



Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE

Importation of *Carica papaya* (papaya) fruit from Costa Rica into the United States for consumption

A Qualitative, Pathway Initiated Pest Risk Assessment

Version 4

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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 papaya, *Carica papaya* (Caricaceae), for consumption from Costa Rica into the United States. Based on the market access request submitted by the National Plant Protection Organization (NPPO) of Costa Rica, we considered the pathway to include the following processes and conditions: papaya fruit at less than half-ripe level of ripeness or maturity that is produced, harvested, and packed in accordance with the applicable provisions in 7 CFR § 319.56. The risk ratings in this risk assessment are contingent upon the application of all components of the pathway as described in this document. Papaya fruit produced under different conditions was not evaluated in this PRA and may have a different pest risk.

Based on the scientific literature, port-of-entry pest interception data, and information from the government of Costa Rica, we developed a pest list which included all potential pests with actionable regulatory status for the United States and Territories that are known to occur in Costa Rica (on any host) and to be associated with *Carica papaya* (anywhere in the world). Of these, none had a reasonable likelihood of being associated with papaya fruit following harvest and prior to any post-harvest processing and thus is potentially able to follow the pathway.

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1. Introduction

1.1. Background

This document was prepared by the Plant Pest Risk Analysis unit of 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 papaya fruit (*Carica papaya* L.) for consumption from Costa Rica into the United States¹.

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 *Guidelines for Plant Pest Risk Assessment of Imported Fruit and Vegetable Commodities* (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, 2016b). The use of biological and phytosanitary terms is consistent with ISPM No. 5, “Glossary of Phytosanitary Terms” (IPPC, 2016a).

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

1.2. Initiating event

The importation of fruits and vegetables for consumption into the United States is regulated under Title 7 of the Code of Federal Regulations, Part 319.56. Under this regulation, authorized fruits and vegetables and their import requirements are comprehensively listed on the internet at <https://epermits.aphis.usda.gov/manual> (USDA-FAVIR, 2020). Currently, Costa Rica is authorized to export papaya ‘Solo’ cultivars into the continental United States, Puerto Rico and the U.S. Virgin Islands but only from the provinces of Guanacaste, Puntarenas, and San Jose. Papayas from these provinces must be accompanied by a phytosanitary certificate declaring that the papayas in the consignment were grown, packed, and shipped in accordance with the provisions of 7 CFR 319.56. This commodity risk assessment was initiated due to a request by the National Plant Protection Organization (NPPO) of Costa Rica to expand the importation of papayas to allow entry of all varieties or cultivars from all areas in Costa Rica into all ports of the United States (Ferguson, 2017; Gonzalez, 2016).

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

A weed risk assessment is not needed for *Carica papaya* fruit because it is already enterable into the United States (USDA-FAVIR, 2020).

1.4. Description of the pathway

A pathway is “any means that allows the entry or spread of a pest” (IPPC, 2016b). In the context of this risk assessment, the pathway is the commodity to be imported, together with all the

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

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 commercially-produced fresh fruit of *Carica papaya* L. (papaya) for consumption from Costa Rica into the United States and Territories; 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 and processes that the commodity will undergo from production in Costa Rica through importation and distribution in the United States and Territories. These conditions provided the basis for creating the pest list and assessing the likelihood of introduction of the pests selected for further analysis. Hence, the risk ratings in this risk assessment are contingent upon the application of all components of the pathway as described.

1.4.1. Description of the commodity

The commodity to be imported is fresh papaya fruit, *Carica papaya*, with a small portion of the peduncle attached.

1.4.2. Production and harvest procedures in the exporting area

The papayas will be grown by a grower registered with the NPPO of Costa Rica. Fruit fly traps will be placed in the field where the papayas are grown at least one year prior to harvest and will be maintained through the completion of harvest. The traps will be placed at a density of one trap per hectare and will be checked for fruit flies at least once weekly by plant health officials of the NPPO. Fifty percent of the traps will be of the McPhail type and 50 percent will be of the Jackson type (7 CFR §319.56-25, 2020; USDA-FAVIR, 2020).

At least 30 days before harvest begins and continuing through the completion of harvest, all papaya trees in the field will be kept free of papayas that are one-half ripe or more, and all culled and fallen fruit will be buried, destroyed, or removed from the farm at least twice a week (7 CFR §319.56-25, 2020; USDA-FAVIR, 2020).

When packed, the papayas are to be less than one-half ripe (the shell surface is no more than one-fourth yellow, surrounded by light green), and appear to be free of all injurious insect pests (USDA-FAVIR, 2020).

1.4.3. Post-harvest procedures in the exporting area

The only post-harvest procedures in the exporting area that will be considered is minimal washing (Ferguson, 2017).

1.4.4. Shipping and storage conditions

Shipping and storage conditions have not been specified.

2. Pest List and Pest Categorization

The pest list is a compilation of all plant pests with actionable regulatory status for the United States and territories that are present in Costa Rica (on any host) and associated with *Carica papaya* (anywhere in the world). Species on the pest list with a reasonable likelihood of being present on papaya at the time of harvest could follow the pathway into the United States and territories and are therefore assessed 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

Papaya as a host for *Anastrepha* spp. and *Ceratitis capitata* in general. Mature green and color-break papayas are conditional non-hosts of several *Anastrepha* spp. and *C. capitata* (USDA-APHIS, 2019). The inability of *A. fraterculus*, *A. ludens*, *A. obliqua*, *A. serpentina*, *A. striata*, and *C. capitata* to infest mature green and color-break papayas may be attributed to the natural resistance provided by benzyl isothiocyanate. Isothiocyanate compounds are secondary metabolites that provide plants with chemical defenses against herbivores (Pesticide Research Institute, 2014). Benzyl isothiocyanate is abundant in the pulp and seeds of papayas (Tang, 1971). Seo and Tang (1982) observed that mature green and color-break papayas produce benzyl isothiocyanate at concentrations that are toxic to eggs and larvae of fruit flies. In addition to the toxic effects of benzyl isothiocyanate, the results of Seo et al. (1983) suggest that it also deters oviposition by female fruit flies. Data from Seo and Tang (1982) and Seo et al. (1983) may explain the results obtained by Lara and Marin (1990) and Malavasi et al. (1995), which provide direct evidence that mature green and color-break papayas are conditional non-hosts to *Anastrepha* spp. and *C. capitata*. The resistance of mature green and color-break papayas to *Anastrepha* spp. and *C. capitata* due to the toxicity and ovipositional deterrence of benzyl isothiocyanate is not expected to vary by variety. Thus, the systems approach approved by APHIS-PPQ to mitigate fruit flies in ‘Solo’ papayas grown in Central America, Brazil, Colombia, Ecuador or Peru (USDA-FAVIR, 2020) may apply to all varieties of papaya.

