk rating.
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	

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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	Low	MC	Given the high degree of polyphagy, limited (local) dispersal ability of crawlers, importation of grapes into the United States during summer months, and the discarding of grape stems as refuse, if a gravid female or mobile crawler survived post-harvest processing and transport, it could come into contact with host material. However, their limited mobility would make movement from discarded stems to suitable host plants unlikely. Based on this, the rating for this risk element is Low. A source of uncertainty is how far crawlers could be dispersed over long distances by wind.
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, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	Medium	N/A	The combined likelihood of establishment of *Icerya seychellarum* in the continental United States is medium with low uncertainty. If the pest arrives on imported grapes, it is likely to be distributed in the endangered area but might not find a suitable host.
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment	Medium	N/A	

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

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Assessment of the consequences of introduction of *Icerya seychellarum* into the PRA area

Criteria	Meets criteria? (Y/N)	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	No	MC	The biology of the species indicates that it only becomes a pest, in any environment, when it is tended by ants, as otherwise naturally occurring ladybird beetles and parasitoids keep it under control (PNKTO, 1982). Ants are often controlled in production areas in the United States to limit damage from mealybugs and other pests (Grafton-Cardwell, 2012; Rust and Choe, 2012). Cryptochaetid parasitoids and *Rodolia* spp. ladybird beetles have already been introduced into the United States to control the congener *Icerya purchasi* (a serious pest of commercial fruit production with a host range similar to *I. seychellarum*), and they have effectively controlled *I. seychellarum* elsewhere, including American Samoa, in the past (Cochereau, 1966; Quezada and DeBach, 1973; Waterhouse, 1993; Grafton-Cardwell, 2012; Schmaedick, 2007; Sayed et al., 2013; Kerns et al., 2015). We estimate the damage potential of *I. seychellarum* in the endangered area at less than 10 percent. A source of uncertainty is how many novel control efforts would be required and how quickly damage to environmental hosts would be detected.

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element C2: Spread potential	N/A		
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	No	N/A	
Trade Impacts			
Risk Element D1: Export markets at risk	Yes	C	Countries that include the pest on their Harmful Organism lists include Brazil, Costa Rica, Ecuador, Egypt, the Republic of Korea, Peru, and the Syrian Arab Republic (PeExD, 2016). *Icerya seychellarum* can feed on some economically important crops (see above) that are exported from the United States in a fresh, unprocessed state (e.g., apples, avocado, citrus, guava, mangoes, peaches/nectarines, pears, roses) (FAOSTAT, 2016). However, *I. seychellarum* prefers to feed on leaves and stems (PNKTO, 1982a), and is unlikely to be present on the stage of these commodities that is exported. Based on this evidence, *I. seychellarum* could put the U.S. export market for avocados to South Korea at risk.
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	No	MC	South Korea does not have any specific mitigation or treatment requirements related to avocado imports or *Icerya seychellarum* (MIFAFF, 2016). Other than some geographic restrictions on avocado production areas (see below), the only requirement is that the commodity be accompanied by a phytosanitary certificate (issued by the exporting country) declaring it inspected at

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			the port of egress as free of quarantine pests. South Korea currently imports avocados from New Zealand, where *Icerya seychellarum* is present.
Risk Element D: Pest is likely to cause significant trade impacts	No	N/A	
Conclusion			
Is the pest likely to cause unacceptable consequences in the PRA area?	No	N/A	

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

3.2.7. Mealybugs (Hemiptera: Pseudococcidae)

We assessed the likelihood that the mealybug species *Maconellicoccus hirsutus*, *Nipaecoccus viridis*, *Pseudococcus cryptus*, and *Rastrococcus iceryoides* would be introduced into the United States via imported grapes from India by assessing the likelihood of entry and establishment and then combining these two likelihoods to give an overall combined rating. Based on our analysis, specifically Element B1 under Likelihood of Establishment, we determined the overall likelihood of introduction to be Negligible. The analysis is given below.

Assessment of the likelihood of introduction of *Maconellicoccus hirsutus, Nipaecoccus viridis, Pseudococcus cryptus,* and *Rastrococcus iceryoides* into the endangered area via the importation of grapes from India

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	We analyzed the likelihood of establishment first. See below.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	N/A	N/A	

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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 host material in the endangered area	Negligible	MC	See explanation below.
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

Life stage biology. Female mealybugs typically go through four life stages after the egg stage, and some species, such as *Dysmicoccus brevipes* (Cockerell), bear live young (Ito, 1938). The first two nymphal instars have large legs compared to adults and are quite active. The third instar nymph has shortened legs and resembles the adult. Grasswitz and James (2008) studied movement of *Pseudococcus maritimus* (Ehrhorn) nymphs and found little tendency for them to move away from the point where they were released. The farthest movement was 90 cm, but most distances were considerably shorter. Furthermore, no evidence indicated that mealybug movement was influenced by any cues (e.g., light or gravity) other than surface features of the host. Cid et al. (2010) found that *Planococcus citri* (Risso) nymphs hatched in bark crevices in the woody part of grapevines and rarely made it up into the green parts of the vine unless populations were very large. Nymphs stopped moving upward when they encountered places in the bark to feed, and did not appear to move between plants by contact between green organs. In a study with three species of *Rastrococcus* mealybugs, *R. mangiferae* (Green), *R. iceryoides*, and *R. invadens* Williams, no active migration of individuals between trees, tree to soil or tree to debris occurred (Narasimham and Chacko, 1991). The crawlers (first-instar nymphs) are also very sensitive to desiccation (Browning, 1959). Furness (1976) also hypothesized that low humidity was responsible for the high mortality seen in dispersing first-instar nymphs of *Pseudococcus longispinus* (L.).

The adult female emerges from the third instar nymph. They are wingless and cannot disperse by flying. Females are often large and distorted from the eggs or nymphs, which they carry in their

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abdomens, although those of most species retain their legs and can move to some extent. Males, by contrast, develop wings and flight capabilities as adults (McKenzie, 1967).

Other dispersal mechanisms. Given their limited ability to disperse by walking, mealybugs may have some mechanism for longer range dispersal, and evidence indicates that wind may carry nymphs away from hosts. First- and second-instar nymphs of *Pseudococcus longispinus* were blown from pear trees onto sticky traps on warm, windy days (Barrass et al., 1994). Vitullo (2009) found that the density of females on a plant influenced the number of nymphs caught. Also, dispersal by wind depends to a large extent on being exposed to wind well off the ground, in the branches of the host plant (Barrass et al., 1994; Grasswitz and James, 2008). Crawlers on imported infested fruit are highly unlikely to be in such circumstances (see below), reducing the potential for effective aerial dispersal.

Dispersal by wind is dependent on prevailing wind direction; nymphs have no control over where they are blown. This dispersal strategy relies on a very high number of nymphs, so that a few will arrive serendipitously on a suitable new host. Commercial fruit arriving in the United States is highly unlikely to carry high populations of pregnant females. Crawlers would be unlikely to survive shipment, especially in chilled, low-humidity conditions. In the event that inedible fruit is disposed of in outdoor compost bins, since only a small number of fruit are likely to be infested, only very rarely would infested fruit be composted. For these reasons, mealybugs arriving on commercial fruit for consumption have a negligible likelihood of dispersing to hosts.

3.2.8. *Monilinia fructigena*

We determined the overall likelihood of introduction of *M. fructigena* to be Medium. We present the results of this assessment in the table below. *Monilinia fructigena* only infects grape under suitable environmental conditions (Byrde, 1977), but this fungus would be able to survive the 0-2 °C storage conditions of grapes from India (MOA-India, 2008).

We determined that establishment of *M. fructigena* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below. *Monilinia fructigena* may not cause any unacceptable direct economic impacts in the United States because this species is not as economically damaging as *M. fructicola*, which is already widely distributed throughout the United States (Byrde, 1977; Jones and Aldwinckle, 1990), and *M. fructigena* can be controlled by the same fungicides that are already used to control apple and pear scab (Jones and Aldwinckle, 1990). However, *M. fructigena* is regulated by Canada (CFIA, 2014), so U.S. exports could be subjected to additional phytosanitary regulations if *M. fructigena* were to become established in the United States.

Determination of the portion of the continental United States endangered by *Monilinia fructigena*

Climatic suitability	*Monilinia fructigena* occurs in Europe, Egypt, Morocco, parts of the Middle East, Russia, Taiwan, Korea, and several provinces/regions in China (Guangxi, Anhui, Gansu, Hebei, Henan, Hubei, Hunan, Jiangsu, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, and Zhejiang) (CABI, 2016; Farr and Rossman, 2015). A minor outbreak of *M.*

	fructigena in Maryland was eradicated (Jones and Aldwinckle, 1990). Reports of this fungus from South America are likely misidentifications (CABI, 2016). Based on that information, we estimate that this fungus could establish in areas of the United States corresponding to USDA Plant Hardiness Zones 5-9, and possibly Zones 4 and 10 (Magarey et al., 2008; PERAL, 2015).
Potential hosts at risk in PRA Area	*Monilinia fructigena* primarily infects *Prunus* spp. (stone fruit), *Malus* spp. (apple), and *Pyrus* spp. (pear), but it is also associated with *Cydonia oblonga* (quince), *Vitis vinifera* (grape), *Cotoneaster* sp., and *Corylus avellana* (common filbert) (Farr and Rossman, 2015; Jones and Aldwinckle, 1990). These hosts are widely distributed throughout USDA Plant Hardiness Zones 5-9 in the continental United States (Kartesz, 2015; NASS, 2015a; NRCS, 2016).
Economically important hosts at risk[a]	Apples, pears, stone fruit, grapes, quince, and filberts are economically important fruit crops (NASS, 2015a).
Pest potential on economically important hosts at risk	*Monilinia fructigena* causes rotting of mature fruit, wilting, and collapse of floral parts, and cankers on shoots and branches (Byrde, 1977; CABI, 2016; Jones and Aldwinckle, 1990).
Defined Endangered Area	The area endangered by *M. fructigena* includes areas in the United States within USDA Plant Hardiness Zones 5-9 where apples, pears, stone fruit, grapes, quince, and filberts 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 *Monilinia fructigena* into the continental United States via the importation of grapes from India

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	MC	Only a few reports (e.g., Tai, 1979) indicate that this fungus infects grapes. That seems to happen only under certain environmental conditions (Byrde, 1977) that are somewhat unlikely to co-occur.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MC	*Monilinia fructigena* causes a circular brown rot of fruit that gradually extends outwards (Byrde, 1977). Eventually, the entire fruit surface can become covered with conidial tufts and fungal mycelium, and the fruit becomes shriveled and "mummified" (Byrde, 1977). Thus, late-stage infections are highly likely to be observed (CABI, 2016) and removed during post-harvest grading and selection (see section 1.4.3). Latent infections may not be detected, but based on this evidence, we decreased the previous rating by one level.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	MC	The grapes will be refrigerated at 0-2 °C (Ministry of Agriculture India, 2008). *Monilinia fructigena* is able to produce spores and grow, albeit very slowly, at 0 °C (Byrde, 1977). Because *M. fructigena* can survive these conditions but grows at a reduced rate, we left the previous risk rating unchanged.
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	High	C	The spores of *Monilinia* species primarily move to new areas via wind and air currents, and wounds are not required for penetration into host tissue (Byrde, 1977). The primary hosts for this fungus (apples, stone fruits, and pears) are grown throughout the endangered area (NASS, 2015a), so we rated this risk element High.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	High	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 *Monilinia fructigena* into the continental United States (i.e., the PRA area)

Criteria	Meets criteria? (Y/N)	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	No	MC	*Monilinia fructigena* is not as economically damaging as the related species *M. fructicola*, which is already widely distributed throughout the United States (Byrde, 1977; Jones and Aldwinckle, 1990; Ritchie, 2000). Additionally, *M. fructigena* is controlled by the same fungicides that are already used to control apple and pear scab (Jones and Aldwinckle, 1990).
Risk Element C2: Spread potential	NA	NA	
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	No	N/A	
Trade Impacts			

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element D1: Export markets at risk	Yes	MC	Twenty percent of the exported U.S. apples and 34 percent of the exported U.S. peaches go to Canada (FAS, 2012), where *M. fructigena* does not occur (CABI, 2016; Jones and Aldwinckle, 1990). Canada lists *M. fructigena* as a harmful organism (CFIA, 2014).
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	Yes	C	Canada requires apples from China, Japan, and Korea and stone fruits from Spain to be free of *M. fructigena* as a condition of entry (CFIA, 2012), so apples and stone fruit exported from the United States to Canada would likely also be subject to similar phytosanitary requirements if *M. fructigena* was established in the United States.
Risk Element D: Pest is likely to cause significant trade impacts	Yes	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

3.2.9. *Retithrips syriacus*

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

We determined that the establishment of *R. syriacus* in the continental United States is not 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 *Retithrips syriacus*

Climatic suitability	This insect is distributed in the United States (Florida and Puerto Rico), Brazil, Egypt, Ghana, India, Israel, Kenya, Lebanon, Libya, Somalia, Sudan, Syria, Tanzania, Uganda (Hamon and Edwards, 1994), Saudi Arabia (Abu Abu Yaman, 1966), and Tunisia (Elimem et al., 2011).

