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

Importation of papaya fruit (*Carica papaya* L.) for consumption from Brazil into the United States (excluding Hawaii)

A Qualitative, Pathway Initiated Pest Risk Assessment

Version 2

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Executive Summary
The purpose of this report is to expand the current areas of export of fresh papaya fruit (*Carica papaya*) (Caricaceae) from Brazil into the United States (excluding Hawaii), for consumption. This effort was based on a request from the Phytosanitary Import Management staff to update/revise the current Brazil papaya program to expand the export areas to all Brazilian states, and to consider all papaya varieties. The PRA on which the export program was initiated was completed in 1996.

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

We found no organisms that met the threshold for unacceptable consequences of introduction and are potentially able to follow the pathway.

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1. Introduction

1.1. Background

The purpose of this report is to expand the the current areas of export of fresh papaya fruit (*Carica papaya* L.) for consumption from Brazil (referred to as the export area) into the United States, excluding Hawaii[1] (referred to as the pest risk analysis or PRA area).

This is a qualitative risk assessment. The likelihood of pest introduction is expressed as a qualitative rating rather than in numerical terms. This methodology is consistent with guidelines provided by the International Plant Protection Convention (IPPC) in the International Standard for Phytosanitary Measures (ISPM) No. 11, "Pest Risk Analysis for Quarantine Pests" (IPPC, 2017). The use of biological and phytosanitary terms is consistent with ISPM No. 5, "Glossary of Phytosanitary Terms" (IPPC, 20182021).

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

1.2. Initiating event

The importation of fruits and vegetables for consumption into the United States is regulated under Title 7 of the Code of Federal Regulations, Part 319.56-3 (7 CFR §319.56-3, 2019). Under this regulation, the entry of fresh papaya fruit from Brazil into the PRA area is only authorized from the following regions of Brazil: State of Espirito Santo; all areas in the State of Bahia that are between the Jequitinhonha River and the border with the State of Espirito Santo and all areas in the State of Rio Grande del Norte that contain the following municipalities: Touros, Pureza, Rio do Fogo, Barra de Maxaranguape, Taipu, Ceara Mirim, Extremoz, Lelmon Marinho, Sao Goncalo do Amarante, Natal, Maciaba, Parnamirim, Veracruz, Sao Jose de Mipibu, Nizia Floresta, Monte Aletre, Areas, Senador Georgino Avelino, Espirito Santo, Goianinha, Tibau do Sul, Vila Flor, and Canguarentama e Baia Formosa. This commodity risk assessment was initiated in response to a request by the government of Brazil to change the Federal Regulation to expand market access for the entire country of Brazil.

1.3. Potential weediness of the commodity

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

A weed risk analysis is not required when (a) the commodity is already enterable into the PRA area from other countries, (b) the commodity plant species is widely established (native or naturalized) or cultivated in the PRA area, or (c) the imported plant part(s) cannot easily propagate on its own or be propagated. We determined that the weed risk of fresh papaya fruit does not need to be analyzed because this commodity is currently authorized entry into the United States (APHIS, 2021), and is grown commercially in California, Florida, Hawaii, and Texas (USDA-NASS, 2017).

[1]The PRA area includes all states except Hawaii, District of Columbia, Guam, the Commonwealth of the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands.

1.4. Description of the pathway

A pathway is “any means that allows the entry or spread of a pest” (IPPC, 2021). In the context of this document, the pathway is the commodity to be imported, together with all the process the commodity undergoes from production through importation and distribution. The following description of this pathway focuses on the conditions and processes that may have an impact on pest risk. Our assessment is therefore contingent on the application of all components of the pathway as described in this section.

1.4.1. Description of the commodity

The specific pathway of concern is the importation of fresh papaya fruit for consumption.

1.4.2. Summary of the production, harvest, post-harvest, shipping, and storage conditions considered

Export requirements, which are required to export fresh papaya from parts of Brazil (see section 1.2), are being considered for this PRA, which include:

1. Beginning at least 30 days before harvest began and continuing through the completion of harvest, all trees in the area where the papayas were grown must be kept free of papayas that were one-half or more ripe (more than one-quarter of shell surface yellow), and all culled and fallen fruit were removed from the field at least twice a week.
2. When packed, the papayas were less than one-half ripe (shell surface no more than one-quarter yellow, surrounded by light green) and appear to be free of all injurious plant pests.

2. Pest List and Pest Categorization

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

2.1. Pest list

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

Table 1. List of quarantine pests associated with *C. papaya* fruit (in any country) and present in Brazil (on any host)

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further? [3]
MITE: Tetranychidae *Aponychus schultzi* (Blanchard)	Pedrosa-Macedo et al., 2003	Bolland et al., 1998	Leaf (Guerrero and Bellotti, 1973)	No.
MITE: Tetranychidae *Oligonychus gossypii* (Zacher)	Bolland et al., 1998	Bolland et al., 1998	Leaf (Flechtmann, 1989)	No.
MITE: Tetranychidae *Tetranychus bastosi* Tuttle, Baker & Sales	de Moraes and Flechtmann, 1981	de Moraes and Flechtmann, 1981	Leaf (da Cruz et al., 2012)	No.
INSECT: Coleoptera: Chrysomelidae *Diabrotica speciosa* (Germar)	Walsh, 2004	Walsh, 2003	Leaf, Flower, Fruit, Root (EPPO, 2005)	No. Adults are external feeders, and mobile. They would not remain on the fruit during harvesting, and processing.
INSECT: Coleoptera: Curculionidae *Metamasius hemipterus* (L.)	Fancelli et al., 2012	EPPO, 2021	Root (Woodruff and Baranowski, 1985), Rotten Fruit (Wolcott, 1955), Leaf (Wyniger, 1962)	No. Present in the United States in Florida, Puerto Rico, and the U.S. Virgin Islands (CABI, 2021). Action required only to Hawaii (ARM, 2021).
INSECT: Coleoptera: Curculionidae *Piazurus obesus* Boheman	Lima, 1956	Lima, 1956	Stem (Lima, 1956)	No.
INSECT: Coleoptera: Curculionidae *Pseudopiazurus papayanus* Marshall	Fancelli et al., 2008	Fancelli et al., 2008	Stem (Fancelli et al., 2008)	No.