***Anastrepha curvicauda* (Gerstaecker).** Norrbom (2019) and Pantoja et al. (2002) documented the presence of *A. curvicauda* in Costa Rica. Selman et al. (2019) reported the occurrence of *A. curvicauda* in the United States, with established populations in southern Texas, southern Florida, and Puerto Rico.

Anastrepha curvicauda prefers to lay eggs in immature fruit (Landolt and Hendrichs, 1983; Landolt and Reed, 1990; Pantoja and Peña, 2006; Peña et al., 1986a,b) where larvae feed primarily on the coating of seeds rather than on the mesocarp of the fruit (Landolt and Reed, 1990; Knab and Yothers, 1914; Peña et al., 1986b, Weems, 1981). The green, immature papaya fruits infested with *A. curvicauda* prematurely turn yellow and subsequently drop on the ground (Selman et al., 2019). The APHIS-approved systems approach protocol (USDA-FAVIR, 2020) requires that at least 30 days before harvest and continuing through the completion of harvest, all trees in the NPPO certified orchards must be free of one-half or more ripe papayas, and all culled and fallen fruits are buried, destroyed, or removed from the orchards at least twice a week. The stringent sanitation requirements assure that all infested fruits on trees and the ground are

destroyed, and the developing larvae are killed and prevented from metamorphosing into adults.

Anastrepha curvicauda in papaya requires no action except when fruits are destined to Hawaii (PestID, 2020). Interceptions of *A. curvicauda* in commercially produced papaya are rare with three interception records from permitted cargo (all originating from Mexico; PestID 2020), where APHIS has an “inspect and release” regulation for papayas from Mexico (USDA-FAVIR, 2020). There have been no interceptions on permitted cargo from Costa Rica. Because of the efficacy of the systems approach, we did not include *A. curvicauda* on the pest list.

***Anastrepha fraterculus* Weidemann.** Jiron and Hedström (1988) and Hernández-Ortiz (1992) documented the presence of *A. fraterculus* in Costa Rica. Putruele (1996) reported infestation of papaya (level of ripeness not described) by *A. fraterculus* under natural field conditions in Argentina. Malavasi et al. (1995) and dos Santos Felix Melo et al. (2012) reported *A. fraterculus* infestation of ripe papayas in Brazil. Lara and Marin (1990) showed that *A. fraterculus* infested fully ripe but not mature green to three-quarter ripe ‘Solo’ papayas under forced-cage experimental field conditions in Costa Rica. Based on forced-cage infestation experiments conducted on ‘Solo’ papaya orchards in Brazil, Malavasi et al. (1995) reported that *A. fraterculus* did not infest mature green to three-quarter ripe papayas. PestID (2020) has no interception records of *A. fraterculus* in papaya. While ripe papayas are suitable rearing hosts in the laboratory and may be utilized as hosts in the field, mature green and color-break papayas are conditional non-hosts of *A. fraterculus* in accordance with the FAO (2016) and NAPPO (2008) guidelines. We did not include *A. fraterculus* on the pest list.

***Anastrepha littoralis* (Blanchard).** Very little is known about this pest beyond the taxonomic description by Blanchard (1959). There is no validated record of field infestation of papaya by *T. littoralis* (Norrbon, 2019). Because of the absence of any evidence of commercial papaya as a pathway for *T. littoralis*, we did not include it on the pest list.

***Anastrepha ludens* Loew (Diptera: Tephritidae).** Foote (1967) documented the occurrence of *A. ludens* in Costa Rica. The only record of field infestation of *A. ludens* in papaya (level of ripeness not described) was from fruit samples collected in Guatemala (Eskafi and Cunningham, 1987). Forced field cage infestation conducted by Arredondo et al. (2014) in Mexico showed that *A. ludens* did not infest ‘Maradol’ papaya fruits at the commercial level of ripeness (i.e., “green with one or two yellow stripes”). PestID (2020) has no interception records of *A. ludens* in papaya. The USDA list of established regulated articles for *A. ludens* does not include papaya, and the USDA does not regulate papaya as a suitable host of *A. ludens* (USDA-APHIS, 2016a). We did not include *A. ludens* on the pest list.

***Anastrepha obliqua* Macquart (Diptera: Tephritidae).** Jiron and Hedström (1988) reported the presence of *A. obliqua* in Costa Rica. There are no records of field infestation of *A. obliqua* in papaya (Liquido et al., 2020). Nascimento et al. (2000) documented infestation of ‘Sunrise’ papayas by *A. obliqua* under laboratory conditions. Lara and Marin (1990) showed infestation of *A. obliqua* in fully ripe but not mature green to three-quarter ripe ‘Solo’ papayas under forced-cage experimental field conditions in Costa Rica. PestID (2020) has no interception records of *A. obliqua* in papaya. The USDA list of established regulated articles for *A. obliqua* does not

include papaya, and the USDA does not regulate papaya as a suitable host of *A. obliqua* (USDA-APHIS, 2016b). We did not include *A. obliqua* on the pest list.

***Anastrepha serpentina* Wiedemann (Diptera: Tephritidae).** Jiron and Hedström (1988) documented the presence of *A. serpentina* in Costa Rica. We found no records of field infestation of *A. serpentina* in papaya. Lara and Marin (1990) showed that under forced-cage field conditions, *A. serpentina* did not infest mature green to half-ripe ‘Solo’ papayas in Costa Rica. PestID (2020) has no interception records of *A. serpentina* in papaya. Based on the attributes of a natural, suitable host as defined in the FAO (2016) and NAPPO (2008) guidelines, papaya is not a host of *A. serpentina*. We did not include *A. serpentina* on the pest list.