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	Based on this distribution, we estimate establishment is possible in USDA Plant Hardiness Zones 9-11 (PERAL, 2015).
Potential hosts at risk in PRA Area	Numerous suitable hosts are grown throughout Zones 9-11 (see below).
Economically important hosts at risk	Economically important hosts in Zones 9-11 include grape, cotton, grapevines, rose, persimmon, quince, avocado, mango, and guava (NASS, 2012; PERAL, 2015).
Pest potential on economically important hosts at risk[a]	*Retithrips syriacus* is an economic pest and feeds on many crops, causing leaf damage and malformation of plant part,s including causing flowers to abort.
Defined Endangered Area	Cotton, grape, rose, avocado mango, guava, and other crops in Plant Hardiness Zones 9 to 11 in the continental United States are at risk for *R. syriacus* 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 *Retithrips syriacus* into the endangered area via the importation of grapes from India

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	C	*Retithrips syriacus* is present in much of India (CABI, 2016). Presence and damage on grape has been reported in Israel and Tunisia, although leaves are the primary feeding site.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MU	Culling of damaged grapes as described in the management plan would not reduce the likelihood of the thrips being present in the commodity due to the small size and cryptic nature of the pest. We did not reduce the rating as a result.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	MC	The exposure of *R. syriacus* to temperatures below 14 °C is reported to cause mortality (Avidov and Harpaz, 1969); therefore, the low temperature storage and shipping conditions of the grapes at 4 °C will reduce the presence of the thrips. We reduced the rating to low.
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	

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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	Low	MC	Grapes for consumption are usually eaten. Only a small fraction will be discarded, and of those, only a small fraction will be discarded outdoors. Suitability of climate and availability of hosts would be limited to part of the year in most parts of the endangered area.
Risk Element B2: Likelihood of arriving in the endangered area	High	MC	More than 25 percent of the U.S. population lives in the endangered area, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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 *Retithrips syriacus* into the continental United States

Criteria	Meets criteria ? (Y/N)	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	No	MC	*Retithrips syriacus* has been in the United States in Florida and Puerto Rico since 1994 (Hamon and Edwards, 1994) and has not been reported to cause economic damage on any crops in the United States. The control of other thrips species would likely result in the control of this pest species if it were introduced into additional areas that are currently not presently occupied by the thrips.

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Criteria	Meets criteria ? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element C2: Spread potential	No	C	*Retithrips syriacus* has not spread from the area of south Florida since 1994, although establishment in other areas of the Caribbean has been reported (Etienne et al., 2015).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	No	N/A	
Trade Impacts			
Risk Element D1: Export markets at risk	No	C	Only a few countries list *R. syriacus* on the harmful organism list (PeExD, 2016). These countries import less than 10 percent of the U.S. exports of grape and other host commodities.
Conclusion			
Is the pest likely to cause unacceptable consequences in the PRA area?	No	N/A	

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

3.2.10. *Rhipiphorothrips cruentatus*

We determined the overall likelihood of introduction of *R. cruentatus* to be Negligible on grapes from India. We present the results of this assessment in the table below.

Because the likelihood of entry is Negligible, we did not determine the endangered area, nor analyze the likelihood of establishment or the consequences of introduction.

Assessment of the likelihood of introduction of *Rhipiphorothrips cruentatus* into the endangered area via the importation of grapes from India

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Likelihood of Entry			

Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	Low	MC	Adults and nymphs feed almost exclusively on the underside of leaves (Rahman and Bhardwaj, 1937), but can damage fruit as well (Batra et al., 1986). Eggs are laid singly in the underside of leaves. Pupae overwinter in the soil (Rahman and Bhardwaj, 1937). *Rhipiphorothrips cruentatus* was a major pest of grapes in India up until the 1980s, but has been replaced by *S. dorsalis*, an ecological homologue (Verghese and Harish, 2010).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MC	Grapes will be cleaned by hand to remove any broken, decayed, deformed, undersized, or discolored berries (see section 1.4.3). Damage to fruits is secondary. Fruits are smaller, develop a corky layer, and appear shriveled (Rahman and Bhardwaj, 1937). Fruit is pre-cooled to less than 4 °C within 6-8 hours before sea shipment. Adults are cold sensitive and experience 100 percent mortality when exposed to 4 °C for five hours (Rahman and Bhardwaj, 1937).

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Negligible	MC	Adults lay eggs on the underside of leaves, and pupation takes place on the leaves. Adults and nymphs feed almost exclusively on the underside of leaves (Rahman and Bhardwaj, 1937), but can damage fruit as well (Batra et al., 1986). Adults and nymphs, the only life stages expected to be associated with the fruit, are cold sensitive and experience 100 percent mortality when exposed to 4 °C for five hours (Rahman and Bhardwaj, 1937). Grapes are stored at 0-2 °C until shipment (see section 1.4.4) There have only been 13 interceptions of *Rhipiphorothrips* sp. since 1985, none of which were on fruit (PestID, 2016).
Risk Element A: Overall risk rating for likelihood of entry	Negligible	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	N/A		
Risk Element B2: Likelihood of arriving in the endangered area	N/A		
Risk Element B: Combined likelihood of establishment	N/A	N/A	
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment [Procedure 7-4]	Negligible	N/A	

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

3.2.11. *Scirtothrips dorsalis*

We determined the overall likelihood of introduction of *S. dorsalis* to be High. We present the results of this assessment in the table below.

We determined that establishment of *S. dorsalis* 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 *Scirtothrips dorsalis*

Climatic suitability	Matching distribution maps (CABI, 2016) with Plant Hardiness Zones (Magarey et al., 2008), it appears that *S. dorsalis* could survive in Hardiness Zones 9 and above. More detailed climate mapping indicates that the species could survive in Washington, Oregon, California, parts of Arizona and Nevada, Texas, Louisiana, Mississippi, Alabama, Georgia, and Florida (Nietschke et al., 2008).
Potential hosts at risk in PRA Area	*Scirtothrips dorsalis* has a wide host range. In Florida alone, Kumar et al. (2012) found the insect feeding on six species of tropical fruits: avocado, canistel, litchi, mango, miracle fruit, and sapodilla, as well as on tea and cotton.
Economically important hosts at risk[a]	Cotton, grapes, and avocado are major U.S. agricultural crops.
Pest potential on economically important hosts at risk	The scab caused by thrips on grape berries reduces quality and marketability (Ranganath et al., 2008). Besides the damage caused by grape thrips to leaves (necrosis or holes in the blade), the punctures of the larvae and adults cause a toxic reaction that retards the development of the shoots and causes a certain amount of abortion at the flowering period. The most severe damage is recorded on the grapes, where the pest causes necrosis and suberization of the epidermis; this considerably decreases the varieties of table grapes (Bournier, 1976).
Defined Endangered Area	The endangered area includes the West Coast and southern states, excluding Florida (Kumar et al., 2012) and Texas (Ludwig and Bográn, 2007), where the insect is already present.

[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 *Scirtothrips dorsalis* into the endangered area via the importation of grapes from India

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	MC	*Scirtothrips dorsalis* larvae have been found at levels of 17 per grape cluster during harvest season (Shibao et al., 1993).

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	High	MC	We found no evidence that post-harvest procedures would affect survivorship, and the small size of the thrips would likely allow it to remain undetected in the cluster.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	MC	At 16 °C, *S. dorsalis* had an overall survival rate of around 15 percent from egg to adult (Shibao, 1996). The lower developmental threshold of this insect is 8.5 °C (Shibao, 1996). Grapes will be held and shipped refrigerated at temperatures between 1 and 2 °C, which is below the developmental threshold and which will likely cause mortality.
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	High	C	*Scirtothrips dorsalis* feeds on a wide range of hosts, including commonly grown vegetables such as tomatoes and peppers, household plants, and common weeds such as garlic (CABI, 2016). Adults can fly short distances of up to 50 meters when populations peak (Masui, 2007).
Risk Element B2: Likelihood of arriving in the endangered area	High	MC	More than 25 percent of the U.S. population lives in the endangered area, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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	

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

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

Criteria	Meets criteria? (Y/N)	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	C	In areas of Florida where *S. dorsalis* has become established, it is causing economic damage to a broad range of host plants (Kumar et al., 2012). *Scirtothrips dorsalis* has been reported to transmit viruses such as Tomato spotted wilt virus (Amin et al., 1981) and Peanut yellow spot virus (Gopal et al., 2010). Of the more than 5500 species of thrips described, only 1 percent are recorded as serious pests, *S. dorsalis* among them (Morse and Hoddle, 2006).
Risk Element C2: Spread potential	Yes	MC	*Scirtothrips dorsalis* appears to be spreading around the world from its native population in southeast Asia to Australia, the Caribbean, Florida, and Texas (Kumar et al., 2012).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	N/A	The combination of damage to hosts and the ability to spread make it likely that the establishment of this pest in parts of the endangered area would result in unacceptable direct impacts.
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

3.2.12. *Spodoptera litura*

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

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We determined that establishment of *S. litura* 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 *Spodoptera litura*

Climatic suitability	*Spodoptera litura* occurs across wide areas of Asia, including China, Japan, India, Pakistan, Korea, the Philippines, and Thailand (CABI, 2016), as well as Guam (Swezey, 1940) and the Northern Mariana Islands (Denoth et al., 2002). This distribution corresponds roughly to Plant Hardiness Zones 8-11 within the United States (Magarey et al., 2008).
Potential hosts at risk in PRA Area	This highly polyphagous pest attacks at least 40 economically important crops in 40 different families. Hosts include okra, onion, peppers, cotton, and tomato (CABI, 2016). Many of those are widely present within Plant Hardiness Zones 8-11 in the United States(NASS, 2012).
Economically important hosts at risk[a]	All of the hosts listed above are economically important crops and are widely available in Plant Hardiness Zones 8-11 (NRCS, 2016).
Pest potential on economically important hosts at risk	*Spodoptera litura* has caused losses in peanut crops in India (Dhir et al., 1992) and cotton crops in Pakistan (Ahmad et al., 2007).
Defined Endangered Area	The area endangered by *S. litura* includes okra, onion, pepper, cotton, tomato and peanut crops in the southern states up to southern Virginia on the east coast, the southern parts of Arizona and New Mexico, California, the western portions of Washington and Oregon.

[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 *Spodoptera litura* into the endangered area via the importation of grapes from India

Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Likelihood of Entry			

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Risk Element	**Risk Rating**	**Uncertainty Rating[a]**	**Justification for rating and explanation of uncertainty (and other notes as necessary)**
Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry)	Medium	MU	*Spodoptera litura* is not often mentioned as a pest of grape bunches, but it has been reported to feed on leaves and small developing fruit (Mani et al., 2014). Larvae often cause the fruit to drop from the plant prior to harvest. Adult *S. litura* have been reported to suck juice from fruit; however, they would be unlikely to remain on the fruit through harvest.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MC	Full-grown larvae are large and may weigh up to 800 mg (CABI, 2016), making them easy to see and their damage obvious. The ease of detection of *S. litura* during harvest and packing (see section 1.4.3) make it highly likely that the pest population would be reduced during processing. Thus, we reduced the previous risk rating by one level.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	MC	The pest has not been intercepted at U.S. ports-of-entry on grapes (PestID, 2016), although it has been intercepted over 500 times on other commodities. This may be more of an indication that field practices and harvest eliminate the pest than that transport conditions reduce numbers. Lethal low temperature is -5 °C (Matsuura et al., 1992), which is lower than the transport temperature for grapes. Thus we did not change the risk rating.
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	

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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	Medium	MC	Suitable climatic conditions are limited to part of the year in portions of the endangered area. The conditions necessary for the pest's transmission to the host are seldom met. Only grapes infested with early instage larvae would likely escape detection at harvest. The low temperature during transit would preclude larval development in transit. For a second generation to find hosts, the grapes would have to be discarded outside and female larvae would have to develop to adulthood, find mates, and lay eggs on a host.
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, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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

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

Criteria	Meets criteria? (Y/N)	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	MU	*Spodoptera litura* has caused losses in peanut crops in India (Dhir et al., 1992) and cotton crops in Pakistan (Ahmad et al., 2007), but growers in the endangered area already routinely control similar pests such as *Helicoverpa zea* (Brickle et al., 2001) and *Heliothis virescens* (Luttrell, 1994). The altered timing needed for certain insecticides and possible resistance factors could result in higher costs or damage from this insect.
Risk Element C2: Spread potential	Yes	U	A related species, *Spodoptera littoralis* (Boisduval), can fly up to 1.5 kilometers in a single night (Salama and Shoukry, 1972).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	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

3.2.13. *Stathmopoda auriferella*

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

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

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Determination of the portion of the United States endangered by *Stathmopoda auriferella*