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

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

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further? [3]
INSECT: Coleoptera: Curculionidae *Rhynchophorus palmarum* (L.)	CABI, 2021; Moura et al., 2006	Lima, 1956	Trunk (CABI, 2021)	No. Present in the United States in Puerto Rico (CABI, 2021).
INSECT: Diptera: Lonchaeidae *Neosilba glaberrima* (Wiedemann)	McAlpine and Steyskal, 1982	Yepes and Velez, 1989	Fruit, Leaf, Stem (McAlpine and Steyskal, 1982)	No. Larvae in decomposing fruit previously attacked by other insects (Korytkowski and Peña 1971).
INSECT: Diptera: Tephritidae *Anastrepha distincta* Greene	Silva et al., 2010	Sánchez, 2016	Fruit (Sánchez, 2016)	No. See Section 2.2.
INSECT: Diptera: Tephritidae *Anastrepha fraterculus* (Wiedemann)	Melo et al., 2012	Melo et al., 2012	Fruit (Melo et al., 2012)	No. See Section 2.2.
INSECT: Diptera: Tephritidae *Anastrepha serpentina* (Wiedemann)	Uchôa and Nicácio, 2010	Aluja et al., 2000	Fruit (Aluja et al., 2000)	No. See Section 2.2.
INSECT: Diptera: Tephritidae *Bactrocera carambolae* Drew & Hancock	do Rosário Almeida et al., 2016	van Sauers-Muller, 2005	Fruit (van Sauers-Muller, 2005)	No. See Section 2.2.
INSECT: Diptera: Tephritidae *Ceratitis capitata* (Wiedemann)	EPPO, 1994; FAO, 1993; White and Elson-Harris, 1992	EPPO, 1994; FAO, 1993; White and Elson-Harris, 1992	Kolbe and Eskafi, 1989	No. See Section 2.2.
INSECT: Hemiptera: Aleyrodidae *Aleurocanthus woglumi* Ashby	de Lemos et al., 2006	Soerodimedjo, 1978	Leaf, Stem (CABI, 2021)	No.
INSECT: Hemiptera: Aphididae *Toxoptera citricidus* (Kirkaldy) (syn.: *T. citricida* (Kirkaldy)	Bartoszeck, 1980	Blackman and Eastop, 2000	Leaf (CABI, 2021)	No. Present in Florida, and Hawaii (CABI, 2021).

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further? [3]
INSECT: Hemiptera: Cicadellidae *Empoasca papayae* Oman	Coutinho, 1996	Coutinho, 1996; Hernández, 2014; Martorell and Aalsuar, 1952	Leaf (Acosta et al., 2017)	No. Listed in 1996 PRA Present in Puerto Rico (Martorell and Aalsuar, 1952).
INSECT: Hemiptera: Cicadellidae *Solanasca bordia* (Langlitz) (syn.: *Empoasca bordia* Langlitz)	Martins and Culik, 2005	Martins and Culik, 2005	Leaf (Gouvea et al., 2018)	No.
INSECT: Hemiptera: Ortheziidae *Praelongorthezia praelonga* (Douglas)	Culik et al., 2007	Dos Santos Martins et al., 1989	Flower, Leaf, Trunk, Twig (Kondo et al., 2013	No. Present in Florida (CABI, 2021).
INSECT: Hemiptera: Pseudococcidae *Maconellicoccus hirsutus* (Green)	Culik et al., 2013	Sagarra and Peterkin, 1999	Young stems, flowers, fruit (Chong et al., 2015), base on the general biology of this species.	No. Present in the continental United States in at least 11 states, Hawaii, Guam, Northern Mariana Islands, Puerto Rico and the U.S. Virgin Islands (García Morales et al., 2016). Mealybugs feed externally on fruit. Infestations of *M. hirsutus* are conspicuous and infected fruit would be removed from the pathway.
INSECT: Lepidoptera: Erebidae *Eudocima materna* (L.) (syn.: *Othreis materna* L.)	Specht et al., 2004	Mille, 2005	Fruit (adult), Leaf (larva) (Tembhare et al., 2004)	No. Adults are fruit-piercing moths (Tembhare et al., 2004).
INSECT: Lepidoptera: Nymphalidae *Lycorella cleobaea* (Godart)	da Costa Lima, 1936	da Costa Lima, 1936; Zhang, 1995	Foliage (D'Araūjo e Silva et al., 1968)	No.

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further? [3]
INSECT: Lepidoptera: Nymphalidae *Lycorella halia* (Godart)	da Costa Lima, 1936; Zhang, 1995	da Costa Lima, 1936; Zhang, 1995,	Leaf (Maurer et al., n.d.)	No.
INSECT: Lepidoptera: Nymphalidae *Lycorea ilione* (Cramer)	Savela, 2009	Savela, 2009	Leaf (Hill, 1994)	No.
INSECT: Lepidoptera: Sphingidae *Xylophanes chiron* (Walker)	da Costa Lima, 1936	Robinson et al., 2010	Leaf (Robinson et al., 2010)	No.
INSECT: Lepidoptera: Tineidaae *Tiquadra nivosa* (Felder & Rogenhoffer)	da Costa Lima, 1936	Jaworski, 2018	Dead wood (Jaworski, 2018)	No.
INSECT: Orthoptera: Proscopiidae *Stiphra robusta* Mello-Leitao	Lhano et al., 2019	Policarpo et al., 2019	Defoliator (Policarpo et al., 2019)	No.
INSECT: Orthoptera: Romaleidae *Tropidacris collaris* (Stoll)	Lhano et al., 2019	Carbonell, 1986	Leaf (Lhano et al., 2019)	No.
INSECT: Thysanoptera: Thripidae *Frankliniella australis* (Morgan)	Zanuncio et al., 2016	Zanuncio et al., 2016	Flower (Manosalva et al., 2011)	No.
NEMATODE *Hemicriconemoides mangiferae* Siddiqi	CABI, 2021	Saeed and Ghaffar, 1979	Root Saeed and Ghaffar, 1979	No. Action required when destined to Puerto Rico, and the U.S. Virgin Islands (ARM, 2021). Present in California and Florida (CABI, 2021).