***Anastrepha striata* Schiner (Diptera: Tephritidae).** Jiron and Hedström (1988) documented the presence of *A. striata* in Costa Rica. Chinchilla and Ujueta (2002) listed papaya as a host of *A. striata* but did not include any field or laboratory evidence. Vayssières et al. (2013) reported field infestation of papaya (without documentation of variety and level of ripeness) by *A. striata*. Lara and Marin (1990) showed that under forced, field-cage conditions, *A. striata* does not infest ‘Solo’ papayas at any level of ripeness in Costa Rica. PestID (2020) has no interception record of *A. striata* in papaya. Based on current scientific evidence, mature green and color-break papayas are conditional non-hosts of *A. striata* (USDA-APHIS, 2019). We did not include *A. striata* on the pest list.

***Ceratitis capitata* Wiedemann (Diptera: Tephritidae).** The suitability of ripe papaya as a host of *C. capitata* is well documented (Liquido et al., 2019; USDA-APHIS, 2019). Lara and Marin (1990) observed that mature green to half-ripe ‘Solo’ papayas were not infested by *C. capitata* under forced-cage field conditions in Costa Rica. In similar forced-cage infestation studies in Brazil, Malavasi et al. (1995) showed that *C. capitata* only infested ripe fruits. Extensive field surveys conducted in commercial orchards in Hawaii found no *C. capitata* infestation in ‘Kapoho Solo’ (Liquido and Cunningham, 1990; Liquido et al., 1989), ‘Sunrise Solo’ (Liquido, 1991a) or ‘Waimanalo Solo’ (Liquido, 1991b) at any level of ripeness. The USDA interception records of *C. capitata* from 1925 through 2019 are summarized in MEDHOST, Version 3.8 (Liquido et al., 2019). MEDHOST has summaries of 25 documented interceptions of *C. capitata* in papayas: 12 from the United States (Hawaii), nine of uncertain origin, and one each from Bermuda (erroneous record; *C. capitata* is not in Bermuda), Jordan, Nigeria, and Spain. The interception records had no descriptions of fruit ripeness. Based on current evidence and in accordance with the FAO (2016) and NAPPO (2008) guidelines, mature green and color-break papayas are conditional non-hosts of *C. capitata*. We did not include *C. capitata* on the pest list.

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

The following arthropods were considered but not included on the pest list due to weak evidence associating these pests with papaya fruit.

***Cyrtomenus bergi* Froeschner (Hemiptera: Cydnidae).** This is a reportable pest, and PestID (2020) recorded a single adult interception of *C. bergi* in papaya permit cargo (i.e., not on the fruit) from Costa Rica. Chinchilla and Ujueta (2002) and McGuire and Crandall (1967) documented the presence of *C. bergi* as a pest of rice in Costa Rica. This pest is primarily a root

feeder (Bellotti et al., 2012; Ochoa, 1989b) and has not been associated with papaya under natural field conditions. Therefore, we did not include *C. bergi* on the pest list.

***Paragonatas costaricensis* (Distant) (Hemiptera: Rhyparochromidae).** This is a reportable pest, and PestID (2020) recorded a single adult interception of *P. costaricensis* in papaya permit cargo (i.e., not on the fruit) from Costa Rica. Slater and Baranowski (1990) documented the occurrence of *P. costaricensis* in Costa Rica and Florida. Putatively a seed feeder, this pest has not been associated with papaya under natural field conditions. Therefore, we did not include *P. costaricensis* on the pest list.

The following plant viruses were considered but not included on the pest list due to weak evidence associating these pests with papaya fruit.

***Begomovirus Melon chlorotic leaf curl virus Costa Rica* (MCLCuV-CR).** This virus is not listed in PestID (2020). We found only one record of MCLCuV-CR infecting papaya leaves in Costa Rica (Brown et al., 2011). The similar virus MCLCuV-GT infected 70 percent of cantaloupe plants in Guatemala in 2000. For MCLCuV-CR, however, we found no information on potential vectors or host range.

***Begomovirus Squash yellow mottle virus* proposed.** This virus is not listed in PestID (2020), and it is not recognized by the International Committee of Taxonomy of Viruses. We found only one record of this virus infecting papaya in Costa Rica and no information on potential vectors, host range, or damage (Karkashian et al., 2002).

The presence of *Stagonosporopsis caricae* (Sydow & P. Sydow) Aveskamp, Gruyter & Verkley syn. *Mycosphaerella caricae* Sydow & P. Sydow (Ascomycetes: Incertae sedis) in Costa Rica is questionable.

***Stagonosporopsis caricae* (Sydow & P. Sydow) Aveskamp, Gruyter & Verkley.** This fungus is actionable and reportable at ports of entry in Puerto Rico and the U.S. Virgin Islands (PestID, 2020) and occurs in California, Florida, Hawaii and Michigan (Farr and Rossman, 2018). However, the evidence for the presence of this fungus in Costa Rica is weak. There is one report from the 1960s that mentions this fungus being present in Costa Rica (McGuire and Crandall, 1967). However, we could find no additional evidence that this species occurs in Costa Rica. Further, the most recent report documenting fungi that occurs in Costa Rica does not include *S. caricae* (Granados-Montero et al., 2018). *Phoma caricae-papayae* is listed as present (Granados-Montero et al., 2018) and *S. caricae* may be a teleomorph for this fungus. However, the teleomorph connection remains debated (Cline, 2005).

2.1.2. Organisms with non-actionable regulatory status

We found evidence of the organisms listed in the Appendix being associated with papaya and being present in Costa Rica; however, because these organisms have non-actionable regulatory status for United States and Territories, 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, 2016b), as we focus assessments on organisms for which biological information is available. Therefore, we generally do not assess risk for organisms identified only to the genus level, particularly if the genus in question is reported in the import area. Many genera contain several species, and we cannot know if the unidentified species occurs in the import area and, consequently, whether it has actionable regulatory status for the import area. On the other hand, if the genus in question is absent from the import area, any unidentified organisms in the genus can have actionable status; however, because such an organism has not been fully identified, we cannot properly assess the likelihood and consequences of its introduction.

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

For this risk assessment, we identified two fungi and two arthropods identified only to the genus level that are reported on *Carica papaya* in Costa Rica or have been intercepted on papaya in permit cargo from Costa Rica (PestID, 2020):

Fungi: *Cercospora* sp. (Ascomycetes: Mycosphaerellales) and *Fusarium* sp. (Ascomycetes: Hypocreales) (Farr and Rossman, 2018).