Climatic suitability	*Stathmopoda auriferella* has the following geographic distribution: **Africa**: Comoro Islands, Egypt, Gambia, Kenya, Madagascar, Nigeria, Sierra Leone, South Africa, Sudan; **Asia**: Afghanistan, Bangladesh, China, India [Nauni, Dharampur, Tanyhar (Himachal Pradesh), Ropar (Punjab)], Israel, Japan (Honshu, Shikoku, Kyushu,Yakushima Island, Okinawa Kume Island, Miyako Island, Ishigaki Island, Iriomote Island), Korea, Malaysia, Pakistan, Philippines, Russia (Far East), Seychelles Island, Sri Lanka, Taiwan, Thailand, West Malaysia (Anonymous, 2016; Badr et al., 1968; Heppner and Inoue, 1992; Ma et al., 2013; Pathania et al., 2009; Robinson et al., 2010; Zhang, 1994). This corresponds to hardiness zones 1-11 (Magarey et al. 2008).
Potential hosts at risk in PRA Area	**Actinidiaceae**: *Actinidia deliciosa*, **Anacardiaceae**: *Mangifera indica*; **Arecaceae**: *Cocos nucifera*; **Asteraceae**: *Helianthus* sp., *H. annuus*; **Fabaceae:** *Acacia nilotica*, *Albizia altissima*; **Lythraceae:** *Punica granatum*; **Myrtaceae**: *Tristania* sp.; **Pinaceae**: *Pinus roxburghii*; **Poaceae**: Sorghum sp., *S. bicolor bicolor*; **Rubiaceae**: *Coffea* sp., *C. canephora*, *C. liberica*; **Rutaceae**: *Citrus sinensis*; **Sapindaceae**: *Nephelium ophiodes* (Park et al., 1994; Prevett, 1963; Robinson et al., 2001; Zhang, 1994).
Economically important hosts at risk[a]	Economically important hosts of *Stahmopoda auriferella* that occur in the climatologically suitable areas include **Actinidiaceae**: *Actinidia deliciosa*; **Anacardiaceae**: *Mangifera indica*; **Arecaceae**: *Cocos nucifera*; **Asteraceae**: *Helianthus* sp., *H. annuus*; **Lythraceae:** *Punica granatum*; and **Rutaceae**: *Citrus sinensis* (NASS, 2012).
Pest potential on economically important hosts at risk[a]	*Stathmopoda auriferella* does not appear to be a primary frugivore. Robinson et al. (2001) give information on the plant parts attacked for the following hosts: *Cocos nucifera* (flowers, decaying flowers), *Helianthus* sp. (flowers), *Sorghum* sp. (decaying flowers), *Acacia nilotica* (seeds, pods), *Albizia altissima* (decaying flowers), *Punica granatum* (rotten fruit), *Tristania* sp. (dead leaves), *Pinus roxburghii* (twigs), and *Nephelium ophiodes* (fruit). Additionally, Badr et al., 1968) refer to this insect as the mango flower moth and are the only researchers to mention *Vitis* as a host, mentioning that *S. auriferella* attacks "mango flowers, date palm fruits, cotton bolls, grape, orange and apple trees." Ma et al. (2013) report that in Korea, *S. auriferella* larvae cause damage to organic kiwifruit by webbing flower buds and newly set fruit together, which often causes affected plant parts to drop from vines. Park et al. (1994) report that, of damage to kiwifruit, 70 percent occurred on the fruit apex and 11 percent on the fruit stalk.
Defined Endangered Area	The endangered area includes the crop hosts mentioned previously, which occur in Plant Hardiness Zones 1-11.

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Assessment of the likelihood of introduction of *Stathmopoda auriferella* into the endangered area via the importation of grapes from India

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	MC	*Stathmopoda auriferella* feeds on leaves and the exterior of fruit. Fruit feeding is on small green fruit, which typically dries and falls from the cluster (Biosecurity Australia, 2011).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MC	*Stathmopoda auriferella* causes shriveled fruit damage that would likely be removed during sorting and packing. Eggs and larvae may remain in the grape bunches (Biosecurity Australia, 2011), as a result, the risk rating was not changed.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	C	There is no evidence indicating that the refrigerated conditions of the grape storage would impact the survival of *S. auriferella*, so the risk rating was not changed.
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	Many hosts of *S. auriferella* occur in the endangered area (see previous). Movement of larvae from infested fruit to hosts is not likely, as the numbers associated with fruit and larval mobility would be low. The majority of infested grapes would be disposed of in traditional sanitation receptacles (i.e. indoor garbage cans) and larvae would not be likely to survive, move to other hosts and complete development.
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, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (PERAL, 2015).

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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 *Stathmopoda auriferella* into the United States

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	*Stathmopoda auriferella* has been reported to cause high levels of damage in organic kiwi orchards in Korea (Ma et al., 2013).
Risk Element C2: Spread potential	Yes	MU	This species is a strong flier, can move in trade, and has small eggs that would be difficult to detect (Gaag and Straten, 2009).
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	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

3.2.14. *Tenuipalpus granati*

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

We determined that the establishment of *T. granati* 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 *Tenuipalpus granati*

Climatic suitability	This mite is found in Cyprus, Greece, India, Iran, Israel, Italy, Saudi Arabia, and Turkey (Hatzinikolis, 1986; Mehrnejad, 2001; Ananda et al., 2009; Meyer et al., 1981; Peverieri et al., 2009; Abu Abu Yaman, 1966). Based on this distribution, we estimate establishment is possible in USDA Plant Hardiness Zones 7-11 (PERAL, 2015).
Potential hosts at risk in PRA Area	Pomegranate, pistachios, and grape are grown throughout Zones 9-11 (NASS, 2012)(see below).
Economically important hosts at risk	Economically important hosts in Zones 9-11 include grape, pistachios, and pomegranate (NASS, 2012; PERAL, 2015).
Pest potential on economically important hosts at risk[a]	*Tenuipalpus granati* is an economic pest of pistachios and feeds on several crops, primarily causing leaf damage(Mehrnejad, 2001)).
Defined Endangered Area	Pomegranate, pistachios, and grape crops in Plant Hardiness Zones 7 to 11 in the continental United States are at risk for 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 *Tenuipalpus granati* into the endangered area via the importation of grapes from India

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	MC	*Tenuipalpus granati* is present in India (Ananda et al., 2009). Feeding on the fruit of grape and causing small spots has been reported in Greece by Hatzinikolis (1986), although leaves are the primary feeding site of this mite.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Medium	MU	Culling of damaged grapes as described in the management plan would not reduce the likelihood of the mite being present in the commodity due to the small size (~250 µm)(Khanjani et al., 2013) and cryptic nature of the pest. We did not reduce the rating as a result.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Medium	MC	The exposure of *T. granati* to temperatures during shipping may result in some mortality; however, the amount of mortality is not known, so we did not reduce the rating.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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	Grapes for consumption are usually eaten. Only a small fraction likely will be discarded, and of those, only a small fraction will be discarded outdoors. The primary hosts, pistachios and pomegranate, are not widely available (NASS, 2012), but grapes are more widely planted and grow frequently in the natural environment (NASS, 2012).
Risk Element B2: Likelihood of arriving in the endangered area	High	MC	More than 25 percent of the U.S. population lives in the endangered area, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is increased in relation to the population. (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 *Tenuipalpus granati* into the continental United States

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Criteria	Meets criteria ? (Y/N)	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	MU	*Tenuipalpus granati* is an economic pest of pistachio trees in Iran and an occasional pest of pomegranate and grapevine. The damage to kernel formation, bud drop, and defoliation from high infestation levels would be detrimental to production of pistachio (Mehrnejad, 2001).
Risk Element C2: Spread potential	Yes	MC	*Tenuipalpus granati* has not been reported to have spread rapidly through the world, but like most flat mites, it is likely to move and disperse on wind currents (Childers and Rodrigues, 2005)
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	Yes	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

3.2.15. *Thrips palmi*

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

We determined that the establishment of *T. palmi* in the United States is unlikely to cause unacceptable impacts. We present the results of this assessment in the table below.

Determination of the portion of the United States endangered by *Thrips palmi*	
Climatic suitability	*Thrips palmi* pupa experience 100 percent mortality after 255 minutes at -5 °C (Murai, 2001). Based on this information, we considered areas in the United States and its territories with daily minimum temperatures below -5 °C during any day of the year to be unsuitable for *T. palmi* establishment. We modeled the 10-year frequency (2003-2012) of daily minimum temperatures below -5 °C occurring in the continental United States to visualize areas where *T. palmi* could not establish, i.e., the results ranged from 0 to 10 years of occurrence (PERAL/CIPM, 2013). We then subtracted the resulting 10-year frequency map from 10 to visualize areas in the continental United States where *T. palmi* could

	establish based on the 10-year frequency of daily minimum temperatures ≥ -5 °C throughout the year. For example, if an area was unsuitable 7 out of 10 years (70 percent of the time), it would be suitable 3 of 10 years (30 percent of the time) (Figure 2). We also modeled Hawaii and the U.S. territories, which were found to be suitable for *T. palmi* establishment 100 percent of the time. We then mapped Plant Hardiness Zones that overlap the at-risk area for *T. palmi* establishment in the continental United States (Figure 3).
Potential hosts at risk in PRA Area	Hosts of *T. palmi* that occur in the climatologically suitable area include **Acanthaceae:** *Crossandra* spp.; **Amaranthaceae:** *Amaranthus* spp., *Gomphrena* spp.; **Anacardiaceae:** *Mangifera* spp.; **Apiaceae:** *Coriandrum* spp., *Daucus carota, Eryngium foetidum*; **Apocynaceae:** *Nerium oleander, Plumeria* spp.; **Araliaceae:** *Schefflera* spp.; **Asteraceae:** *Ageratum* spp., *Bidens pilosa*, *Dahlia* spp., *Helianthus annuus*, *Lactuca* spp., *Leucanthemum maximum, Parthenium hysterophorus*; **Balsaminaceae:** *Impatiens* spp.; **Brassicaceae:** *Brassica oleracea*; **Cannaceae:** *Canna indica*; **Caryophyllaceae:** *Dianthus caryophyllus*; **Commelinaceae:** *Commelina benghalensis*; **Convolvulaceae:** *Ipomoea batatas*; **Cucurbitaceae:** *Citrullus* spp., *Cucumis* spp., *C. melo, C. sativus*, *Cucurbita maxima*, *C. moschata*, *C. pepo, Luffa actutangula, Momordica charantia, Sechium edule*; **Euphorbiaceae:** *Codiaeum* spp., *Euphorbia pulcherrima*; **Fabaceae:** *Arachis hypogaea*, *Cicer arietinum*, *Glycine max*; *Phaseolus* spp., *Pisum* spp., *Senna obtusifolia* (synonym: *Cassia tora*), *Trifolium repens*, *Vigna savi*; **Gentianaceae:** *Eustoma* spp.; **Lamiaceae:** *Salvia* spp.; **Lauraceae:** *Persea americana*; **Liliaceae:** *Alium* spp.; **Lythraceae:** *Punica granatum*; **Malvaceae:** *Abelmoschus esculentus, Gossypium* spp., *Hibiscus* spp.; **Moraceae:** *Ficus* spp., *Morus* spp.; **Nyctaginaceae:** *Bougainvillea* spp., **Orchidaceae:** *Dendrobium* spp.; **Pedaliaceae**: *Sesamum* spp.; **Poaceae:** *Oryza sativa, Zea mays*; **Primulaceae:** *Cyclamen* spp.; **Rosaceae:** *Malus* spp., *Prunus domestica*, *P. persica, Rosa* spp.; **Rubiaceae:** *Gardenia* spp.; **Rutaceae:** *Citrus* spp.; **Scrophulariaceae:** *Antirrhinum* spp.; **Solanaceae:** *Capsicum* spp., *Nicotiana* spp., *Physalis* spp., *Solanum melongena, S. tuberosum*; **Theaceae:** *Camellia sinensis*; **Verbenaceae:** *Lantana* spp.; and **Vitaceae:** *Vitis* spp. (Anonymous, 2004; Capinera, 2008; Jones, 2005; Kartesz, 2013; MacLeod et al., 2004; Martin and Mau, 2007; Nakahara, 1994; NRCS, 2016; PIP, 2009;Ranganath et al., 2008; Sakimura et al., 1986; Salas, 2003; Vijayalakshmi et al., 2004).
Economically important hosts at risk[a]	Economically important hosts of *T. palmi* that occur in the climatologically suitable area include avocado (*Persea americana*), beans (*Phaseolus* spp.), cabbage (*Brassica oleracea*), cantaloupe (*Cucumis* melo), corn (*Zea mays*), cotton (*Gossypium* spp.), cowpea (*Vigna savi*), cucumber (*Cucumis sativus*), dahlia (*Dahlia* spp.), eggplant (*Solanum melongena*), figs (*Ficus* spp.), gardenias (*Gardenia* spp.), groundcherry (*Physalis* spp.), lettuce (*Lactuca* spp.), okra