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further? [3]
NEMATODE *Rotylenchus reniformis* (Cobb) Linford & Oliveira	Castro et al., 2008	Crozzoli et al., 2005	Root (Crozzoli et al., 2005)	No. Present in Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas (ARM, 2021).
FUNGUS *Colletotrichum brevisporum* Noireung, Phouliv., L. Cai & K.D. Hyde	Farr and Rossman, 2021; Vieira et al., 2013	Duan et al., 2018; Vieira et al., 2013	Fruit (Duan et al., 2018; Vieira et al., 2013)	No. See Section 2.2.
FUNGUS *Diaporthe caricae-papayae* (Petr. & Cif.) Rossman & Udayanga (syn.: *Phomopsis caricae-papayae* Petr. & Cif.)	Dantas et al., 2003; Mendes and Urben, 2021	Mendes and Urben, 2021	Fruit (Abeywickrama et al., 2012; Dantas et al., 2003)	No. See Section 2.2.
FUNGUS *Erysiphe diffusa* (Cooke & Peck) U. Braun & S. Takam. (syn.: *Oidium caricae* F. Noack)	Mendes and Urben, 2021	Mendes and Urben, 2021	Leaf, Stem (Braun et al., 2017; Farr and Rossman, 2021)	No.
FUNGUS *Fusarium anthophilum* (A. Braun) Wollenw. (syn.: *Fusarium moniliforme* var. *anthophilum* (A. Braun) Wollenw.)	Mendes and Urben, 2021	Mendes and Urben, 2021	Fruit (Dantas et al., 2003)	No. Present in Kentucky, Minnesota, North Carolina (Farr and Rossman, 2021). See Section 2.2.
FUNGUS *Phaeosphaeria papayae* (Speg.) Quaedvl., Verkley & Crous (syn.: *Phaeoseptoria papayae* Speg.)	Quaedvlieg et al., 2013	Quaedvlieg et al., 2013	Leaf (Quaedvlieg et al., 2013)	No.

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further?[3]
FUNGUS *Phyllactinia caricicola* (U. Braun) Liberato, R.W. Barreto & S. Takam (syn.: *Ovulariopsis caricicola* U. Braun, *Streptopodium caricae* Liberato & R.W. Barreto)	Farr and Rossman, 2021	Liberato et al., 2004	Leaf (Liberato et al., 2004)	No.
FUNGUS *Phyllactinia papayae* (Van der Byl) U. Braun (syn.: *Ovulariopsis papayae* Van der Byl)	Mendes and Urben, 2021	Mendes and Urben, 2021	Leaf (Farr and Rossman, 2021)	No.
FUNGUS *Phyllosticta caricae-papayae* Allesch.	Farr and Rossman, 2021; Mendes and Urben, 2021	Mendes and Urben, 2021	Leaf (Farr and Rossman, 2021)	No. Present in Florida (Farr and Rossman, 2021)
FUNGUS *Stagonosporopsis caricae* (Sydow & P. Sydow) Aveskamp, Gruyter & Verkley (syn.: *Ascochyta caricae-papayae* Tarr, *Mycosphaerella caricae* Syd. &P. Syd., *Phoma caricae-papayae* (Tarr) Punith.)	Farr and Rossman, 2021; Mendes and Urben, 2021	Mendes and Urben, 2021	Fruit (Chowdhury, 1950; Mendes and Urben, 2021; Stewart et al., 2015)	No. No action required except when destined to Puerto Rico and U.S. Virgin Islands (ARM, 2021). See Section 2.2.Present in California, Florida (Farr and Rossman, 2021), Georgia (Rennberger et al., 2018), South Carolina, Michigan, and Puerto Rico (Farr and Rossman, 2021).

Pest name	Presence in Brazil	Host association	Plant part(s) [2]	Considered further? [3]
BACTERIUM *'Candidatus* Phytoplasma asteris'(16SrI-B)	Bedendo et al., 2000; Camargo_Pereira and Bedendo, 2017	Acosta et al., 2013)	Systemic-phloem (Acosta et al., 2013)	No. Present in Alaska (McBeath et al., 2011), California, Florida, Maryland, Missouri (Botti and Bertaccini, 2003), New York, Oklahoma (Lee et al., 1993), Texas (Lee et al., 2003). There is no evidence to date, of any mechanism or pathways in which phytoplasmas may unload (or infect) in fruits for consumption (Dickinson and Hodgetts, 2013).
BACTERIUM *'Candidatus* Phytoplasma hispanicum' (16SrXIII-E)	Melo et al., 2013	Melo et al., 2013	Systemic-phloem (Melo et al., 2013)	No. There is no evidence to date, of any mechanism or pathways in which phytoplasmas may unload (or infect) in fruits for consumption (Dickinson and Hodgetts, 2013).
BACTERIUM *Pseudomonas caricapapayae* Robbs	Silva et al., 2007	Silva et al., 2007	Leaf (Bradbury, 1986; Silva et al., 2007)	No.
VIRUS *Sobemovirus Papaya lethal yellowing virus* (PLYV)	Kitajima, 2020	Kitajima, 2020	Systemic (Lima et al., 2013)	No. See section 2.2.
VIRUS Papaya meleira virus (PMeV)/ Papaya meleira virus 2 (PMeV-2)	Kitajima, 2020	Kitajima, 2020	Systemic (Sa Antunes et al., 2020)	No. See section 2.2.