Arthropods: *Listronotus* sp. (Coleoptera: Curculionidae) and *Blapstinus* sp. (Coleoptera: Tenebrionidae). They were likely hitchhikers, as species of these genera are not pests of papaya (CABI, 2020; Davis, 1970; Maes and O'Brien, 1990).

2.2. Pest list

In Table 1, we list the actionable pests associated with papaya that occur in Costa Rica. The list comprises those actionable pests that occur in Costa Rica on any host and that are associated with papaya whether in Costa Rica 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 Costa Rica. 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 the information on pests in a separate table (Table 2).

Table 1. Actionable pests associated with *Carica papaya* (in any country) and present in Costa Rica (on any host).

Pest name	Evidence of presence in Costa Rica (CR)	Association with papaya ²	Plant part(s) association ³	On harvested plant part(s)? ⁴	Remarks
MITE: Tarsonemidae <i>Tarsonemus minutus</i> (Attiah)	Ochoa et al., 1991	Ochoa et al., 1991	Leaf (Tseng and Lo, 1980)	No	Present in Virginia, Washington, District of Columbia, and Puerto Rico (Tseng and Lo, 1980).
MITE: Tetranychidae <i>Oligonychus gossypii</i> Zacher	Aguilar and Murillo, 2008	Bolland et al., 1998	Leaf (Bolland et al., 1998)	No	Present in the continental United States (Bolland et al., 1998) and Hawaii (CABI, 2020).
MITE: Tuckerellidae <i>Tuckerella knorri</i> Baker & Tuttle	Ochoa, 1989a	Zhang and Hong, 2010	Leaf (Ochoa, 1989a)	No	Ochoa (1989a) reported that <i>T. knorri</i> feeds on fruit of <i>Citrus</i> spp. in Costa Rica.
INSECT: Coleoptera: Chrysomelidae <i>Diabrotica speciosa</i> Germar	CABI, 2020	Walsh, 2003	Flower, fruit, leaf, and root (CABI, 2020; Walsh, 2003)	No	See Section 2.3. Present in continental United States; states not specified (Guo et al., 2011).

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* (PPQ, 2012).

³ The plant parts listed are those for the plant species under analysis. If the information has been extrapolated, such as from plant part association on other plant species, we note that.

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).

Pest name	Evidence of presence in Costa Rica (CR)	Association with papaya ²	Plant part(s) association ³	On harvested plant part(s)? ⁴	Remarks
INSECT: Coleoptera: Curculionidae <i>Diaprepes abbreviatus</i> Linnaeus	CABI, 2020; Chinchilla and Ujueta, 2002	Pantoja et al., 2002	Leaf and root (Pantoja et al., 2002; Pantoja and Peña, 2006)	No	Present in California, Texas (NAPIS, 2018), Florida, and Puerto Rico (Cherry et al., 2011; Pantoja et al., 2002; Weissling et al., 2004).
INSECT: Coleoptera: Curculionidae <i>Hypothenemus eruditus</i> Westwood	Wood, 1982	Pérez-De La Cruz et al., 2009	Branch and twig (Wood, 1982)	No	Present in California, Texas, New Jersey (Wood, 1982), and Hawaii (Nishida, 2002).
INSECT: Coleoptera: Curculionidae <i>Rhabdoscelus obscurus</i> Boisduval, syn.: <i>Rhabdocnemis obscura</i> Boisduval	EPPO, 2019	Napometh et al., 1972; Pantoja and Peña, 2006; Pantoja et al., 2002	Leaf (Pantoja and Peña, 2006; Pantoja et al., 2002) and stem (CABI, 2020)	No	Present in the continental United States; states not specified (CABI, 2020). Present in Hawaii (Bianchi and Owen, 1965; Giblin-Davis et al., 2000; Heu, 2007), Guam (Bianchi and Owen, 1965), and American Samoa (CABI, 2020; EPPO, 2019).
INSECT: Coleoptera: Curculionidae <i>Rhynchophorus palmarum</i> Linnaeus	Chinchilla and Ujueta, 2002; EPPO, 2019	McGuire and Crandall, 1967	Flower, leaf, and stem (CABI, 2020; Sullivan et al., 2013)	No	Present in Arizona, southern Texas (NAPPO, 2015), California, and Puerto Rico (EPPO, 2019; Maes and O'Brien, 1990).

Pest name	Evidence of presence in Costa Rica (CR)	Association with papaya ²	Plant part(s) association ³	On harvested plant part(s)? ⁴	Remarks
INSECT: Coleoptera: Dryophthoridae <i>Metamasius hemipterus</i> L. syn.: <i>M. sericeus</i> Olivier	EPPO, 2019; Anderson, 2002	Pantoja and Peña, 2006; Pantoja et al., 2002; Rogg, 2000	Root (Pantoja and Peña, 2006; Pantoja et al., 2002)	No	Actionable only if the commodity is destined to Hawaii (PestID, 2020). Present in Florida, Puerto Rico (Giblin-Davis et al., 1994; Sudhaus et al., 2011), and the U.S. Virgin Islands (EPPO, 2018).
INSECT: Coleoptera: Dryophthoridae <i>Metamasius hemipterus sericeus</i> Olivier	Chinchilla and Ujueta, 2002; Giblin-Davis et al., 1994; Maes and O'Brien, 1990; McGuire and Crandall, 1967	Giblin-Davis and Peña, 1993; Giblin-Davis et al., 1994	Leaf, stem, and ripe fruit (Giblin-Davis and Peña, 1993; Giblin-Davis et al., 1994)	No	See Section 2.3. Actionable only if the commodity is destined to Hawaii (PestID, 2020). Present in Florida and Puerto Rico (Giblin-Davis et al., 1994; Giblin-Davis and Peña, 1993).
INSECT: Diptera Lonchaeidae <i>Neosilba glaberrima</i> Wiedemann	Anonymous, 2017a, b	Yepes and Velez, 1989	Fruit (White and Elson-Harris, 1992)	No	See Section 2.3.
INSECT: Hemiptera: Aleyrodidae <i>Aleurocanthus woglumi</i> Ashby	Chinchilla and Ujueta, 2002; Evans, 2008	Evans, 2008; Pantoja and Peña, 2006	Leaf and stem (CABI, 2020)	No	Present in Arizona, California, Florida, Hawaii, Michigan, Puerto Rico, Texas, and the U.S. Virgin Islands (Evans, 2007).