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	(*Abelmoschus esculentus*), oleander (*Nerium oleander*), onion (*Alium* spp.), orchids (e.g. *Dendrobium* spp.), peanuts (*Arachis hypogaea)*, peas (*Pisum* spp.), peppers (*Capsicum* spp.), poinsettia (*Euphorbia pulcherrima*), pomegranate (*Punica granatum*), potato (*Solanum tuberosum*), pumpkin (*Cucurbita pepo*), roses (*Rosa* spp.), squash (*Cucurbita maxima*), sweet potato (*Ipomoea batatas*), watermelon (*Citrullus* spp.), citrus (*Citrus* spp.), mango (*Mangifera* spp.), peaches (*Prunus persica*), plums (*Prunus domestica*), rice (*Oryza sativa*), sage (*Salvia* spp.), snapdragon (*Antirrhinum* spp.), soybeans (*Glycine max*), tea (*Camellia sinensis*), tobacco (*Nicotiana* spp.), and white clover (*Trifolium repens*) (Anonymous, 2004; Capinera, 2008; Kartesz, 2013; MacLeod et al., 2004; Martin and Mau, 2007; Nakahara, 1994; NRCS, 2016; PIP, 2009; Sakimura et al., 1986; Vijayalakshmi et al., 2004).
Pest potential on economically important hosts at risk[a]	*Thrips palmi* is highly polyphagous and feeds en masse on flowers, fruit, leaves, and stems, causing physical damage that can kill the host plant (Sakimura et al., 1986). It also transmits plant viruses, including Groundnut bud necrosis virus, Melon yellow spot virus, and Watermelon silver mottle virus (Jones, 2005). Economically important hosts listed above that *T. palmi* has been reported to damage include beans, cantaloupe, cotton, cowpea, cucumbers, eggplant, pumpkin, squash, soybeans, sweet potatoes, and watermelon (Sakimura et al., 1986). *Thrips palmi* is a crop pest in Japan and has damaged cucumbers, eggplant, melons, and sweet peppers (Cannon et al., 2007). *Thrips palmi* is a pest of ornamentals and vegetables in Korea, where potato yield losses of 30 percent have been reported (Cannon et al., 2007). It has caused economic damage to several crops in Hawaii and Florida, including cucurbits, eggplant, okra, peppers, snap beans, squash, and watermelon (Cannon et al., 2007). *Thrips palmi* is a major economic pest of cucumbers, eggplant, melons, and peppers in the Caribbean (Cannon et al., 2007). For example, cucumber and eggplant crop losses between 50 percent and 90 percent have been observed in Trinidad (Cooper, 1991). In South America, *T. palmi* is a major economic pest of beans, cucurbits, melons, ornamentals, peppers, potatoes, and watermelons, and crop losses ranging from 30 percent to 100 percent have been reported (Cannon et al., 2007). *Thrips palmi* is also a major greenhouse pest (Cannon et al., 2007; Kawai, 1995). Thus, *T. palmi* is highly certain to impact economically important crops in the climatologically suitable area, and it already has in Florida and Hawaii (Cannon et al., 2007).
Defined Endangered Area	The endangered area includes the crop hosts mentioned above in the southern United States, the West Coast, and some of the Atlantic Coast, as well as Hawaii and all U.S. territories (Zones 8 and above).

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

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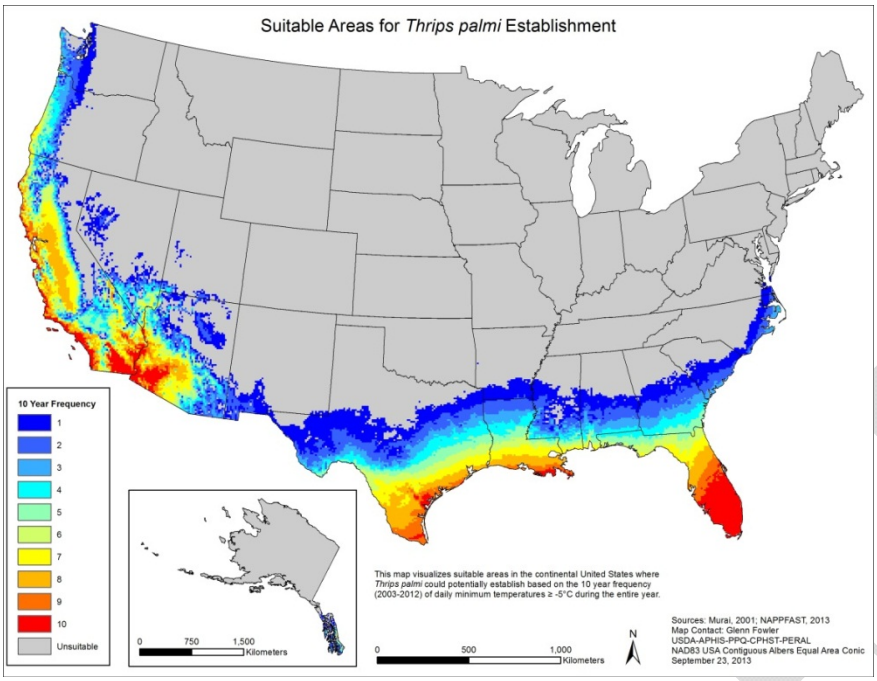

Figure 2. Areas in the continental United States where *T. palmi* could establish based on suitable winter temperatures.

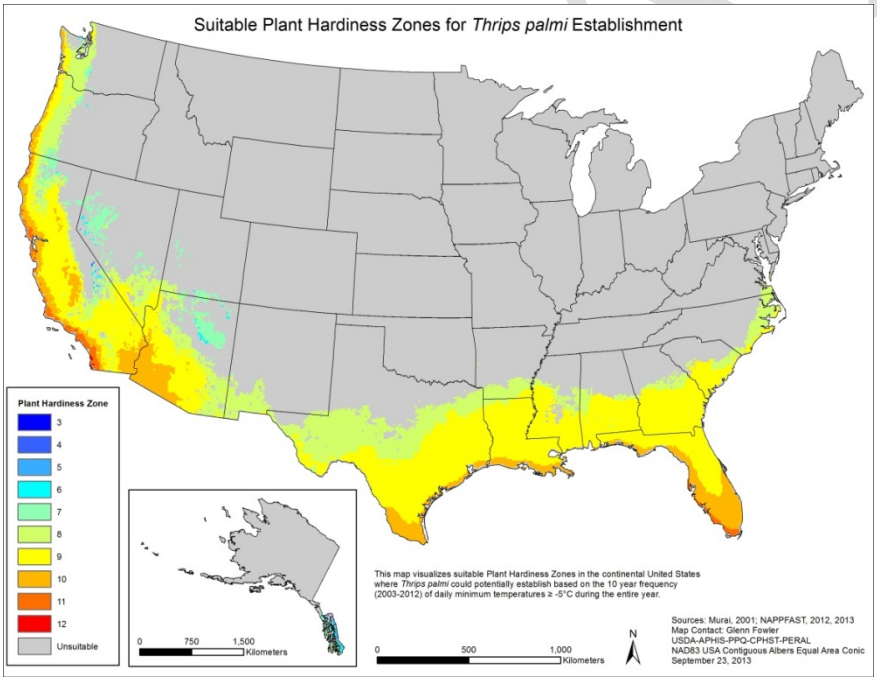

Figure 3. Plant Hardiness Zones in the continental United States where *T. palmi* could establish based on suitable winter temperatures.

Assessment of the likelihood of introduction of *Thrips palmi* into the endangered area via the importation of grapes from India

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)	Low	MC	Studies in India demonstrated that only 0.8 to 4.3 percent of the thrips collected on grape vine plant parts were *T. palmi*, and the least number of thrips were detected on larger grapes, i.e., > 8 mm (Ranganath et al., 2008). This evidence indicates that *T. palmi* is unlikely to be on harvested grapes. We rated this risk element as Low. A source of uncertainty is variation in the distribution of thrips species across India's grape growing regions.
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MU	Harvested grapes will be inspected (see section 1.4.3), but *Thrips palmi* can be difficult to detect if present in low densities or only eggs are present in the plant tissue (IPPC, 2010), indicating that they may escape detection. Based on that evidence, the overall population size seems unlikely to change significantly during this stage, so we did not change the previous risk rating. A source of uncertainty is variation in the detection skill of inspectors.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	MU	Pre-shipment conditions for India grapes are unclear. However, *T. palmi* can survive up to 16 days at 0 °C and 28 days under fluctuating temperatures (Murai, 2001), indicating that it is unlikely to experience harmful environmental conditions during transport. Live *T. palmi* has also been intercepted 9,231 times on plants in permit cargo at U.S. ports-of-entry between October 1984 and February 10, 2016 (PestID, 2016), demonstrating its

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			ability to survive shipment. Overall, we found no strong evidence that the pest population would change significantly during this stage, so we did not change the rating for the previous risk element. A source of uncertainty is the lack of information regarding shipping conditions and methods.
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	High	MC	Many hosts of *T. palmi* occur in the endangered area (see above). *Thrips palmi* can actively fly short distances and can be wind dispersed over longer distances (Vierbergen, 2001). The latter mechanism is thought to have aided its spread in the Caribbean (Vierbergen, 2001). *Thrips palmi* could likely establish in warmer parts of the United States (Figures 2 and 3) where hosts should be consistently available year-round. Based on this evidence, we rated this risk element as High. A source of uncertainty is how wind would affect the natural spread of *T. palmi* in the endangered area.
Risk Element B2: Likelihood of arriving in the endangered area	High	C	The endangered area for *T. palmi* in the United States (Figure 2) primarily contains Plant Hardiness Zones 8 and above (Figure 3). Approximately 48 percent of the U.S. population lives in this area (PERAL, 2015), and U.S. per capita consumption of table grapes is 7 to 8 pounds per person (Boriss et al., 2006), indicating that *T. palmi* could be widely distributed in the endangered area. Based on this evidence, we rated this risk element High.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element B: Combined likelihood of establishment	High	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 *Thrips palmi* into the United States

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	C	*Thrips palmi* can kill host plants (Sakimura et al., 1986). It also transmits plant viruses, including Groundnut bud necrosis virus, Melon yellow spot virus, and Watermelon silver mottle virus (Jones, 2005). As noted above, *T. palmi* is a pest on numerous economically important hosts, with the feeding damage often being extensive (Sakimura et al., 1986). As a pest in several countries, crop losses range from 30 to 100 percent (Cannon et al., 2007). *Thrips palmi* is highly certain to impact economically important crops in the climatologically suitable area, and it already has in Florida and Hawaii.
Risk Element C2: Spread potential	No	C	*Thrips palmi* has been present in Florida since 1990, but has not spread to other areas in the continental United States (Cannon et al., 2007). It is a candidate for official control and is considered a quarantine pest (PestID, 2016). Interstate movement of commodities at-risk for *T. palmi* infestation is regulated in Hawaii (7 CFR § 318.13-26, 2014), but no regulations are listed for its movement in the continental United States.

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Criteria	Meets criteria? (Yes/No)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
			Based on this evidence, we considered *T. palmi* to have insignificant spread potential.
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	No	N/A	
Trade Impacts			
Risk Element D1: Export markets at risk	No	MC	*Thrips palmi* is a pest on many economically important crops (see above) that are exported from the United States, e.g., citrus, potatoes, rice, sweet potatoes, and tomatoes (FAOSTAT, 2016). However, *T. palmi* feeds on flowers, leaves, and stems (Arias, 2013) and is unlikely to be present on the stage of these commodities that is exported, e.g., fruit, tuber, or grain. *Thrips palmi* can move in cut flowers (PestID, 2016). However, countries that consider it a quarantine significant pest do not receive greater than 10 percent of the total U.S. export value of cut flowers based on mean data from 2011 to 2015 (mean = 6.5 percent) and no significant export trend ($\alpha = 0.05$) (PeExD, 2016; USITC, 2016). Based on this evidence, *T. palmi* does not meet the criteria for putting export markets at risk.
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	NA	NA	

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Criteria	Meets criteria? (Yes/No)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element D: Pest is likely to cause significant trade impacts	No	N/A	
Conclusion			
Is the pest likely to cause unacceptable consequences in the PRA area?	No	N/A	

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

3.2.16. *Xanthomonas campestris* pv. *viticola*

We determined the overall likelihood of introduction of *Xanthomonas campestris* pv. *viticola* to be Low. We present the results of this assessment in the table below.

We determined that establishment of *Xanthomonas campestris* pv. *viticola* 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 *Xanthomonas campestris* pv. *viticola*

Climatic suitability	*Xanthomonas campestris* pv. *viticola* occurs in Eastern Brazil and India (Chand et al., 1999; Trindade et al., 2005). There is also a report (thesis) of its occurrence in Thailand (Buensanteai, 2004). Based on that information, we estimate that this fungus could establish in areas of the United States corresponding to USDA Plant Hardiness Zones 10-11 (Magarey et al., 2008; PERAL, 2015).
Potential hosts at risk in PRA Area	*Vitis vinifera* is the only reported host for this pathovar (Chand and Kishun, 1990). This host is distributed in the northeast, California, the northwest, North Carolina, Texas, Georgia, and Florida (NRCS, 2016). The host would be available for the pest in suitable climatic conditions found in California and Florida and perhaps a small part of southern Texas (Magarey et al., 2008; PERAL, 2008, 2015).
Economically important hosts at risk[a]	Grapes are an economically important fruit crop in the United States (NASS, 2015a) where they are widely cultivated for wine production or fresh fruit consumption (Tordsen, 2015).
Pest potential on economically important hosts at risk	The bacterium causes leaf spotting that spreads to the canes and causes cankering and splitting; it also infects berries, causing dark spotting, reduced size, and shriveling (Chand and Kishun, 1990). In India, the bacterium caused 60-80 percent yield loss in severely infected vineyards (Chand and Kishun, 1990).
Defined Endangered Area	The endangered area for *Xanthomonas campestris* pv. *viticola* primarily includes the states of California and Florida (Plant Hardiness Zones 10-11), where grapes are grown.