2.2. Notes on pests identified in the pest list

Anastrepha distincta **Greene (Diptera: Tephritidae)**
Carica papaya was recorded for the first time as a new host of *A. distincta* in Ecuador (Sánchez, 2016). This appears to be the only report of *A. distincta* attacking papaya in any country where this insect is present. Although *A. distincta* is not economically important (Oropeza-Cabrera et al., 2015); it has a preference towards fruits of the family Fabaceae (de Souza et al., 2018), and for *Inga* species in particular (Norrbom and Kim, 1988), it has occasionally been reared from

other economically important host plants (Norrbom and Kim, 1988). Additionally, host association studies in various Brazilian states, e.g., Aguiar-Menezes and Menezes, 1997; de Sá et al., 2008; de Souza et al., 2018; Jesus-Barros et al., 2012; Marsaro et al., 2010; Pereira et al., 2010; Raga et al., 2011; Silva et al., 2010; Uramoto et al., 2008, found no association of *A. distincta* with *C. papaya*. Based upon these studies, it appears unlikely that *A. distincta* will be present with harvested commercial *C. papaya* fruit in Brazil.

***Anastrepha fraterculus* Weidemann**

Putruele (1996) reported infestation of papaya (level of ripeness not described) by *A. fraterculus* under natural field conditions in Argentina. 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. While ripe papayas are suitable rearing hosts in the laboratory and may be used as hosts in the field, mature green and color-break papayas are conditional non-hosts of *A. fraterculus* in accordance with the IPPC (2016) guidelines. As such, in accordance with the applicable provisions in 7 CFR § 319.56–25, mature green to less than half ripe 'Solo' papayas are not regulated hosts of *A. fraterculus*, and may be imported into the U.S. from parts of Brazil (see section 1.2) without any conventional, probit 9-based quarantine treatment requirement for fruit flies.

***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)**

Carica papaya was recorded as a host of *A. serpentina* in Mexico (Aluja et al., 2000). This appears to be the only report of *A. serpentina* attacking papaya in any country where this insect is present. Although *A. serpentina* has a preference towards fruits of the family Sapotaceae, it has been reared from other host plants in other families, some with economic importance (Norrbom and Kim, 1988). Additionally, host association studies in various Brazilian states, e.g., Bomfim et al., 2014; da Silva et al., 2011; Jesus-Barros et al., 2012; Marsaro et al., 2010; Raga et al., 2011; Silva et al., 2010; Uramoto et al., 2008, found no association of *A. serpentina* with *C. papaya*. Based upon these studies, it appears unlikely that *A. serpentina* will be present with harvested commercial *C. papaya* fruit in Brazil.

***Bactrocera carambolae* Drew & Hancock (Diptera: Tephritidae)**

This species is a quarantine pest in Brazil, and is restricted to the states of Amapá, Pará and Roraima (Castilho et al., 2019). *Bactrocera carambolae* was first found attacking *C. papaya* in the backyard of a residential complex in South Andaman, India (Ranganath et al., 1997) (neither the ripeness of the fruit nor the number of infested fruit was recorded). Other studies have shown that *C. papaya* is not a preferred host to *B. carambolae*. In Suriname, van Sauers-Muller (2005) collected 137 papaya fruit in natural settings over a 12 year period, and recorded that only four pupae were recovered. In Indonesia, Koswanudin et al. (2018), placed 90-100 post-copulation females in a plastic jar and connected this jar with tubing that led to another jar containing papapya fruit. They reported that only an average of 2.3 flies entered the jar containg the papaya. From these studies it appears that *C. papaya* is a non-preferred host to *B. carambolae*.

***Ceratitis capitata* (Wiedemann)**

Lara and Marin (1990) provided direct evidence that mature green and color-break papayas are conditional non-hosts to *C. capitata*. Additionally, in accordance with the applicable provisions in 7 CFR § 319.56–25, mature green to less than half ripe 'Solo' papayas are may be imported into the U.S. from parts of Brazil (see section 1.2) without any conventional, probit 9-based quarantine treatment requirement for fruit flies; all culled and fallen fruits are buried, destroyed, or removed from the farm at least twice a week; and the papayas are safeguarded from exposure to fruit flies from harvest to export, including being packaged so as to prevent access by fruit flies and other injurious insect pests.

Colletotrichum brevisporum **Noireung, Phouliv., L. Cai & K.D. Hyde (Sordariomycetes: Glomerellales)**
The combination of ecological or biological requirements of *C. brevisporum* for survival or reproduction are highly unlikely to be met. *Colletotrichum* spp. are waterborne and spread through rain-splash (Dowling et al., 2020). For establishment to occur, infected fruit with mature, sporulating *C. brevispurum* would need to come into contact with host material under rainy conditions (Duan et al., 2018). This scenario is unlikely via the fruit for consumption pathway; therefore, we consider the likelihood of introduction via this pathway as negligible.

Diaporthe caricae-papayae **(Petr. & Cif.) Rossman & Udayanga (Sordariomycetes: Diaporthales)**
Diaporthe caricae-papayae causes a postharvest disease in papaya fruit, as symptoms usually show only in ripe papaya (Ploetz et al., 1994). This fungus is exclusively tropical and its prevalence in the field is unknown but the incidence as a postharvest disease is sporadic and low (i.e., below 5 percent) (Ploetz et al., 1994, Dantas et al., 2003). The requirements of *D. caricae-papayae* for survival and reproduction leading to establishment are highly unlikely to be met in this pathway. Specifically, mature, sporulating infected papaya fruit would need to come into contact with a senescent petiole of papaya fruit in the field (Ploetz et al., 1994). The likelihood of this event occurring in the the fruit for consumption pathway is negligible.

Fusarium anthophilum **(A. Braun) Wollenw. (Sordariomycetes: Hypocreales)**
Rot of papaya fruit is caused by *Fusarium* species, including *F. anthophilum*, and is a secondary pathogen associated with lesions caused by other pathogens, for which, postharvest losses of papaya fruit derived from *Fusarium* rot are not significant (Dantas et al., 2003). *Fusarium anthophilum* was not selected for further analysis due to lack of evidence as a primary pathogen to papaya, and a negligible risk of introduction in fruit for consumption.