Pest name	Evidence of presence in Costa Rica (CR)	Association with papaya ²	Plant part(s) association ³	On harvested plant part(s)? ⁴	Remarks
INSECT: Hemiptera: Aphididae <i>Toxoptera citricida</i> Kirkaldy, syn.: <i>T. citricidus</i> Kirkaldy	Chinchilla and Ujueta, 2002; Mejías et al., 2010	Blackman and Eastop, 2000	Leaf (shoot) (Michaud, 1999)	No	Present in Florida, Puerto Rico (Michaud, 1999), Hawaii (Heu, 2007; Nishida, 2002), the U.S. Virgin Islands (Stoetzel, 1994), Guam, and the Northern Mariana Islands (Miller et al., 2014).
INSECT: Hemiptera: Cercopidae <i>Tomaspis inca</i> Guérin-Méneville	McGuire and Crandall, 1967	McGuire and Crandall, 1967	Leaf and stem (Crews et al., 1998)	No	
INSECT: Hemiptera: Cicadellidae <i>Empoasca papayae</i> Oman	McGuire and Crandall, 1967	McGuire and Crandall, 1967; Morton, 1987	Leaf (Pantoja and Peña, 2006)	No	Present in Puerto Rico (Morton, 1987).
INSECT: Hemiptera: Membracidae <i>Aconophora femoralis</i> Stal.	Chinchilla and Ujueta, 2002	Chinchilla and Ujueta, 2002; McGuire and Crandall, 1967	Leaf sheath and stem (Dietrich, 2002)	No	
INSECT: Hemiptera: Membracidae <i>Aconophora nitidae</i> Fowler	Chinchilla and Ujueta, 2002	Chinchilla and Ujueta, 2002	Leaf sheath and stem (Dietrich, 2002)	No	
INSECT: Hemiptera: Membracidae <i>Aconophora projecta</i> (Funkl.)	Chinchilla and Ujueta, 2002	Chinchilla and Ujueta, 2002; McGuire and Crandall, 1967	Leaf sheath and stem (Dietrich, 2002)	No	

Pest name	Evidence of presence in Costa Rica (CR)	Association with papaya ²	Plant part(s) association ³	On harvested plant part(s)? ⁴	Remarks
INSECT: Hemiptera: Pseudococcidae <i>Maconellicoccus hirsutus</i> Green	CABI, 2020	García Morales et al., 2016; Sagarra and Peterkin, 1999	Leaf, shoot, and young stem (Sagarra and Peterkin, 1999)	No	Present in California (Roltsch, 2001), Florida (Amalin et al., 2009), Georgia (Hoy et al., 2006), Hawaii (Heu, 2007; Nishida, 2002), Louisiana, North Carolina, South Carolina, Texas (Weeks et al., 2012), Puerto Rico, the U.S. Virgin Islands (García Morales et al., 2016; Hoy et al., 2006), Guam, and the Northern Mariana Islands (Reddy et al., 2009).
INSECT: Hymenoptera: Formicidae <i>Atta sexdens</i> Linnaeus	Weber, 1969; Chinchilla and Ujueta, 2002; McGuire and Crandall, 1967	Marín Acosta, 1969	Leaf (CABI, 2020)	No	
INSECT: Lepidoptera: Nymphalidae <i>Lycorea cleobaea</i> (Godart)	Dyer and Gentry, 2002; Maurer et al., n.d.	Maurer et al., n.d.; Robinson et al., 2010; Vane-Wright and Ackery, 1992	Leaf (Maurer et al., n.d.; Vane-Wright and Ackery, 1992)	No	See Section 2.3. Present in Florida and Puerto Rico (Calhoun, 1997; Vane-Wright and Ackery, 1992).
INSECT: Thysanoptera: Thripidae <i>Corynothrips stenopterus</i> Williams	Chinchilla and Ujueta, 2002; Sakimura, 1986	Chinchilla and Ujueta, 2002	Leaf (Bellotti et al., 2012; Saunders et al., 1998)	No	Present in Puerto Rico (Sakimura, 1986).

Pest name	Evidence of presence in Costa Rica (CR)	Association with papaya ²	Plant part(s) association ³	On harvested plant part(s)? ⁴	Remarks
NEMATODE <i>Hemicriconemoides mangiferae</i> Siddiqi (Criconematidae)	CABI, 2020	Saeed and Ghaffar, 1979	Root and soil (Saeed and Ghaffar, 1979)	No	Action required when destined to Hawaii, Puerto Rico, and the U.S. Virgin Islands (PestID, 2020). Present in California and Florida (CABI, 2020).
BACTERIUM <i>Rickettsia</i> sp. (papaya bunchy top)	Davis et al., 1996; Davis et al., 1977	Luis-Pantoja et al., 2015	Whole plant (Davis et al., 1996)	Yes	Present in Florida and Puerto Rico. Evidence indicates that <i>Empoasca papayae</i> is a potential vector of <i>Rickettsia</i> sp. in papaya (Acosta et al., 2013). Papaya fruit, however, would be a dead-end pathway for this pathogen because <i>E. papayae</i> is a leaf hopper that feeds on leaves, not on the fruit (Pantoja and Peña, 2006).

2.3. Notes on pests identified in the pest list

Diabrotica speciosa larvae are root feeders, and adults feed on leaves, flowers, and surface of fruits, such as corn and cucurbits (Walsh, 2003). CABI (2020) noted association of this pest with host fruit but did not specify which fruit commodity.

Neosilba glaberrima is a secondary feeder attacking damaged, rotting fruit (White and Elson-Harris, 1992). It is not expected to follow the pathway because poor quality, damaged fruit are culled during post harvest processing.

Metamasius hemipterus sericeus adult may feed externally on ripe host fruit. This insect will not follow the pathway because it only infests ripe fruit and is not expected to be associated with mature green to less than half-ripe papayas.

Lycorea cleobaea, commonly known as the milkweed butterfly, has several subspecies. *Lycorea cleobaea* subsp. *demeter* C&R Felder has been found in Florida but is considered a stray and is not established there (Calhoun 1997; Vane-Wright and Ackery, 1992). The subspecies occurring in Costa Rica is probably *L. cleobaea* subsp. *atergatis* (CRIL, 2018).

3. Summary and Conclusions of Risk Assessment

We did not identified any pests associated with *Carica papaya* worldwide and present in Costa Rica with a reasonable likelihood of being associated with papaya fruit following harvesting from the field and prior to any post-harvest processing.