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[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 *Xanthomonas campestris* pv. *viticola* into the endangered area via the importation of grapes from India

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	MC	This pest is primarily a leaf pathogen, but does cause lesions/cankers on berries and rachis (Chand et al., 1999; Trindade et al., 2007).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MC	The bacteria can be present in asymptomatic berries and would not be detected in post-harvest processing (Oliveira Tostes et al., 2014); however, if symptoms are expressed, berry lesions are brown to black and cankerous, and berries may become shriveled. These symptomatic berries may be detected within the bunch and removed during post-harvest processing. Based on this evidence, the rating for the previous risk element (A1) was decreased by one level from Medium to Low.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	MU	The grapes will be refrigerated at 0-2 °C (MOA-India, 2008). Cooler temperatures may reduce the growth rate of the bacteria, but are not anticipated to have a significant effect on survival. The risk rating remains the same.
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	

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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	Low	MC	Bacteria are spread passively by wind-driven rain, irrigation water, and injury of host plant tissues by insects and contaminated farm equipment/implements (Chand et al., 1999). *Vitis vinifera* is the only reported host for this pathogen (Chand and Kishun, 1990). The host would only be available for the pest in suitable climatic conditions found in California and Florida and perhaps a small part of southern Texas (Magarey et al., 2008; PERAL, 2015).
Risk Element B2: Likelihood of arriving in the endangered area	Low	C	USDA Plant Hardiness Zones 10-11 contain about 6.7 percent of the U.S. population, and it is estimated that fruit imported into the country will be distributed into areas where there are higher populations, thus the risk is reduced in relation to the population. (PERAL, 2015).
Risk Element B: Combined likelihood of establishment	Low	N/A	
Overall Likelihood of Introduction			
Combined likelihoods of entry and establishment	Low	N/A	

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

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Assessment of the consequences of introduction of *Xanthomonas campestris* pv. *viticola* into the continental United States

Criteria	Meets criteria? (Y/N)	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	Losses in India in 1986-87 reached an estimated 60-80 percent (Chand and Kishun, 1990). This pest is also one of the main phytosanitary issues for grape in Brazil (Almeida, 2013). Cultural methods and host resistance are used to manage the disease, whereas chemical control is not always effective (Chand et al., 1999). The current distribution of the pathogen is in warmer climatic areas corresponding to U.S. Plant Hardiness Zones 10-11 (Magarey et al., 2008; PERAL, 2015), and therefore not all grape production areas in the United States may be affected by this pathogen (NASS, 2015b). However, damage potential would likely be greater than 10 percent in at least one commercially cultivated host in the United States.

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element C2: Spread potential	Yes	U	The pathogen was first detected in India in 1969 and was not reported in any other country until 1988 (Brazil) and 2004 (Thailand) (Almeida, 2013; Buensanteai, 2004). Its introduction to Brazil was believed to be from the movement of contaminated stock of Red Globe grapes from India (Almeida, 2013). Silva et al. (2012) found that the bacteria were able to survive on infected grapevine tissue on soil surfaces for 80 days, but were destroyed after 10 days when plant material was composted. The bacteria passively move in water or infected plant material, and can have latent infections (Almeida, 2013; Chand et al., 1999); however, grape is the only known natural host for this pathogen. While there is spread potential for this species in the United States, there is uncertainty due to its slow spread elsewhere and restricted host range/climate availability in the 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	

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
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

3.2.17. *Nippoptilia vitis*, *Oxyptilus regulus*, and *Platyptilia ignifera*

We determined the overall likelihood of introduction of *N. vitis*, *O. regulus*, and *P. ignifera* to be Medium. We present the results of this assessment in the table below. Due to a lack of information and high uncertainty in regards to *P. ignifera* biology, we used information common to all Pterophoridae in some instances to complete the analysis, and combined the analyses of *N. vitis*, *O. regulus*, and *P. ignifera,* as the biology of the three pests is similar enough to draw broad conclusions.

We determined that establishment of *N. vitis*, *O. regulus*, or *P. ignifera* 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 *N. vitis, O. regulus,* and *P. ignifera*

Climatic suitability	*Nippoptilia vitis* is known from Japan, Korea, India, Taiwan, Thailand (Gielis, 2003), and China (Lu, 2012), where grapes are grown. *Oxyptilus regulus* is known from India (Gielis, 2003) and the Australian/Oceanian and Oriental faunal regions (Matthews and Lott, 2005), more specifically Northern Australia and Ceylon (Subramaniam, 1940). *Platyptilia ignifera* is known from Japan and India (Yano, 1963). These areas correspond to global plant hardiness zones 6-9 (*N. vitis*) and 10-13 (*O. regulus*) (Magarey et al., 2008). These species feed on grapes, but grapes are cultivated or grow wild in all of the continental United States, corresponding to global hardiness zones 5-11 (Magarey et al., 2008; NRCS, 2016).
Potential hosts at risk in PRA Area	*Nippoptilia vitis* feeds mainly on grape (Zhang, 1994), but also feeds on other species in the Vitaceae family (Kim et al., 2010). *Oxyptilus regulus* feeds mainly on *Vitis vinifera* (Matthews and Lott, 2005; Subramaniam, 1940) and is not known from other hosts. *Platyptilia ignifera* is only reported on *Vitis vinifera* (Yano, 1963).
Economically important hosts at risk[a]	Grapes are a major U.S. crop (CTGC, 2013).
Pest potential on economically	*Nippoptilia vitis* has been described as a pest of grapes (Kim et al., 2010), as have *O. regulus* (Subramaniam, 1940) and *P. ignifera* (Yano, 1963). *Nippoptilia vitis* and *O. regulus* are listed as pests of grape in the

important hosts at risk	most recent edition of The Grape Entomology (Mani et al., 2014), indicating that they are considered current pests of grapes. Spot application of buprofezin, deltamethrin, fenvalerate, and acetamiprid are effective against plume moths (Mani, 1992).
Defined Endangered Area	Areas of the United States where grape and other Vitaceae crops are grown in Zones 5-11 are at risk for 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 *N. vitis, O. regulus*, and *P. ignifera* into the endangered area via the importation of grapes from India

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	U	Larvae, eggs, or pupae are potentially associated with the commodity at the time of harvest. Eggs of *N. vitis* (Zheng et al., 1993), *O. regulus* (Subramaniam, 1940), and *Platyptilia spp.* (Lange, 1950) are laid singly at the base of fruit buds and larvae bore into and feed on ripening fruits. Pupae attach to stems or fruit which may drop (Lange, 1950; Subramaniam, 1940). Grapes are allowed to fully ripen on the vine (see section 1.4.2).
Risk Element A2: Likelihood of surviving post-harvest processing before shipment	Low	MU	Hand-harvesting and grading (see section 1.4.3) are likely to remove most damaged grapes from the pathway. Infested fruit is easily detected and often drops from the vine. Pupae and damaged fruit are easily visible (Subramaniam, 1940; Zheng et al., 1993; Lange, 1950). As a result, we reduced the rating by one level to low.
Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment	Low	U	Grapes are stored at 0-2 °C until shipment (see section 1.4.4); however, the cold tolerance of plume moths is unknown, so we did not change the rating of the element.

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Risk Element	Risk Rating	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element A: Overall risk rating for likelihood of entry	Low	N/A	
Likelihood of Establishment			
Risk Element B1: Likelihood of coming into contact with host material in the endangered area	Medium	MU	Suitable hosts are not continuously distributed throughout the endangered area. These species only feed on species in the family Vitaceae (Kim et al., 2010; Matthews and Lott, 2005; Subramaniam, 1940; Yano, 1963).
Risk Element B2: Likelihood of arriving in the endangered area	High	MU	Greater 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 *N. vitis*, *O. regulus*, and *P. ignifera* into the continental United States (i.e., the PRA area)

Criteria	Meets criteria? (Y/N)	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	No	U	Grapes are listed as a host of *Nippoptilia vitis*, *O. regulus*, and *P. ignifera* (Mani et al., 2014; Yano, 1963). We found no information that these insects would cause damage that would result in 10 percent or greater yield losses in grapes.
Risk Element C2: Spread potential	N/A	N/A	
Risk Element C: Pest introduction is likely to cause unacceptable direct impacts	No	N/A	
Trade Impacts			

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Criteria	Meets criteria? (Y/N)	Uncertainty Rating[a]	Justification for rating and explanation of uncertainty (and other notes as necessary)
Risk Element D1: Export markets at risk	Yes	MC	The top four U.S. export markets for grapes are Canada, Hong Kong, Australia, and Indonesia, but the United States also exports to the United Kingdom and New Zealand (FAOSTAT, 2013).
Risk Element D2: Likelihood of trading partners imposing additional phytosanitary requirements	Yes	MU	*Nippoptilia vitis* is known from Japan, Korea, India, Taiwan, Thailand (Gielis, 2003), and China (Lu, 2012). *Oxyptilus regulus* is known from India (Gielis, 2003) and the Australian/Oceanian and Oriental faunal regions (Matthews and Lott, 2005), more specifically Northern Australia and Ceylon (Subramaniam, 1940). *Platyptilia ignifera* is known from Japan and India (Yano, 1963). In a risk assessment, New Zealand proposed importation from a pest free place of production or methyl bromide fumigation as mitigations for *N. vitis* (MAF Biosecurity New Zealand, 2009). If these pests were to become established in the United States, it is likely that similar measures would be required.
Risk Element D: Pest is likely to cause significant trade impacts	Yes	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

4. Summary and Conclusions of Risk Assessment

Of the organisms associated with grapes worldwide and present in India, we identified those 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

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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.

Of the pests selected for further analysis, we determined that those identified in Table 3 are *not* candidates for risk management, either because no portion of the continental United States is likely to be endangered by them, they are unlikely to cause unacceptable consequences of introduction, 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 3.

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 4.

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 3. 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]**
Icerya seychellarum	Does not meet unacceptable consequences of introduction threshold	
Maconellicoccus hirsutus	Likelihood of establishment in areas not already present is negligible	
Platyptilia ignifera	Establishment in the continental United States is unlikely to cause unacceptable impacts	
Pseudococcus cryptus	Likelihood of introduction is negligible	
Rastrococcus iceryoides	Likelihood of introduction is negligible	
Retithrips syriacus	Does not meet unacceptable consequences of introduction threshold	
Rhipiphorothrips cruentatus	Likelihood of introduction is negligible	
Thrips palmi	Does not meet unacceptable consequences of introduction threshold	

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

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Table 4. 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]
Bactrocera correcta	Medium	
Bactrocera dorsalis	Medium	
Conogethes punctiferalis	Medium	
Cryptoblabes gnidiella	Medium	
Helicoverpa armigera	Medium	
Nippoptilia vitis	Medium	
Oxyptilus regulus	Medium	
Platyptilia ignifera	Meduim	
Scirtothrips dorsalis	High	*Scirtothrips dorsalis* is present in part of the endangered area. However, impacts would be greater if the pest were to arrive into additional areas where grapes are produced and lower in areas where the pest is established.
Spodoptera litura	Medium	
Stathmopoda auriferella	Medium	
Tenuipalpus granati	Medium	
Monilinia fructigena	Medium	*Monilinia fructigena* may not cause any unacceptable direct economic impacts in the United States because this species is not as economically damaging as *M. fructicola*, which is already widely distributed throughout the United States (Byrde, 1977; Jones and Aldwinckle, 1990), and *M. fructigena* can be controlled by the same fungicides that are already used to control apple and pear scab (Jones and Aldwinckle, 1990). However, *M. fructigena* is regulated by Canada (CFIA, 2014), so U.S. exports could be subjected to additional phytosanitary regulations if *M. fructigena* were to become established in the United States.

Pest	Likelihood of Introduction overall rating	Uncertainty statement (optional)[a]
Xanthomonas campestris pv. *viticola*	Low	There is uncertainty about the spread potential in the continental United States due to a narrow host range and whether the pathogen would be limited to the warmest parts of the continental United States (Plant Hardiness Zones 10-11).

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

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7. Appendix: Pests with non-actionable regulatory status

We found some evidence of the below listed organisms being associated with grapes and being present in India. 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 grapes or their presence in India. 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 India.

Below we list these organisms along with the references supporting their potential association with grapes, their potential presence in India, 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.