Stagonosporopsis caricae **(Sydow & P. Sydow) Aveskamp, Gruyter & Verkley (Dothideomycetes: Pleosporales)**
Stagonosporopsis caricae is present in all the papaya-producing areas of the world (Sivanesan, 1990). This fungus has affected 10 to 15 percent of fruits on the trees in papaya orchards (Chowdhury, 1950). Unmitigated losses have ranged from 5 to 42 percent for the papaya cultivar Solo in Hawaii (Chau and Alvarez, 1979). Black rot develops externally and internally on infected papaya fruit 3 to 4 days after infection (Chau and Alvarez, 1979); symptoms will be clearly visible and detectable then and after. This fungus requires a specific combination of biological requirements to survive and reproduce, specifically airborne infecting spores only grow and sporulate on latex exuding from a susceptible papaya plant in the field (Chau and

Alvarez, 1979). The likelihood of *S. caricae* establishment in the U.S. through imported papaya fruit is negligible considering its biological requirements and the intended use of the commodity.

Sobemovirus Papaya lethal yellowing virus **(PLYV) (Solemoviridae)**
Papaya lethal yellowing virus is only present at low incidence in northeastern Brazil orchards, and papaya is its single host of commercial concern (Kitajima, 2020). This virus has been reported as associated with papaya showing greenish circular spots on fruits as the fruit ripens (Lima et al., 2013). Due to the pest prevalence and association with papaya fruits on the ripening process we consider the likelihood of entry to be low. However, for PLYV to become established from imported papaya fruit, the virus would have to spread from the infected fruit to susceptible hosts, and the conditions necessary for this to happen are unlikely to occur. This is because the virus has a very limited host range, papaya stands are sparsely distributed through the endangered area, and this virus in highly unlikely to move on its own from the commodity to a new host; PLYV is not seed transmitted and there is no evidence of a vector (Lima et al., 2013). Furthermore, fruit intended for consumption is unlikely to be introduced into commercial production areas because fruit will be consumed or, if disposed, would go to a commercial landfill and is unlikely to come in contact with host material in the limited endangered area. Considering the evidence mentioned, the likelihood of PLYV establishment in the U.S. through imported papaya fruit is negligible.

Totivirus Papaya meleira virus (PMeV) (Totiviridae)/Umbravirus Papaya meleira virus 2 (PMeV-2) (Tombusviridae) complex
Papaya sticky disease (PSD) was reported in Brazil in the 1980 (Sa Antunes et al., 2020), and later associated with Papaya meleira virus (PMeV) as the causal agent (Maciel-Zambolim et al., 2003). Papaya sticky disease symptoms are now known to be caused by an umbravirus, PMeV-2, which needs an auxilliary virus for infection, PMeV in the case of Brazil (Sa Antunes et al., 2020). The incidence of PSD has been reported to be between 20 to 100 percent in papaya orchards in Brazil (Ventura et al., 2004). Infected plants often remain unnoticed until fruits develop the first symptoms (Maciel-Zambolim et al., 2003), mainly spontaneous exudation of translucent and watery latex (Perez-Brito et al., 2012; Ventura et al., 2004), which happened within 30 to 45 days in inoculated plants (Perez-Brito et al., 2012; Ventura et al., 2004). For these reasons, we consider the overall likelihood of entry for PMeV/PMeV-2 from Brazil into the U.S. to be high. PMeV/PMeV-2 only spreads in the field, likely through agricultural practices (Abreu et al., 2015). The presence of a biological vector of PMeV/PMeV-2 in the field has not been confirmed in Brazil so far, neither a seed transmission route for PMeV/PMeV-2 (Sa Antunes et al., 2020). The biological requirements for PMeV/PMeV-2 complex to survive, spread, and cause infection in the field are highly unlikely to be met. The likelihood of PMeV/PMeV-2 establishment in the U.S. through imported papaya fruit is negligible, considering consumption as the intended use of the commodity.

2.3. Pests considered but not included on the pest list

<u>2.3.1. Organisms with non-quarantine status</u>
We found evidence of organisms that are associated with *C. papaya*, and are present in the export area, but are not of quarantine significance for the PRA area. These organisms are listed in the Appendix.

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

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

Colletotrichum magnum (S.F. Jenkins & Winstead) Rossman & W.C. Allen has been previously associated with *Carica papaya* fruit in Brazil, identified as *C. magna* Jenkins & Winstead (Nascimento et al., 2010). However, *C. magnum* is currently a species complex of at least 10 species (Damm et al., 2019). Species identification is not possible for the isotates reported from papaya based on ITS data; the sequence of *C. magnum* is identical with several other species in the complex (Damm et al., 2019). Thus, we excluded *C. magnum* from the quarantine pest list due to uncertainty on its current species identity.

Septoria caricae Speg. was listed in the previous 1996 PRA. This species name is not a current or former valid taxonomic species.

Phytoplasmas in groups 16SrI, 16SrII, and 16SrXV are present in Brazil (Melo et al., 2013). However, we found no reports in Brazil for the following subgroups reported as associated with *C. papaya*: '*Candidatus* Phytoplasma asteris'16SrI-C (Rojas-Martínez et al., 2011), 16SrI-X (Acosta et al., 2013), and 16SrI-Z (Acosta-Pérez et al., 2017); '*Ca.* Phytoplasma aurantifolia' 16SrII-A and 16SrII-N (Acosta et al., 2013); and, '*Ca.* Phytoplasma brasiliense' 16SrXV-B* [a variant unique to Peru (Wei et al., 2017)]. Thus, there is uncertainty about the presence of these subgroups in Brazil.

Ralstonia solanacearum (Smith) Yabuuchi et al. is part of a species complex, which has been split into 3 species, two of which have been reported in Brazil (*R. solanacearum* sensu stricto and *R. pseudosolanacearum*; Santiago et al., 2020). So far, the only reported isolate of *R. solanacearum* from papaya has been found in Bangladesh (Hossain et al., 2021). Brazil is considered one of the ancient centers of origin of *R. solanacearum*, and there is a wide diversity and variation among isolates within regions and hosts in the country (Santiago et al., 2020). An association with *C. papaya* of either *R. solanacearum* or *R. psudosolanecearum* has not been reported in Brazil. Considering the diversity and variation in host specificity of *R. solanacearum,* and the lack of evidence in Brazil for a specific associaton with *C. papaya*, we consider unlikely that the pathogen will be present in the commodity and follow the pathway.