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5. Appendix

We found some evidence of the listed organisms being associated with *Carica papaya* and being present in Costa Rica. Because these organisms have non-actionable regulatory status for the United States and, 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 papaya or their presence in Costa Rica. Because we did not evaluate the strength of the evidence, we consider the following pests to have only potential association with the commodity and potential presence in Costa Rica.

We list these organisms along with the references supporting their potential association with papaya, their potential presence in Costa Rica, their presence in the United States and territories (if applicable), and their regulatory status for the United States and territories. For organisms not present in the United States and territories, we also provide justification for their non-actionable status.

Appendix. Pests with non-actionable regulatory status for the United States and territories.

Organism	Evidence and/or other notes
MITE: Tarsonemidae <i>Polyphagotarsonemus latus</i> Banks, syn.: <i>Hemitarsonemus latus</i> (Banks), <i>Tarsonemus latus</i> Banks	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Nishina et al., 2000; Ochoa et al., 1994; Pantoja and Peña, 2006).
MITE: Tenuipalpidae <i>Brevipalpus californicus</i> Banks, syn.: <i>Tenuipalpus australis</i> Tucker	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Childers et al., 2003).
MITE: Tenuipalpidae <i>Brevipalpus obovatus</i> Donnadieu	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Childers et al., 2003; Heu, 2007).
MITE: Tenuipalpidae <i>Brevipalpus phoenicis</i> Geijskes, syn.: <i>B. papayensis</i> Baker	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Childers et al., 2003; Heu, 2007; Nakasone and Paull, 1998; Nishina et al., 2000; Pantoja and Peña, 2006; Tandon, 1993).
MITE: Tetranychidae <i>Eotetranychus lewisi</i> McGregor, syn.: <i>Tetranychus lewisi</i> McGregor	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Bolland et al., 1998; Jeppson et al., 1975).
MITE: Tetranychidae <i>Eutetranychus banksi</i> McGregor	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Bolland et al., 1998; Heu, 2007; Jeppson et al., 1975; Nakasone and Paull, 1998; Nishina et al., 2000; Pantoja and Peña, 2006).
MITE: Tetranychidae <i>Panonychus citri</i> McGregor syn.: <i>Metatetranychus citri</i> (McGregor), <i>Paratetranychus citri</i> (McGregor)	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Bolland et al., 1998; Heu, 2007; Jeppson et al., 1975; Nakasone and Paull, 1998; Nishina et al., 2000).
MITE: Tetranychidae <i>Tetranychus urticae</i> Koch syn.: <i>T. cinnabarinus</i> Boisduval	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Bolland et al., 1998; Heu, 2007; Nakasone and Paull, 1998; Nishina et al., 2000; Pantoja and Peña, 2006; Tandon, 1993).

Organism	Evidence and/or other notes
MITE: Tuckerellidae <i>Tuckerella pavoniformis</i> Ewing	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Aguilar and Murillo, 2008; Jeppson et al., 1975; Nishida, 2002; Nishina et al., 2000; Ochoa, 1989a; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Coleoptera: Anthribidae <i>Araecerus fasciculatus</i> De Geer, syn.: <i>Anthribus peregrinus</i> Herbst, <i>Araecerus coffeae</i> (Fabricius), <i>Curculio fasciculatus</i> (De Geer)	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Nishida, 2002; Waterhouse, 1993).
INSECT: Coleoptera: Bostrichidae <i>Stephanopachys rugosus</i> (Olivier)	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Beiriger, 2002; Ochoa et al., 1991; Webster et al., 2012).
INSECT: Coleoptera: Chrysomelidae <i>Diabrotica balteata</i> J. L. LeConte	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Arnett, 2000; Metcalf and Metcalf, 1993; Ochoa, 1989b).
INSECT: Coleoptera: Curculionidae <i>Hypothenemus crudiæ</i> Panzer	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Nishida, 2002; Poole and Gentili, 1996; Wood, 1982).
INSECT: Coleoptera: Curculionidae <i>Xyleborus volvulus</i> Fabricius syn.: <i>X. torquatus</i> Eichhoff	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (CABI, 2020; Poole and Gentili, 1996; Wood, 1982).
INSECT: Coleoptera: Curculionidae <i>Xylosandrus crassiusculus</i> Motschulsky, syn.: <i>Xyleborus semigranosus</i> Blanford	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Atkinson et al., 2011).
INSECT: Coleoptera: Cetoniidae <i>Cotinis mutabilis</i> Gory and Percheron, syn.: <i>Gymnetis atrata</i> Gory & Percheron	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Arnett, 2000).
INSECT: Hemiptera: Aleyrodidae <i>Aleurodicus dispersus</i> Russell	Pest is deregulated (PestID, 2020). (Botha et al., 2007; CABI, 2020; Evans, 2008; Heu, 2007; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Aleyrodidae <i>Bemisia tabaci</i> Gennadius	Pest is both reportable and nonreportable at U.S. ports of entry (PestID, 2020); no action required except when on tomato from Dominican Republic. (Arnett, 2000; Evans, 2008; McGuire and Crandall, 1967; Rogg, 2000; Tandon, 1993).
INSECT: Hemiptera: Aleyrodidae <i>Bemisia tabaci</i> (MEAM1) (Gennadius) Biotype B, syn.: <i>B. argentifolii</i> Bellows & Perring	Pest is nonreportable at U.S. ports of entry (PestID, 2020); action required when found in association with tomatoes originating from the Dominican Republic. Junior synonym of <i>Bemisia tabaci</i> (Gennadius) Biotype B. (CABI, 2020; McAuslane, 2009).
INSECT: Hemiptera: Aleyrodidae <i>Bemisia tabaci</i> (Gennadius) Biotype Q	Pest is nonreportable at U.S. ports of entry (PestID, 2020; CABI, 2020).
INSECT: Hemiptera: Aleyrodidae <i>Trialeurodes variabilis</i> (Quaintance)	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Bellotti et al., 2012; Evans, 2008; Ochoa, 1989b; Pantoja and Peña, 2006; Peña et al., 2005).
INSECT: Hemiptera: Aphididae <i>Aphis gossypii</i> Glover	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Blackman and Eastop, 2000; Heu, 2007; Kerns et al., 2015; Mejías et al., 2010; Miller et al., 2014; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002; Stoetzel, 1994; Tandon, 1993).