Pest	Distribution	Host association
ARTHROPODS		
Acari: Eriophyidae		
Calepitrimerus vitis Nalepa	IN (Rather, 2008), US (Pimentel, 2007)	Bournier, 1976; CABI, 2016; Rather, 2008
Colomerus vitis (Pagenstecher) [Syn: *Eriophyes vitis* (Pagenstecher)]	IN (Prasad, 1974; Rather, 2008), US (CABI, 2016)	Hill, 1983; Prasad, 1974; Rather, 2008
Acari: Tarsonemidae		
Polyphagotarsonemus latus Banks	IN, US (CABI, 2016)	CABI, 2016
Acari: Tenuipalpidae		
Brevipalpus californicus Banks	IN (CABI, 2016; Rather, 2008), US (CABI, 2016)	CABI, 2016; Childers et al., 2003; Hill, 1983; Rather, 2008
Brevipalpus lewisi McGregor	IN (Dhooria et al., 2005), US (CABI, 2016)	Bournier, 1976; Pimentel, 2007
Brevipalpus obovatus Donnadieu	IN (CABI, 2016; Rather, 2008), US (CABI, 2016)	Childers et al., 2003; Rather, 2008
Brevipalpus phoenicis Geijskes	IN (CABI, 2016; Rather, 2008), US (CABI, 2016)	Childers et al., 2003; Dhooria and Sandhu, 1975; Rather, 2008
Acari: Tetranychidae		
Bryobia praetiosa Koch	IN, US (Bolland et al., 1998)	Bolland et al., 1998
Bryobia rubrioculus (Scheuten)	IN, US (Bolland et al., 1998)	Bolland et al., 1998
Eotetranychus pruni (Oudemans)	IN (Rather, 2008), US (Jeppson et al., 1975)	Rather, 2008
Eotetranychus sexmaculatus (Riley)	IN, US (Bolland et al., 1998)	Bolland et al., 1998; Jeppson et al., 1975
Eotetranychus uncatus Garman	IN, US (Bolland et al., 1998)	Bolland et al., 1998

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Pest	Distribution	Host association
Oligonychus coffeae (Nietner)	IN, US (Bolland et al., 1998; CABI, 2016)	Bolland et al., 1998; CABI, 2016
Oligonychus punicae (Hirst)	IN (Nair, 1975; Prasad, 1974; Rather, 2008), US (Bolland et al., 1998)	Bolland et al., 1998; Nair, 1975; Prasad, 1974; Rather, 2008
Panonychus citri McGregor	IN, US (Bolland et al., 1998; CABI, 2016)	Bolland et al., 1998; CABI, 2016
Panonychus ulmi Koch	IN (Bolland et al., 1998; Rather, 2008), US (Bolland et al., 1998; CABI, 2016)	Bolland et al., 1998; CABI, 2016; Rather, 2008
Petrobia latens (Müller)	IN, US (Bolland et al., 1998)	Bolland et al., 1998
Tetranychina harti (Ewing) (Syn: *Petrobia harti*)	IN, US (Bolland et al., 1998)	Bolland et al., 1998
Tetranychus cinnabarinus (Boisduval)	IN (Prasad, 1974; Rather, 2008), US (CABI, 2016)	CABI, 2016; Prasad, 1974; Rather, 2008
Tetranychus kanzawai Kishida	IN (Bolland et al., 1998; Rather, 2008), US (Bolland et al., 1998)	Bolland et al., 1998; Rather, 2008
Tetranychus ludeni Zacher	IN, US (Bolland et al., 1998)	Bolland et al., 1998
Tetranychus neocaledonicus André	IN (Bolland et al., 1998; Prasad, 1974; Rather, 2008), US (Bolland et al., 1998)	Bolland et al., 1998; Prasad, 1974; Rather, 2008
Tetranychus urticae Koch	IN (Bolland et al., 1998; Rather, 2008), US (CABI, 2016)	Bolland et al., 1998; Hill, 1983; Rather, 2008
Coleoptera: Bostrichidae		
Rhizopertha dominica Fabricius	IN (Matthews and Lott, 2005), US (Potter, 1935)	Matthews and Lott, 2005
Xylopsocus capucinus Fabricius	IN, US (Woodruff et al., 1978)	Woodruff et al., 1978
Coleoptera: Nitidulidae		
Carpophilus dimidiatus Fabricius	IN, US (CABI, 2016)	Avidov and Harpaz, 1969
Carpophilus humeralis (Fabricius)	IN, US (CABI, 2016)	CABI, 2016
Coleoptera: Scolytidae		
Hypothenemus birmanus (Eichhoff)	IN, US (Wood, 1992)	Wood, 1992
Hypothenemus hampei (Ferrari)	IN (CABI, 2016); US (PestID, 2016)	Maes, 2004
Xyleborus dispar (Fabricius)	IN (Wood and Bright, 1992), US (CABI, 2016)	Wood and Bright, 1992
Xylosandrus compactus (Eichhoff)	IN (CABI, 2016), US (Wood, 1982)	Wood, 1982

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Pest	Distribution	Host association
Xylosandrus crassiusculus (Motschulsky) (Syn: *Xyleborus semiopacus* Eich.)	IN (CABI, 2016; Hill, 1983), US (Atkinson et al., 2007)	Hill, 1983
Coleoptera: Silvanidae		
Oryzaephilus surinamensis Linnaeus	IN (Matthews and Lott, 2005), US (CABI, 2016)	Matthews and Lott, 2005
Coleoptera: Tenebrionidae		
Tribolium castaneum (Herbst)	IN (Matthews and Lott, 2005), US (CABI, 2016)	Matthews and Lott, 2005
Diptera: Drosophilidae		
Drosophila melanogaster Meigen	IN (CABI, 2016; Gupta and Ray-Chaudhuri, 1970), US (CABI, 2016)	CABI, 2016
Drosophila suzukii (Matsumura)	IN (Gupta and Ray-Chaudhuri, 1970; Steck et al., 2009), US (Steck et al., 2009)	Shiraki, 1952b; Steck et al., 2009
Hemiptera: Aleyrodidae		
Bemisia tabaci (B biotype) (Gennadius) (Syn: *B. argentifolii*)	IN, US (McAuslane, 2009)	Pimentel, 2007; Rodríguez et al., 2005
Singhiella citrifolii (Morgan)	IN (Evans, 2008), US (Nguyen et al., 2007)	Evans, 2008
Singhius hibisci (Kotinsky)	IN, US (Evans, 2008)	Evans, 2008; Hua, 2000
Trialeurodes vaporariorum (Westwood)	IN, US (Hua, 2000; Mound and Halsey, 1978)	Hua, 2000; Mound and Halsey, 1978
Hemiptera: Aphididae		
Aphis fabae Scopoli	IN, US (CABI, 2016)	CABI, 2016
Aphis gossypii Glover	IN (CABI, 2016; Hill, 1983), US (CABI, 2016)	CABI, 2016; Hill, 1983
Aphis spiraecola Patch	IN, US (CABI, 2016)	CABI, 2016
Macrosiphum euphorbiae Thomas	IN, US (CABI, 2016)	CABI, 2016
Hemiptera: Asterolecaniidae		
Russellaspis pustulans pustulans (Cockerell)	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009
Hemiptera: Coccidae		
Ceroplastes sinensis Del Guercio	IN, US (EPPO, n.d..)	Gentry, 1965
Coccus hesperidum hesperidum Linnaeus	IN, US (Ben-Dov et al., 2009)	Avidov and Harpaz, 1969; Ben-Dov et al., 2009; Maes, 2004
Coccus longulus (Douglas) (Syn: *Lecanium longulum* Dougl.)	IN (Hua, 2000; Nair, 1975; Varshney, 1992)US (PestID, 2016	Hua, 2000; Nair, 1975; Varshney, 1992

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Pest	Distribution	Host association
Coccus viridis (Green)	IN, US (FL, HI) (CABI, 2016)	Maes, 2004
Eulecanium tiliae (Linnaeus)	IN, US (Ben-Dov et al., 2009; CABI, 2016)	Ben-Dov et al., 2009; CABI, 2016
Parasaissetia nigra (Nietner)	IN (CABI, 2016; Hill, 1983), US (CABI, 2016)	CABI, 2016; Hill, 1983
Parthenolecanium corni (Bouché)	IN, US (CABI, 2016)	CABI, 2016; Hill, 1983
Parthenolecanium persicae (Fabricius)	IN, US (Ben-Dov, 1993; CABI, 2016)	Ben-Dov, 1993; CABI, 2016; Hill, 1983
Pulvinaria vitis (Linnaeus)	IN (Sharma and Sharma, 1993), US (Ben-Dov et al., 2009)	Bournier, 1976; Pimentel, 2007
Saissetia coffeae (Walker)	IN, US (CABI, 2016)	CABI, 2016
Saissetia oleae oleae (Olivier)	IN (Ben-Dov et al., 2009; Hill, 1983), US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Hill, 1983
Hemiptera: Coreidae		
Leptoglossus gonagra (Fabricius)	IN (CABI, 2016), US (Schaefer and Panizzi, 2000)	Maes, 2004
Hemiptera: Diaspididae		
Aonidiella aurantii (Maskell)	IN (Atwal, 1976), US (Ben-Dov et al., 2009)	Annecke and Moran, 1982; Atwal, 1976
Aonidiella orientalis Newstead	IN (Suresh and Mohanasundaram, 1996), US (CABI, 2016)	CABI, 2016
Aspidiotus destructor Signoret (Syn: *A. transparens* Green)	IN (Nair, 1975; Suresh and Mohanasundaram, 1996), US (CABI, 2016)	CABI, 2016; Maes, 2004; Nair, 1975
Aspidiotus nerii Bouché	IN (Suresh and Mohanasundaram, 1996), US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Koch and Waterhouse, 2000
Chionaspis salicis Linnaeus	IN (Ben-Dov et al., 2009; Watson, 2005), US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Watson, 2005
Chrysomphalus aonidum Linnaeus	IN (Ben-Dov et al., 2009; Nair, 1975), US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Nair, 1975
Chrysomphalus dictyospermi (Morgan)	IN, US (CABI, 2016)	CABI, 2016
Diaspidiotus perniciosus (Comstock) (Syn: *Quadraspidiotus perniciosus* Comstock)	IN, US (CABI, 2016)	Annecke and Moran, 1982; CABI, 2016
Diaspis boisduvalii Signoret	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009

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Pest	Distribution	Host association
Duplaspidiotus tesseratus (Grandpré & Charmoy)	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009
Hemiberlesia cyanophylli (Signoret)	IN, US (Watson, 2005)	Watson, 2005
Hemiberlesia lataniae (Signoret) (Syn: *Aspidiotus cydoniae* Comst., *A. lataniae* Sign.)	IN (Nair, 1975; NHB, 2009), US (CABI, 2016)	Nair, 1975; NHB, 2009
Hemiberlesia rapax (Comstock)	IN, US (Watson, 2005)	Koch and Waterhouse, 2000; Watson, 2005
Lepidosaphes beckii (Newman)	IN, US (Watson, 2005)	Watson, 2005
Lepidosaphes gloverii (Packard)	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Hua, 2000
Lepidosaphes ulmi (Linnaeus)	IN, US (Watson, 2005)	Watson, 2005
Lindingaspis rossi (Maskell)	IN, US (Ben-Dov et al., 2009; Watson, 2005)	Ben-Dov et al., 2009; Hua, 2000
Lopholeucaspis japonica (Cockerell)	IN, US (Ben-Dov et al., 2009; Watson, 2005)	Ben-Dov et al., 2009; Watson, 2005
Mycetaspis personata (Comstock)	IN, US (Watson, 2005)	Watson, 2005
Oceanaspidiotus spinosus (Comstock)	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009
Parlatoria camelliae Comstock	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Hua, 2000
Parlatoria oleae (Colvée)	IN, US (Ben-Dov et al., 2009; Watson, 2005)	Ben-Dov et al., 2009; Watson, 2005
Parlatoria pergandii Comstock	IN (Nair, 1975), US (CABI, 2016)	Nair, 1975
Parlatoria proteus (Curtis)	IN, US (Ben-Dov et al., 2009; Watson, 2005)	Ben-Dov et al., 2009; Watson, 2005
Pinnaspis strachani (Cooley)	IN, US (Ben-Dov et al., 2009; CABI, 2016)	Ben-Dov et al., 2009; CABI, 2016
Pseudaonidia duplex (Cockerell)	IN, US (Watson, 2005)	Hua, 2000; Watson, 2005
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886) MacGillivray, 1921	IN, US (CABI, 2016)	CABI, 2016; Watson, 2005
Selenaspidus articulatus (Morgan)	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Maes, 2004
Hemiptera: Lygaeidae		
Nysius niger Baker	IN (CABI, 2016), US (Schaefer and Panizzi, 2000)	CABI, 2016
Nysius raphanus Howard	IN (Thangavelu, 1978), US (Demirel and Cranshaw, 2006)	Pimentel, 2007