Alfamovirus Alfalfa mosaic virus (AMV) has only been reported once affecting *C. papaya*, found in 2007 in an experimental field at the municipality of Piracicaba, Sao Paulo, Brazil (Moreira et al., 2010). The virus occurred in coinfection with *Papaya ringspot virus*-type P (PRSV-P). Two out of 48 experimental plants tested positive then. This is likely an isolated incident as we found no other reports of AMV associated with *C. papaya*.

Tobacco necrosis virus (TNV), now known as *Alphanecrovirus Tobacco necrosis virus A*, was isolated from asymptomatic papaya plants in 1960 (Costa and Carvalho, 1960). No other report of association with evidence of damage or symptoms in *C. papaya* was found in the available literature. We excluded TNV from the quarantine pest list due to uncertainty on its association as a pathogen to *C. papaya*.

Potexvirus Papaya mosaic virus (PapMV) is a pathogen of *C. papaya* fruit (Varun et al., 2017); however, we found no evidence of its presence in Brazil.

2.3.3. Organisms identified only to the genus level
In commodity risk assessments, the taxonomic unit for pests selected for evaluation beyond the pest categorization stage is usually the species (IPPC, 20172017). Generally, we do not assess risk for organisms identified only to the genus level, especially if the genus is reported in the PRA area. Many genera contain multiple species, and we cannot know if the unidentified species occurs or is regulated in the PRA area. Because the organism has not been fully identified, we cannot properly assess the likelihood and consequences of its introduction. However, if the genus is absent from the PRA area or is actionable at U.S. ports of entry, the genus can be regulated as a quarantine pest.

We found evidence that the following organisms identified only to the genus level are reported on *C. papaya* in Brazil:

Hanseniella sp. (Symphyla: Scutigerellidae)
Species within this genus have been reported to cause damage to *C. papaya* roots (Camargos-Loureiro et al., 1971).

Pseudococcus sp. (Hemiptera: Pseudococcidae)
Species within this genus have been reported to cause damage to *C. papaya* stems (Culik et al., 2007)

2.4. Pests selected for further analysis or already regulated

No quarantine pests were identified that could follow the pathway. Thus, no pests were selected for further analysis.

3. Summary
Of the organisms associated with *C. papaya* worldwide and present in the export area, we identified no organism that is a quarantine pest for Brazil.

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6. Appendix: Pests with non-quarantine status

We found evidence that the organisms listed below are associated with *Carica papaya* and present in Brazil. Because these organisms are not of quarantine significance for the United States (excluding Hawaii) (PestID, 2019); or as defined by ISPM 5, IPPC, 20182021), we did not list them in Table 1. Therefore, the organisms are considered to have only "potential" association with the commodity and presence in Brazil.

We listed these organisms along with the references supporting their potential presence in Brazil, their presence in United States (if applicable), and their potential association with the *C. papaya*. If any of the organisms are **not** present in the United States, we also provided justification for their non-quarantine status. Unless otherwise noted, these organisms are non-actionable at U.S. ports of entry (PestID, 2020).

Organism	In Brazil	In U.S.	Host Association	Notes
MITE: Tarsonemidae *Polyphagotarsonemus latus* (Banks)	Jeppson et al., 1975	Jeppson et al., 1975	CABI, 2021	
MITE: Tenupalpidae *Brevipalpus californicus* (Banks)	CABI, 2021	CABI, 2021	Dina and Santoso, 2017	
MITE: Tenupalpidae *Brevipalpus obovatus* Donnadieu	CABI, 2021	CABI, 2021	Dina and Santoso, 2017	
MITE: Tenupalpidae *Brevipalpus phoenicis* (Geijskes)	Jeppson et al., 1975	Jeppson et al., 1975	Verghese et al., 2007	
MITE: Tetranychidae *Eutetranychus banksi* (McGregor)	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Oligonychus yothersi* (McGregor)	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Panonychus citri* (McGregor)	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Tetranychus cinnabarinus* (Boisduval)	CABI, 2021	CABI, 2021	CABI, 2021	
MITE: Tetranychidae *Tetranychus desertorum* Banks	Jeppson et al., 1975; Coutinho, 1996	Jeppson et al., 1975; Coutinho, 1996	Migeon and Dorkeld, 2021	

Organism	In Brazil	In U.S.	Host Association	Notes
MITE: Tetranychidae *Tetranychus evansi* Baker & Pritchard	Jeppson et al., 1975	Jeppson et al., 1975		Listed in 1996 PRA. This appears to be an error. Jeppson et al. (1975) cited "Plaine de Papayes" as a host of this mite. Plaine de Papayes is a town in Mauritius.
MITE: Tetranychidae *Tetranychus gloveri* Banks	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Tetranychus ludeni* Zacher	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Tetranychus marianae* McGregor	CABI, 2021	CABI, 2021	CABI, 2021	
MITE: Tetranychidae *Tetranychus mexicanus* (McGregor)	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Tetranychus neocalidonicus* Andre	Jeppson et al., 1975	Jeppson et al., 1975	Migeon and Dorkeld, 2021	
MITE: Tetranychidae *Tetranychus urticae* Koch	Jeppson et al., 1975; Metcalf and Metcalf, 1993	Jeppson et al., 1975; Metcalf and Metcalf, 1993	Migeon and Dorkeld, 2021	
INSECT: Coleoptera: Anthribidae *Araecerus fasciculatus* (De Geer)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Coleoptera: Curculionidae *Xyleborus volvulus* (Fabricius)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Diptera: Drosophilidae *Drosophila suzukii* Matsumura	Zanuncio, et al., 2018	Hauser, 2011	Zanuncio, et al., 2018	
INSECT: Diptera: Muscidae *Atherigona orientalis* Schiner	CABI, 2021	CABI, 2021	CABI, 2021	