Organism	Evidence and/or other notes
INSECT: Hemiptera: Aphididae <i>Aphis nerii</i> Boyer de Fonscolombe	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Heu, 2007; Mejías et al., 2010; Miller et al., 2014; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002; Stoetzel, 1994).
INSECT: Hemiptera: Aphididae <i>Aphis spiraecola</i> Patch, syn.: <i>A. citricola</i> Van Der Goot	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Blackman and Eastop, 2000; Heu, 2007; Mejías et al., 2010; Miller et al., 2014; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002; Stoetzel, 1994).
INSECT: Hemiptera: Aphididae <i>Myzus persicae</i> Sulzer	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Blackman and Eastop, 2000; Heu, 2007; Mejías et al., 2010; Miller et al., 2014; Nishida, 2002; Nishina et al., 2000; Pantoja et al., 2002; Stoetzel, 1994; Tandon, 1993).
INSECT: Hemiptera: Aphididae <i>Pentalonia nigronervosa</i> Coquerel	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Heu, 2007; Mejías et al., 2010; Nishida, 2002).
INSECT: Hemiptera: Coccidae <i>Coccus hesperidum</i> L.	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Morton, 1987; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Coccidae <i>Milviscutulus mangiferae</i> Green	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Coccidae <i>Parasaissetia nigra</i> syn.: <i>Saissetia nigra</i> Nietner	Pest is nonreportable at U.S. ports of entry PestID (2019). (García Morales et al., 2016; Heu, 2007; Nishida, 2002; Pantoja and Peña, 2006).
INSECT: Hemiptera: Coccidae <i>Philephedra tuberculosa</i> Nakahara & Gill	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Matsunaga, 2018; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Diaspididae <i>Aonidiella aurantii</i> Maskell	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Diaspididae <i>Aspidiotus destructor</i> Signoret	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Morton, 1987; Nishida, 2002; Ochoa, 1989b; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Diaspididae <i>Aulacaspis tubercularis</i> Newstead	Pest has recorded interceptions on papaya fruit in baggage and on stem and leaf in general cargo from Costa Rica (PestID (2019). It is known to occur in Florida (Hodges et al., 2005), Puerto Rico, and the U.S. Virgin Islands (CABI, 2020).
INSECT: Hemiptera: Diaspididae <i>Chrysomphalus aonidum</i> L.	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; CABI, 2020; Heu, 2007; Nishida, 2002).
INSECT: Hemiptera: Diaspididae <i>Chrysomphalus dictyospermi</i> Morgan	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Diaspididae <i>Morganella longispina</i> Morgan	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002).

Organism	Evidence and/or other notes
INSECT: Hemiptera: Diaspididae <i>Pseudaulacaspis trilobitiformis</i> (Green) syn.: <i>Aspidiotus trilobitiformis</i> Green	Pest is deregulated (PestID, 2020); pest mainly associated with a plant part other than the fruit. (García Morales et al., 2016; Heu, 2007; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Diaspididae <i>Pseudaulacaspis pentagona</i> Targioni Tozzetti	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Nishina et al., 2000; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Pseudococcidae <i>Ferrisia virgata</i> Cockerell	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Nishida, 2002; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Pseudococcidae <i>Nipaecoccus nipae</i> Maskell	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Nishida, 2002).
INSECT: Hemiptera: Pseudococcidae <i>Paracoccus marginatus</i> Williams & Granara de Willink	Pest is deregulated (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Miller et al., 1999; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Hemiptera: Pseudococcidae <i>Planococcus citri</i> Risso (PestID syn.: <i>P. citricus</i> Ezzat & McConnell)	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Heu, 2007; Pantoja and Peña, 2006; Pantoja et al., 2002; Tandon, 1993).
INSECT: Hemiptera: Pseudococcidae <i>Pseudococcus jackbeardsleyi</i> Gimpel & Miller	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (García Morales et al., 2016; Nishida, 2002; Pantoja et al., 2002).
INSECT: Hemiptera: Pseudococcidae <i>Pseudococcus viburni</i> (Signoret)	Pest is nonreportable at U.S. ports of entry (PestID, 2020); intercepted on papaya in permit cargo from CR. (Heu, 2007; Pantoja and Peña, 2006).
INSECT: Hemiptera: Rhyparochromidae <i>Myodocha longicollis</i> Stal.	Pest is nonreportable at U.S. ports of entry (PestID, 2020); intercepted on papaya in permit cargo from Costa Rica.
INSECT: Hemiptera: Rhyparochromidae <i>Neopamera bilobata</i> (Say)	Pest is nonreportable at U.S. ports of entry (PestID, 2020); intercepted on papaya in permit cargo from Costa Rica.
INSECT: Hymenoptera: Formicidae <i>Solenopsis geminata</i> F.	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Heu, 2007; Nishida, 2002; Wetterer, 2011).
INSECT: Lepidoptera: Noctuidae <i>Spodoptera frugiperda</i> Smith & Abbot	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Andrade et al., 2000; Capinera, 2008).
INSECT: Lepidoptera: Sphingidae <i>Erinnyis alope</i> Drury	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Morton, 1987; Ochoa, 1989b; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Lepidoptera: Sphingidae <i>Erinnyis ello</i> L.	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (McGuire & Crandall 1967; Morton, 1987; Ochoa, 1989b; Pantoja and Peña, 2006; Pantoja et al., 2002).
INSECT: Lepidoptera: Sphingidae <i>Manduca sexta</i> L.	Pest is nonreportable at U.S. ports of entry (PestID, 2020). (Metcalf and Metcalf, 1993; Morton, 1987; White et al., 1994).
NEMATODE <i>Helicotylenchus dihystrer</i> (Cobb) Sher (Hoplolaimidae)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).
NEMATODE <i>Helicotylenchus multicinctus</i> (Cobb) Golden (Hoplolaimidae)	Presence in the continental United States, Hawaii, and Costa Rica, and association with papaya (CABI, 2020). Nonreportable at the U.S. ports of entry (PestID, 2020).