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Pest	Distribution	Host association
Hemiptera: Margarodidae		
Icerya purchasi purchasi Maskell	IN, US (Ben-Dov et al., 2009)	Ben-Dov et al., 2009; Shiraki, 1952a
Hemiptera: Pentatomidae		
Halyomorpha halys (Stal)	IN (Hua, 2000), US (CABI, 2016)	Hua, 2000
Nezara viridula (Linnaeus)	IN, US (CABI, 2016)	Avidov and Harpaz, 1969; Koch and Waterhouse, 2000
Hemiptera: Phylloxeridae		
Viteus vitifoliae (Fitch)	IN, US (CABI, 2016)	Annecke and Moran, 1982; CABI, 2016; Hill, 1983
Hemiptera: Pseudococcidae		
Dysmicoccus brevipes (Cockerell)	IN (Varshney, 1992), US (CABI, 2016)	Varshney, 1992
Ferrisia virgata Cockerell	IN (CABI, 2016; Hill, 1983), US (CABI, 2016)	CABI, 2016; Varshney, 1992
Nipaecoccus nipae (Maskell)	IN, US (Ben-Dov, 1994)	Ben-Dov, 1994; Gentry, 1965; Hua, 2000
Planococcus citri (Risso)	IN, US (CABI, 2016)	Bournier, 1976; CABI, 2016; Pimentel, 2007
Planococcus ficus (Signoret)	IN (Ben-Dov, 1994), US (Ben-Dov et al., 2009)	Annecke and Moran, 1982; Bournier, 1976; Walton et al., 2009
Planococcus minor (Maskell)	IN (CABI, 2016; Peña et al., 2002), US Stocks and Roda, 2011)	CABI, 2016
Pseudococcus comstocki (Kuwana)	IN (Hua, 2000), US (CABI, 2016)	Hua, 2000; Shiraki, 1952b
Pseudococcus longispinus Targioni Tozzetti	IN, US (CABI, 2016)	Annecke and Moran, 1982; CABI, 2016; Walton et al., 2009
Lepidoptera: Gelechiidae		
Sitotroga cerealella Olivier	IN (Matthews and Lott, 2005), US (CABI, 2016)	Matthews and Lott, 2005
Lepidoptera: Noctuidae		
Agrotis ipsilon Hufnagel	IN, US (CABI, 2016)	CABI, 2016; Ebeling, 1959
Anomis flava Fabricius	IN (Ades and Kendrick, 2004), US (Opler et al., 2010)	Hattori, 1969
Noctua pronuba Linnaeus (Syn: *Triphaena pronuba* Linnaeus)	IN, US (Pogue, 2006)	Avidov and Harpaz, 1969; Carter, 1984
Spodoptera exigua (Hübner) (Syn: *Laphygma exigua* Hb.)	IN (Carter, 1984; Nair, 1975), US (Carter, 1984)	Avidov and Harpaz, 1969; Carter, 1984; Nair, 1975
Trichoplusia ni (Hübner)	IN, US (CABI, 2016)	Maes, 2004

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Pest	Distribution	Host association
Xestia c-nigrum (Linnaeus)	IN, US (CABI, 2016; Zhang, 1994)	CABI, 2016; Hill, 1983
Lepidoptera: Nymphalidae		
Cynthia cardui Linnaeus (Syn: *Vanessa cardui* Linnaeus)	IN (Kunte, 2005), US (CABI, 2016)	Avidov and Harpaz, 1969
Lepidoptera: Pyralidae		
Cadra calidella Guenée (Syn: *Ephestia calidella* Guenée)	IN (Gupta and Sharma, 2004)	Carter, 1984
Cadra cautella Walker (Syn: *Ephestia cautella* Walker)	IN (Matthews and Lott, 2005), US (CABI, 2016)	Carter, 1984; Matthews and Lott, 2005
Plodia interpunctella (Hübner)	IN, US (CABI, 2016)	Carter, 1984; Maes, 2004
Orthoptera: Gryllotalpidae		
Gryllotalpa gryllotalpa (Linnaeus)	IN, US (CABI, 2016)	CABI, 2016
Thysanoptera: Phlaeothripidae		
Karnyothrips flavipes (Jones)	IN (Verghese and Harish, 2010), US (Hoddle et al., 2012)	Verghese and Harish, 2010
Xylaplothrips sp.	IN (Verghese and Harish, 2010), US (PestID, 2016)	Verghese and Harish, 2010
Thysanoptera: Thripidae		
Heliothrips haemorrhoidalis Bouché	IN, US (CABI, 2016)	Bournier, 1976; Koch and Waterhouse, 2000; Maes, 2004
Selenothrips rubrocinctus (Giard)	IN, US (CABI, 2016)	CABI, 2016
Thrips hawaiiensis (Morgan)	IN, US (CABI, 2016)	CABI, 2016
Thrips tabaci Lindeman	IN, US (CABI, 2016)	CABI, 2016; Lewis, 1997
NEMATODES		
Helicotylenchus dihystera (Cobb) Sher	IN, US (USDA-ARS, 2010; CABI, 2016)	CABI, 2016
Helicotylenchus multicinctus (Cobb) Golden	IN, US (USDA-ARS, 2010; CABI, 2016)	CABI, 2016
Helicotylenchus pseudorobustus (Steiner) Golden	IN, US (USDA-ARS, 2010; CABI, 2016)	CABI, 2016
Longidorus elongatus (de Man) Thorne & Swanger	IN (CABI, 2016; CABI/EPPO, 2002a; Siddiqi et al., 1962), US (USDA-ARS, 2010)	CABI, 2016; Pearson and Goheen, 1988

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Pest	Distribution	Host association
Meloidogyne arenaria (Neal) Chitwood	IN, US (USDA-ARS, 2010; CABI/EPPO, 2003c)	Pearson and Goheen, 1988
Meloidogyne hapla Chitwood	IN (Rangaswami and Mahadevan, 2006), US (USDA-ARS, 2010)	CABI, 2016; Pearson and Goheen, 1988
Meloidogyne incognita (Kofoid & White) Chitwood	IN, US (CABI, 2016)	Pearson and Goheen, 1988
Meloidogyne javanica (Treub) Chitwood	IN, US (CABI, 2016)	Pearson and Goheen, 1988
Paratrichodorus porosus (Allen) Sidd.	IN (CABI, 2016; CABI/EPPO, 2009), US (USDA-ARS, 2010; CABI/EPPO, 2009)	CABI, 2016
Pratylenchus brachyurus (Godfrey) Filipjev & Schuurmans Stekhoven	IN, US (CABI, 2016)	Pearson and Goheen, 1988
Pratylenchus penetrans (Cobb) Filipjev & Schuurmans Stekhoven	IN (CABI, 2016; CABI/EPPO, 2003b), US (USDA-ARS, 2010)	CABI, 2016
Pratylenchus thornei Sher & Allen	IN, US (USDA-ARS, 2010; CABI, 2016)	CABI, 2016
Pratylenchus vulnus Allen & Jenson	IN, US (USDA-ARS, 2010; CABI, 2016)	Pearson and Goheen, 1988
Rotylenchulus reniformis Linford & Oliveira	IN (USDA-ARS, 2010; CABI, 2016), US (USDA-ARS, 2010; Wang, 2001)	CABI, 2016
Scutellonema brachyurus (Steiner) Andrassy	IN, US (CABI, 2016; CABI/EPPO, 2006)	CABI, 2016
Tylenchulus semipenetrans Cobb.	IN (CABI, 2016; CABI/EPPO, 1999), US (USDA-ARS, 2010; NGDC, 1984)	Pearson and Goheen, 1988
Xiphinema americanum Cobb.	IN (CABI, 2016), US (USDA-ARS, 2010)	Pearson and Goheen, 1988
Xiphinema index Thorne & Allen	IN (CABI, 2016; CABI/EPPO, 2000), US (USDA-ARS, 2010; NGDC, 1984)	Pearson and Goheen, 1988
FUNGI AND CHROMISTANS[32]		
Alternaria alternata (Fr. : Fr.) Keissl.	IN (Bilgrami et al., 1981; MOA-India, 2008; NRC,	Bilgrami et al., 1981

[32] Fungi are listed by current accepted name (primarily Farr and Rossman, 2015 or CABI, 2016). If the fungus is reported in India under a name other than the current accepted name, we bolded that name.

Pest	Distribution	Host association
	2008), US (Farr and Rossman, 2015; UGA, 2012b)	
Alternaria longipes (Ellis & Everh.) E. Mason	IN (Bilgrami et al., 1981), US (USDA, 1960)	Bilgrami et al., 1981
Alternaria radicina Meier, Drechsler & E.D. Eddy [Syn: ***Pseudostemphylium radicinum*** (Meier, Drechsler & E.D. Eddy) Subram.]	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Armillaria mellea (Vahl:Fr.) P. Kumm.	IN (Bilgrami et al., 1981; CABI, 2016), US (UGA, 2012b)	Pearson and Goheen, 1988
Armillaria tabescens (Scop.) Emel	IN (Farr and Rossman, 2015), US (Farr and Rossman, 2015)	Farr and Rossman, 2015
Aspergillus aculeatus Iizuka	IN (Farr and Rossman, 2015); Listed as Non-reportable for the US (PestID, 2016	Pearson and Goheen, 1988
Aspergillus carbonarius (Bainier) Thom	IN (Bilgrami et al., 1981), US (CA) (Rooney-Latham et al., 2008)	Bilgrami et al., 1981
Aspergillus nidulans (Eidam) G. Winter	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Aspergillus niger Tiegh.	IN (Bilgrami et al., 1981; MOA-India, 2008), US (Farr and Rossman, 2015; UGA, 2012b; USDA, 1960)	Bilgrami et al., 1981
Botryosphaeria dothidea (Moug.: Fr.) Ces. & De Not. [Synanamorph: ***Macrophoma flaccida*** (Viala & Ravax) Cavara (Denman et al., 2000; Phillips, 1998; Phillips, 2007)]	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; Pearson and Goheen, 1988)	Bilgrami et al., 1981
Botryosphaeria obtusa (Schwein.) Shoemaker [Syn: *Physalospora obtusa* (Schwein.) Cooke]	IN (CABI, 2016), US (CABI, 2016; UGA, 2012b; Úrbez-Torres et al., 2006)	Farr and Rossman, 2015; Úrbez-Torres et al., 2006
Botryosphaeria ribis Gross. & Duggar	IN (Bilgrami et al., 1981), US (UGA, 2012b; Pearson and Goheen, 1988)	Bilgrami et al., 1981
Botryosphaeria stevensii Shoemaker	IN (Farr and Rossman, 2015), US (Farr, 2015; Úrbez-Torres et al., 2006)	Pearson and Goheen, 1988; Úrbez-Torres et al., 2006

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Pest	Distribution	Host association
*Botryotinia fuckeliana (*de Bary) Whetzel (Anamorph: *Botrytis cinerea* Pers.:Fr)	IN (CABI, 2016; Sarbhoy et al., 1975; MOA-India, 2008), US (UGA, 2012b)	Pearson and Goheen, 1988; Singh et al., 1999
Chaetomium arcuatum J.N. Rai & J.P. Tewari	IN (Bilgrami et al., 1981)	Bilgrami et al., 1981
Chaetomium convolutum Chivers	IN (Bilgrami et al., 1981), US (KS) (Farr and Rossman, 2015)	Bilgrami et al., 1981
Cladosporium cladosporioides (Fresen.) G.A. De Vries	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Cladosporium oxysporum Berk. & M.A. Curtis	IN (Sarbhoy et al., 1975), US (Farr and Rossman, 2015)	Sarbhoy et al., 1975
Cladosporium tenuissimum Cooke	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Cochliobolus lunatus R.R. Nelson & Haasis	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Cochliobolus pallescens (Tsuda & Ueyama) Sivan. (Syn: ***Curvularia pallescens*** Boedijn)	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Coniella diplodiella (Speg.) Petr. & Syd. [Syn: *Coniothyrium diplodiella* (Speg.) Petra & Syd, *Phoma diplodiella* Speg.]	IN (Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006; MOA-India, 2008), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Curvularia aeria (Bat., J.A. Lima & C.T. Vasconc.) Tsuda [Syn: ***C. lunata* var. *aeria*** (Bat., I.H. Lima & Vasconc.) M.B. Ellis]	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Davidiella tassiana (De Not.) Crous & U. Braun [Anamorph: ***Cladosporium herbarum*** (Pers. : Fr.) Link]	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; UGA, 2012b; USDA, 1960)	Bilgrami et al., 1981
Diaporthe viticola Nitschke[33] [Syn: *D. rudis* (Fr. : Fr.) Nitschke; *D. medusaea* Nitschke]	IN (Bilgrami et al., 1979; Rangaswami and Mahadevan, 2006), US (Farr and Rossman, 2015)	Rangaswami and Mahadevan, 2006

[33] Species of *Diaporthe* are typically linked to *Phomopsis* anamorphs (Hanlin, 1990), and this species of *Diaporthe* may link to *P. viticola*, which is also reported in India (on grape), but uncertainly exists about these linkages (Uecker, 1988; van Niekerk et al., 2005; Santos et al., 2010). Therefore, we treated them separately here.