Organism	In Brazil	In U.S.	Host Association	Notes
INSECT: Diptera: Tephritidae *Toxotrypana curvicuada* Gerstaecker	White and Elson-Harris, 1992	White and Elson-Harris, 1992	Landolt and Hendrichs, 1983	
INSECT: Hemiptera: Aleyrodidae *Aleurodicus dispersus* Russell	CABI, 2021	CABI, 2021	CABI, 2021	Present in Florida (Cherry, 1980), Hawaii (Kumashiro et al., 1983), and Puerto Rico (Medina-Gaud et al., 1991)
INSECT: Hemiptera: Aleyrodidae *Bemisia tabaci* (Gennadius)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Aleyrodidae *Bemisia tabaci* (B biotype) (Gennadius)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Aphididae *Acyrthosiphon pisum* (Harris)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Aphididae *Aphis craccivora* Koch	CABI, 2021	CABI, 2021	Blackman and Eastop, 2000	
INSECT: Hemiptera: Aphididae *Aphis fabae* Scopoli	CABI, 2021	CABI, 2021	Blackman and Eastop, 2000	
INSECT: Hemiptera: Aphididae *Aphis gossypii* Glover	CABI, 2021	CABI, 2021	Blackman and Eastop, 2000	
INSECT: Hemiptera: Aphididae *Aphis nerii* Fonscolombe	dos Santos Martins et al., 2016	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Aphididae *Aphis spiraecola* Patch	CABI, 2021	CABI, 2021	Blackman and Eastop, 2000	
INSECT: Hemiptera: Aphididae *Macrosiphum euphorbiae* (Thomas)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Aphididae *Myzus persicae* (Sulzer)	CABI, 2021	CABI, 2021	Blackman and Eastop, 2000	

Organism	In Brazil	In U.S.	Host Association	Notes
INSECT: Hemiptera: Aphididae *Pentalonia nigronervosa* Coquerel	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Aphididae *Rhopalosiphum maidis* (Fitch)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Coccidae *Coccus hesperidum* (Linnaeus)	Culik et al., 2007	CABI, 2021	Culik et al., 2007	
INSECT: Hemiptera: Coccidae *Milviscutulus mangiferae* (Green)	García Morales et al., 2016	García Morales et al., 2016	Peña and Moyhuddin, 1997	
INSECT: Hemiptera: Coccidae *Parasaissetia nigra* (Nietner)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Coccidae *Saissetia oleae* (Olivier)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Conchaspididae *Conchaspis angraeci* Cockerell	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Aonidiella aurantii* (Maskell)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Aonidiella comperei* McKenzie	García Morales et al., 2016	Puerto Rico, U.S. Virgin Islands (García Morales et al., 2016)	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Aonidiella orientalis* (Newstead)	García Morales et al., 2016	Florida, Puerto Rico, U.S. Virgin Islands (García Morales et al., 2016)	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Aonidomytilus albus* (Cockerell)	García Morales et al., 2016	Florida, New Mexico, Puerto Rico, U.S. Virgin Islands (García Morales et al., 2016)	García Morales et al., 2016	

Organism	In Brazil	In U.S.	Host Association	Notes
INSECT: Hemiptera: Diaspididae *Aspidiotus destructor* Signoret	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Diaspididae *Aulacaspis tubercularis* Newstead	CABI, 2021	CABI, 2021	Posada Ochoa, 1989	
INSECT: Hemiptera: Diaspididae *Chrysomphalus aonidum* (Linnaeus)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Diaspididae *Chrysomphalus dictyospermi* (Morgan)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Diaspididae *Clavaspis herculeana* (Cockerell & Hadden)	García Morales et al., 2016	Florida, Texas, Puerto Rico, U.S. Virgin Islands (García Morales et al., 2016)	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Morganella longispina* (Morgan)	da Costa Lima, 1936; Nakahara, 1982	da Costa Lima, 1936 Nakahara, 1982	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Pseudaonidia trilobitiformis* (Green)	García Morales et al., 2016	Florida, Puerto Rico, U.S. Virgin Islands (García Morales et al., 2016)	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Pseudaulacaspis pentagona* (Targioni Tozzetti)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Dysmicoccus grassii* (Leonardi)	Culik et al., 2007	CABI, 2021	Culik et al., 2007	
INSECT: Hemiptera: Pseudococcidae *Ferrisia virgata* (Cockerell)	CABI, 2021	CABI, 2021	CABI, 2021	

Organism	In Brazil	In U.S.	Host Association	Notes
INSECT: Hemiptera: Pseudococcidae *Nipaecoccus nipae* (Maskell)	García Morales et al., 2016	California, Florida, Louisiana (García Morales et al., 2016)	CABI, 2021	
INSECT: Hemiptera: Pseudococcidae *Planococcus citri* (Risso)	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Pseudococcidae *Pseudococcus jackbeardsleyi* Gimpel & Miller	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Pseudococcidae *Phenacoccus solenopsis* Tinsley	CABI, 2021	CABI, 2021	CABI, 2021	
INSECT: Hemiptera: Pseudococcidae *Selenaspidus articulatus* (Morgan)	Martins et al., 2015	CABI, 2021	Martins et al., 2015	
INSECT: Hymenoptera: Formicidae *Solenopsis geminata* (F.)	CABI, 2021	CABI, 2021	Habitat (CABI, 2021)	
INSECT: Lepidoptera: Tineidae *Opogona sacchari* (Bojer)	Peña et al., 1990	Peña et al., 1990	Peña et al., 1990	
INSECT: Lepidoptera: Noctuidae *Agrotis ipsilon* (Rottemburg)	Coutinho, 1996; Metcalf and Metcalf, 1993	Coutinho, 1996; Metcalf and Metcalf, 1993		
INSECT: Lepidoptera: Sphingidae *Erinnyis alope* (Dnuy)	da Costa Lima, 1936; Coutinho, 1996; Zhang, 1995; CABI, 2021	da Costa Lima, 1936; Coutinho, 1996; Zhang, 1995	Zhang, 1995	
INSECT: Lepidoptera: Sphingidae *Erinnyis ello* (L.)	da Costa Lima, 1936; EPPO, 1995; FAO, 1993	da Costa Lima, 1936; EPPO, 1995; FAO, 1993	Zhang, 1995	
NEMATODE *Helicotylenchus dihystera* (Cobb) Sher	CABI, 2021	CABI, 2021	CABI, 2021	
NEMATODE *Helicotylenchus multicinctus* (Cobb) Golden	CABI, 2021	CABI, 2021	Khan et al., 2007	