Organism	Evidence and/or other notes
NEMATODE <i>Meloidogyne arenaria</i> (Neal) Chitwood (Heteroderidae)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica (CABI, 2020), association with papaya (Holtsmann and McSorley, 1993). Nonreportable at U.S. ports of entry (PestID, 2020).
NEMATODE <i>Meloidogyne hapla</i> Chitwood (Heteroderidae)	Presence in the continental United States, Hawaii, and Costa Rica (CABI, 2020), association with papaya (Holtsmann and McSorley, 1993). Nonreportable at U.S. ports of entry (PestID, 2020).
NEMATODE <i>Meloidogyne acrita</i> , syn.: <i>M. incognita</i> (Heteroderidae)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica (CABI, 2020), association with papaya (Holtsmann and McSorley, 1993). Nonreportable at U.S. ports of entry (PestID, 2020).
NEMATODE <i>Meloidogyne javanica</i> (Treub) Chitwood (Heteroderidae)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica (CABI, 2020), association with papaya (Holtsmann and McSorley, 1993). Nonreportable at U.S. ports of entry (PestID, 2020).
NEMATODE <i>Rotylenchulus reniformis</i> Linford and Oliveira (Hoplolaimidae)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).
NEMATODE <i>Scutellonema brachyurus</i> (Steiner) Andrassy (Hoplolaimidae)	Presence in the continental United States, Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Alternaria alternata</i> (Fr.: Fr.) Keissl. syn.: <i>A. tenuissima</i> (Nees & T. Nees: Fr.) Wiltshire (Ascomycetes: Pleosporales)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Asperisporium caricae</i> (Speg.) Maubl. (Ascomycetes: Incertae sedis)	Presence in Florida, Hawaii, Puerto Rico, Texas, the U.S. Virgin Islands, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Athelia rolfsii</i> (Curzi) C.C. Tu & Kimbr. syn.: <i>Sclerotium rolfsii</i> Sacc. (Basidiomycetes, Polyporales)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Berkeleyomyces basicola</i> (Berk. & Broome) W.J. Nel, Z.W. de Beer, T.A. Duong & M.J. Wingf. syn.: <i>Chalara elegans</i> Nag Raj & W.B. Kendr.	Presence in the continental United States, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Not in PestID (2020).
FUNGUS <i>Colletotrichum acutatum</i> Simmonds (Ascomycetes: Phyllachorales)	Presence in the continental United States, Hawaii, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Colletotrichum gloeosporioides</i> (Penz.) Penz. & Sacc. (Ascomycetes: Phyllachorales)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).

Organism	Evidence and/or other notes
FUNGUS <i>Colletotrichum truncatum</i> (Schwein.) Andrus & W.D. Moore, syn.: <i>C. capsici</i> (Syd.) E.J. Butler & Bisby (Ascomycetes: Phyllachorales)	Presence in the Continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Corynespora cassiicola</i> (Berk. & M.A. Curtis) C.T. Wei (Ascomycetes: Pleosporales)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands and Guam (Farr and Rossman, 2018). Presence in Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Curvularia lunata</i> (Wakker) Boedijn, syn.: <i>Cochliobolus lunatus</i> R.R. Nelson & F.A. Haasis (Ascomycetes: Pleosporales)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Erysiphe diffusa</i> (Cooke & Peck) U. Braun & S. Takam. syn.: <i>Oidium caricae</i> F. Noack, <i>Oidium papayae</i> M. Seq.	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). The genus is reportable in PestID (2019).
FUNGUS <i>Fusarium solani</i> (Mart.) Sacc. (Ascomycetes: Hypocreales)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). Not nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Globisporangium debaryanum</i> (R. Hesse) Uzuhashi, Tojo & Kakish. syn.: <i>Pythium</i> <i>debaryanum</i> R. Hesse	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica, and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Globisporangium ultimum</i> (Trow) Uzuhashi, Tojo & Kakish. syn.: <i>Pythium</i> <i>ultimum</i> Trow	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Golovinomyces cichoracearum</i> (Ehrenb.) Heluta, syn.: <i>Erysiphe cichoracearum</i> DC (Ascomycetes: Erysiphales)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Lasiodiplodia theobromae</i> (Pat.) Griffon & Maubl. (Ascomycetes: Dothideales)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Phytophthora capsici</i> Leonian (Oomycetes: Pythiales)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Phytophthora nicotianae</i> Breda de Haan, syn.: <i>P. parasitica</i> Dastur (Oomycetes: Pythiales)	Presence in the continental United States, Hawaii, the U.S. Virgin Islands, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).

Organism	Evidence and/or other notes
FUNGUS <i>Phytophthora palmivora</i> (E.J. Butler) E.J. Butler (Oomycetes: Pythiales)	Presence in the continental United States, Hawaii, the U.S. Virgin Islands, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Pythium aphanidermatum</i> (Edson) Fitzp. (Oomycetes: Pythiales)	Presence in the continental United States, Hawaii, the U.S. Virgin Islands, and Costa Rica and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Rhizoctonia solani</i> J.G. Kühn (Basidiomycetes: Polyporales)	Presence in the continental United States, Hawaii, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Rhizopus stolonifer</i> (Ehrenb.: Fr.) Vuill. syn.: <i>R. nigricans</i> Ehrenb. (Zygomycetes: Mucorales)	Presence in the continental United States, Hawaii, the U.S. Virgin Islands, and Costa Rica and association with papaya (Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
FUNGUS <i>Stemphylium lycopersici</i> (Enjoji) W. Yamam. (Ascomycetes: Pleosporales)	Presence in Florida and Costa Rica, questionable record in Hawaii, and association with papaya (CABI, 2020; Farr and Rossman, 2018). Nonreportable at U.S. ports of entry (PestID, 2020).
BACTERIUM <i>Enterobacter cloacae</i> (Jordan) Hormaeche & Edwards	Presence in the continental United States, Hawaii, and Costa Rica (CABI, 2020; Santoro et al., 2006). Association with papaya (CABI, 2020). Not present in PestID (PestID, 2020).
BACTERIUM <i>Pectobacterium atrosepticum</i> (Van Hall) Gardan et al.	Presence in the continental United States and Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).
VIRUS <i>Potyvirus Papaya ringspot virus</i> (PRSV)	Presence in the continental United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).
VIRUS <i>Tospovirus Tomato spotted wilt virus</i> (TSWV)	Presence in the continental United States, Hawaii, Puerto Rico, and Costa Rica and association with papaya (CABI, 2020). Nonreportable at U.S. ports of entry (PestID, 2020).