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Pest	Distribution	Host association
Diplodia viticola Desmaz.	IN (Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006), US (Pearson and Goheen, 1988; USDA, 1960)	Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006
Elsinoë ampelina Shear; [Anamorph: *Sphaceloma ampelinum* De Bary; *Gloeosporium ampelophagum* (Pass.) Sacc.]	IN (Bilgrami et al., 1981; Singh et al., 1999; Suhag et al., 1982; MOA-India, 2008), US (Pearson and Goheen, 1988; UGA, 2012b)	Bilgrami et al., 1981; Singh et al., 1999
Erysiphe necator var. *necator* Schwein. [Syn: ***Uncinula necator*** (Schwein.) Burrill]	IN (Bilgrami et al., 1981; MOA-India, 2008; NRC, 2008), US (Farr and Rossman, 2015; Pearson and Goheen, 1988; USDA, 1960)	Bilgrami et al., 1981; Singh et al., 1999
Eutypella aequilinearis (Schwein. : Fr.) Starbäck [Syn: ***Eutypella vitis*** (Schwein. : Fr.) Ellis & Everh.]	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Fusarium oxysporum Schlechtend : Fr.	IN (CABI, 2016; MOA-India, 2008), US (UGA, 2012b)	MOA-India, 2008
Gibberella intricans Wollenw. [Anamorph: *Fusarium equiseti* (Corda) Sacc.]	IN (MOA-India, 2008), US (UGA, 2012b; USDA, 1960)	MOA-India, 2008; Farr and Rossman, 2015
Glomerella acutata Guerber & J.C. Correll (Anamorph: *Colletotrichum acutatum* J. H. Simmonds)	IN (CABI/EPPO, 2003a; MOA-India, 2008), US (UGA, 2012b)	Steel et al., 2006
Glomerella cingulata (Stoneman) Spauld. & H. Schrenk [Syn: *Gloeosporium rufomaculans* Berk. & Thum. (CABI, 2010)]	IN (Bilgrami et al., 1981), US (Pearson and Goheen, 1988)	Bilgrami et al., 1981
Greeneria uvicola (Berk. & M.A. Curtis) Punith. (Syn: ***Greenaria fuliginosa*** Scribn. & Viala)	IN (Bilgrami et al., 1981), US (Alfieri et al., 1984; Farr and Rossman, 2015)	Bilgrami et al., 1981
Guignardia bidwellii (Ellis) Viala & Ravaz	IN (Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006; MOA-India, 2008; Singh et al., 1999), US (Pearson and Goheen, 1988; UGA, 2012b)	Bilgrami et al., 1981; Pearson and Goheen, 1988; Rangaswami and Mahadevan, 2006; Singh et al., 1999

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Pest	Distribution	Host association
Haematonectria haematococca (Berk. & Broome) Samuels & Rossman [Syn: *Nectria haematococca* Berk. & Broome, Anamorph: ***Fusarium solani*** (Mart.) Sacc]	IN (Bilgrami et al., 1981), US (UGA, 2012b)	Bilgrami et al., 1981
Helminthosporium rostratum (Drechs.)	IN (Bilgrami et al., 1981; Suhag et al., 1982), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981; Suhag et al., 1982
Lasiodiplodia theobromae (Pat.) Griffon & Maubl. [Syn: ***Botryodiplodia theobromae*** Pat.]	IN (Bilgrami et al., 1981; MOA-India, 2008), US (Farr and Rossman, 2015; CABI, 2016; UGA, 2012b)	Bilgrami et al., 1981; CABI, 2016
Lewia infectoria (Fuckel) M.E. Barr & E.G. Simmons [Syn: ***Pleospora infectoria*** Fuckel, Anamorph: *Alternaria infectoria* E.G. Simmons]	IN (Bilgrami et al., 1981; Farr and Rossman, 2015), US (USDA, 1960)	Bilgrami et al., 1981
Mucor circinelloides Tiegh.	IN (Bilgrami et al., 1979; MOA-India, 2008; CABI, 2016), US (Farr and Rossman, 2015)	CABI, 2016
Mycosphaerella personata Higgins [Anamorph: ***Pseudocercospora vitis*** (Lév.) Speg., Synanamorph: ***Cercospora viticola*** (Ces.) Sacc.]	IN (Bilgrami et al., 1981; Mehta and Yadav, 1987; Rangaswami and Mahadevan, 2006; Singh et al., 1999), US (Farr and Rossman, 2015; UGA, 2012b; USDA, 1960)	Bilgrami et al., 1981; Mehta and Yadav, 1987; Rangaswami and Mahadevan, 2006; Singh et al., 1999
Neoscytalidium dimidiatum (Penz.) Crous & Slippers (Syn: ***Hendersonula toruloidea*** Nattrass; *Exosporina fawcettii* E.E. Wilson)	IN (Bilgrami et al., 1981; Sarbhoy et al., 1975), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981; Sarbhoy et al., 1975
Penicillium chrysogenum Thom[34]	IN (Bilgrami et al., 1981; MOA-India, 2008), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Penicillium expansum Link	IN (Bilgrami et al., 1979; CABI, 2016; MOA-India, 2008), US (UGA, 2012b)	CABI, 2016; Crous et al., 2000

[34] Spelling was "*chrysogenus*" in Bilgrami et al., 1981.

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Pest	Distribution	Host association
Pestalotia menezesiana Bres. & Torr.	IN (Bilgrami et al., 1981), US (Alfieri et al., 1984; Farr and Rossman, 2015)	Bilgrami et al., 1981
Pestalotia uvicola Speg.	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; USDA, 1960)	Bilgrami et al., 1981
Pestalotiopsis mangiferae (Henn.) Steyaert (Syn: *Pestalotia mangiferae* Henn.)	IN (Bilgrami et al., 1979; MOA-India, 2008), US (USDA, 1960)	MOA-India, 2008; Mordue, 1968
Phakopsora euvitis Y. Ono [35]	IN (CABI, 2016; CABI/EPPO, 2007; MOA-India, 2008), US (CABI, 2016; CABI/EPPO, 2007; Ono, 2000)	CABI, 2016; Ono, 2000
Phellinus noxius (Corner) G. Cunn.	IN (Ann et al., 2002)	Ann et al., 2002
Phoma glomerata (Corda) Wollenw. & Hochapfel	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Phoma macrostoma Mont.	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Phomopsis viticola (Sacc.) Sacc.	IN (CABI, 2016; Lal and Arya, 1982; NRC, 2008; MOA-India, 2008), US (UGA, 2012b)	Pearson and Goheen, 1988; Singh et al., 1999
Phytophthora cinnamomi Rands	IN (Rangaswami et al., 1970), US (UGA, 2012b)	Rangaswami et al., 1970
Phytophthora nicotianae Breda de Haan [Syn: ***P. nicotianae* var. *parasitica*** (Dastur) G.M. Waterhouse]	IN (Bilgrami et al., 1981), US (Erwin and Ribeiro, 1996)	Bilgrami et al., 1981
Plasmopara viticola (Berk. & M.A. Curtis) Berl & De Toni in Sacc.	IN (Bilgrami et al., 1981; MOA-India, 2008; NRC, 2008; Singh et al., 1999), US (UGA, 2012b)	Bilgrami et al., 1981; Singh et al., 1999
Pleospora tarda E. Simmons [Anamorph: ***Stemphylium botryosum*** Wallr.]	IN, US (Farr and Rossman, 2015)	Pearson and Goheen, 1988

[35] Based on Ono (2000), for this species' entry we included references of *Phakopsora vitis* on grape from India (e.g., Rangaswami and Mahadevan, 2006) as well as *Angiospora ampelopsidis* (Dietel & P. Syd.) Thirum. & Kern, Synonym: *Phakopsora ampelopsidis* Dietel & P. Syd. (Bilgrami et al., 1981; Rangaswami et al., 1970; Chand et al., 1999).

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Pest	Distribution	Host association
Pleurotus ostreatus (Jacq. : Fr.) P. Kumm.	IN (MOA-India, 2008), US (USDA, 1960; Vail et al., 1995)	MOA-India, 2008; Vail et al., 1995
Poria barbaeformis Berk. & Curt. [Syn: *P. papyracea* (Schwein.) Cooke (Lowe, 1963)]	IN (Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006), US (Lowe, 1963)	Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006
Pythium debaryanum R. Hesse	IN, US (Farr and Rossman, 2015)	CABI, 2016; Farr and Rossman, 2015
Pythium irregulare Buisman	IN (CABI, 2016; Farr and Rossman, 2015), US (UGA, 2012b)	Farr and Rossman, 2015
Pythium sylvaticum W.A. Campb. & J.W. Hendrix (Syn: ***Pythium debaryanum* var. *viticola*** Jain[36])	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Rhizopus arrhizus A. Fischer	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015; UGA, 2012b)	Bilgrami et al., 1981; Pearson and Goheen, 1988
Rhizopus stolonifer (Ehrenb.) Vuill.	IN (CABI, 2016; Rangaswami and Mahadevan, 2006; MOA-India, 2008), US (UGA, 2012b)	Pearson and Goheen, 1988
Rosellinia necatrix Prill.	IN (Bilgrami et al., 1981; Rangaswami and Mahadevan, 2006), US (Pearson and Goheen, 1988; USDA, 1960)	Bilgrami et al., 1981; Pearson and Goheen, 1988; Rangaswami and Mahadevan, 2006
Sclerotinia sclerotiorum (Lib.) de Bary	IN (Farr and Rossman, 2015), US (Farr and Rossman, 2015; UGA, 2012b)	Hall et al., 2002
Sclerotium rolfsii Sacc.	IN; US (Farr and Rossman, 2015)	Farr and Rossman, 2015
Trichothecium roseum (Pers. : Fr.) Link	IN (CABI, 2016; MOA-India, 2008), US (Farr and Rossman, 2015; USDA, 1960)	CABI, 2016; MOA-India, 2008
Valsaria insitiva (Tode) Ces. & De Not. [Syn: ***Diatrype viticola*** Schwein. ex Berk.(Ju et al., 1996)]	IN (Bilgrami et al., 1981), US (Farr and Rossman, 2015)	Bilgrami et al., 1981
Verticillium dahliae Klebahn	IN (CABI, 2016; Rangaswami and Mahadevan, 2006; MOA-	Pearson and Goheen, 1988

[36] Spelled "*Pythium debaryanum* var. *viticolum*" in Bilgrami Jamaluddin and Rizwi (1981). Hendrix and Campbell (1974) moved this subspecies to a new species, *P. sylvaticum*, which is cosmopolitan (and present in the United States) (Farr and Rossman, 2015).

Pest	Distribution	Host association
	India, 2008), US (UGA, 2012b)	
BACTERIA AND PHYTOPLASMAS		
Aster yellows phytoplasma group	IN (CABI, 2016; MOA-India, 2008); US (CABI, 2016)	MOA-India, 2008
Bacillus subtilis (Ehrenberg) Cohn	IN (CABI, 2016; MOA-India, 2008), US (CABI, 2016)	MOA-India, 2008
Pantoea agglomerans (Ewing & Fife) Gavini	IN (CABI, 2016; MOA-India, 2008), US (CABI, 2016; UGA, 2012a)	CABI, 2016
Pseudomonas fluorescens (Trevisan) Migula	IN (CABI, 2016; MOA-India, 2008), US (CABI, 2016)	MOA-India, 2008
Pseudomonas syringae pv. *syringae* van Hall	IN (CABI, 2016; MOA-India, 2008), US (UGA, 2012a)	CABI, 2016
Pseudomonas syringae pv. *viticola* [37]	IN (Rangaswami and Mahadevan, 2006), US (CABI, 2016)	Rangaswami and Mahadevan, 2006; CABI, 2016
Rhizobium radiobacter (Beijerinck & van Delden) Young [Syn: *Agrobacterium tumefaciens* (Smith & Townsend) Conn]	IN (CABI, 2016), US (Pearson and Goheen, 1988; UGA, 2012a	CABI, 2016; Pearson and Goheen, 1988
VIRUSES AND VIROIDS		
Alfalfa mosaic virus (AMV)	IN (CABI, 2016; MOA-India, 2008), US (Brunt et al., 1996 onwards; UGA, 2012c)	CABI, 2016; Pearson and Goheen, 1988
Broad bean wilt virus (BBWV)	IN (CABI, 2016; MOA-India, 2008), US (CABI, 2016; Hall, 1991)	CABI, 2016; Pearson and Goheen, 1988
Citrus exocortis viroid (CEVd)	IN (CABI, 2016; MOA-India, 2008), US (Adaskaveg, 2008; Horst, 2008; UGA, 2012c)	CABI, 2016; Eiras et al., 2006
Cucumber mosaic virus (CMV)	IN (CABI, 2016; MOA-India, 2008), US (UGA, 2012c)	CABI, 2016
Grapevine fanleaf virus (GFLV)	IN (Singh et al., 1999); US (CABI, 2016; Mekuria et al., 2008; UGA, 2012c)	Singh et al., 1999
Grapevine leafroll virus (GLRV)	IN (Singh et al., 1999), US (Martinson et al., 2008;	Pearson and Goheen, 1988; Singh et al., 1999

[37] As written in Rangaswami and Mahadevan (2006), this is not an accepted bacterial name. *Pseudomonas syringae* has been reported on *Vitis,* but not as a distinct pathovar. Accordingly, we treated it at the species level.

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Pest	Distribution	Host association
	Pearson and Goheen, 1988; UGA, 2012c)	
Tobacco necrosis virus (TNV)	IN (CABI, 2016; MOA-India, 2008), US (CABI, 2016)	CABI, 2016; Pearson and Goheen, 1988
Tobacco ringspot virus (TRSV)	IN (CABI, 2016; MOA-India, 2008), US (Pearson and Goheen, 1988; UGA, 2012c)	CABI, 2016; Pearson and Goheen, 1988; Singh et al., 1999
Tomato spotted wilt virus (TSWV)	IN (CABI, 2016; MOA-India, 2008), US (UGA, 2012c)	CABI, 2016

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