Organism	In Brazil	In U.S.	Host Association	Notes
NEMATODE *Meloidogyne arenaria* (Neal) Chitwood	CABI, 2021	CABI, 2021	de Dios Jaraba et al., 2007	
NEMATODE *Meloidogyne hapla* Chitwood	CABI, 2021	CABI, 2021	Crop Knowledge Master, 2011	
NEMATODE *Meloidogyne incognita* (Kofoid & White) Chitwood	CABI, 2021	CABI, 2021	CABI, 2021	
NEMATODE *Meloidogyne javanica* (Treub) Chitwood	CABI, 2021	CABI, 2021	Perera et al., 2008	
NEMATODE *Rotylenchulus reniformis* Linford and Oliveira	CABI, 2021	CABI, 2021	Bridge, 1988	
NEMATODE *Scutellonema brachyurus* (Steiner) Andrassy	CABI, 2021	CABI, 2021	CABI, 2021	
NEMATODE *Xiphinema index* Thorne & Allen	CABI, 2021	CABI, 2021	Ahmed et al., 2019	
FUNGUS *Alternaria alternata* (Fr.:Fr.) Keissl. (syn.: *Alternaria citri* Ellis & N. Pierce)	CABI, 2021; Mendes and Urben, 2021	CABI, 2021	Mendes and Urben, 2021	
FUNGUS *Asperisporium caricae* (Speg.) Maubl.	Mendes and Urben, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021; Mendes and Urben, 2021	
FUNGUS *Asterina caricarum* Rehm.	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Athelia rolfsii* (Curzi) Tu & Kimbr. (syn.: *Sclerotium rolfsii* Sacc.)	Mendes and Urben, 2021	Farr and Rosmann, 2021	Mendes and Urben, 2021	Listed in 2020 PRA from Costa Rica
FUNGUS *Cercospora apii* Fresen.	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	

Organism	In Brazil	In U.S.	Host Association	Notes
FUNGUS *Cercospora papayae* Hansf. (syn.: *Cercospora mamaonis* Viegas & Chupp)	Mendes and Urben, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Cladosporium herbarum* (Pers. : Fr.) Link (syn.: *Mycosphaerella tassiana* (de Not.) Johans.)	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Colletotrichum acutatum* J.H. Sinnnonds	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Colletotrichum coccodes* (Wallr.) S. Hughes	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Colletotrichum fructicola* Prihast., L. Cai & K.D. Hyde	CABI, 2021	CABI, 2021	Marquez-Zequera et al., 2018	
FUNGUS *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. in Penz.	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Corynespora casiicola* (Berk. & M.A. Curtís) C.T. Wei	Mendes and Urben, 2021	CABI, 2021	Mendes and Urben, 2021	
FUNGUS *Exserohilum rostratum* (Drechsler) K.J. Leonard & Suggs (syn.: *Drechslera rostrata* (Drechsler) M.J. Richardson & E.M. Fraser)	Farr and Rossman, 2021	Farr and Rossman, 2021	Ahmed et al., 2019	
FUNGUS *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl.	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Macrophomina phaseolina* (Tassi) Goid.	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Neocosmospora solani* (Mart.) L. Lombard & Crous (syn.: *Fusarium solani* (Mart.) Sacc.)	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	

Organism	In Brazil	In U.S.	Host Association	Notes
FUNGUS *Phytophthora capsici* Leonian	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Phytophthora nicotianae* Breda de Haan	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Phytophthora palmivora* (E.J. Butler) E.J. Butler	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Pythium aphanidermatum* (Edson) Fitzp.	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
FUNGUS *Rhizoctonia solani* J. G. Kühn	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Rhizopus stolonifer* (Ehr. ex Fr.)	Mendes and Urben, 2021	Farr and Rossman, 2021	Raabe et al., 1981	
FUNGUS *Stemphylium lycopersici* (Enjoji) W. Yamam.	Mendes and Urben, 2021	Farr and Rossman, 2021	Mendes and Urben, 2021	
FUNGUS *Thielaviopsis paradoxa* (De Seynes) Höhn.	Farr and Rossman, 2021	Farr and Rossman, 2021	Farr and Rossman, 2021	
BACTERIUM *Enterobacter cloacae* (Jordan) Hormaeche and Edwards	Moreira et al., 2013	Nishijima et al., 2010; Senter et al., 1985; Schroeder et al., 2009; Zaid et al., 2011	Nishijima et al., 1987; Nishijima et al., 2010	
BACTERIUM *Pectobacterium atrosepticum* (van Hall) Gardan et al. (syn.: *Pectobacterium carotovorum* subsp. *atrosepticum* (van Hall) Hauben et al.)	CABI, 2021	CABI, 2021	CABI, 2021	
BACTERIUM *Pectobacterium carotovorum* subsp. *carotovorum* (Jones) Hauben et al. (syn.: *Erwinia carotovora* subsp. *carotovora* (Jones) Bergey et al.)	CABI, 2021	CABI, 2021	Ahmed et al., 2019	

Organism	In Brazil	In U.S.	Host Association	Notes
BACTERIUM *Pseudomonas syringae* van Hall (syn.: *Pseudomonas syringae* pv. *syringae* van Hall)	Fioravanço et al., 2004	CABI, 2021	Fioravanço et al., 2004	
VIRUS *Potyvirus Papaya ringspot virus* type P (PRSV-P)	Kitajima, 2020	Gonsalves et al., 2010	Gonsalves et al., 2010	
VIRUS *Tomato spotted wilt orthotospovirus* (TSWV)	Gioria et al., 2010	CABI, 2021	Sa Antunes et al., 2020	