

**Pest List for the Importation of
Dragon Fruit (multiple genera and species) into the
Continental United States from Thailand**

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Ver. 2

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1. Introduction

We developed this pathway-initiated commodity pest list to identify potential plant pest risks associated with the proposed importation of dragon fruit (pitahaya, pitaya) from Thailand into the continental United States. The list of dragon fruit pests is based on extensive survey data on dragon fruit grown in Thailand, published scientific literature, and worldwide pest interception records of the United States Department of Agriculture (PestID, 2009). All future references to the proposed importation of dragon fruit will imply restriction to the continental United States.

The botanical nomenclature of dragon fruit is unsettled (Jacobs, 1999; Raveh et al., 1993; Soloman, 2006). This is partly due to its morphological similarities to and ability to hybridize with other *Hylocereus* spp. and cactus genera (Morton, 1987; Raveh et al., 1993; Tel-Sur et al., 2001). Numerous synonyms and frequent misidentifications exist for the commodity (NGRP, 2006; Jacobs, 1999; Morton, 1987; Tel-Sur et al., 2001). Therefore, we have listed the fruit of cacti that are referred to as "dragon fruit" or "pitaya" that we assessed (Table 1).

Table 1. Cacti fruit that are referred to as Dragon Fruit or Pitaya¹

Cactus species	Synonym(s)/Alternate nomenclature
<i>Acanthocereus occidentalis</i>	none
<i>Acanthocereus tetragonus</i>	<i>Acanthocereus colombianus</i> , <i>A. floridanus</i> , <i>A. pentagonus</i> , <i>A. pitajaya</i> , <i>Cactus pentagonus</i> , <i>C. pitajaya</i> , <i>C. tetragonus</i> , <i>Cereus pentagonus</i> , <i>C. pitajaya</i>
<i>Cereus hildmannianus</i>	<i>Cactus peruvianus</i> , <i>Cereus uruguayanus</i>
<i>Echinocereus conglomeratus</i>	<i>Cereus conglomeratus</i>
<i>Echinocereus stramineus</i>	<i>Cereus stramineus</i> , <i>Echinocereus enneacanthus</i> var. <i>stramineus</i>
<i>Escontria chiotilla</i>	<i>Cereus chiotilla</i>
<i>Hylocereus costaricensis</i>	<i>Cereus trigonus</i> var. <i>costaricensis</i>
<i>Hylocereus ocamponis</i>	<i>Cereus ocamponis</i>
<i>Hylocereus polyrhizus</i>	<i>Cereus polyrhizus</i> , <i>H. lemairi</i>
<i>Hylocereus undatus</i>	<i>Cactus triangularis</i> , <i>Cereus triangularis</i> , <i>C. tricostatus</i> , <i>C. trigonus</i> var. <i>guatemalensis</i> , <i>C. undatus</i> , <i>Hylocereus guatemalensis</i> , <i>H. tricostatus</i>
<i>Myrtillocactus geometrizans</i>	<i>Cereus geometrizans</i>
<i>Stenocereus stellatus</i>	<i>Cereus stellatus</i>
<i>Stenocereus thurberi</i>	<i>Cereus thurberi</i> , <i>Lemairocereus thurberi</i> , <i>Marshallocereus thurberi</i> , <i>Pachycereus thurberi</i>

¹ NGRP, 2006; Jacobs, 1999; Morton, 1987; Soloman, 2006.

2. Pest Categorization

We listed pests associated with dragon fruit that occur in Thailand below (Table 2). This list includes information on the presence or absence of these pests in the United States, the affected plant part or parts, the quarantine status of the pest with respect to the United States, an indication of the pest-host association, and pertinent references for pest distribution and biology.

Note: In the pest list, we only provided information on plant part association and whether the pest is likely to follow the pathway for quarantine pests, not for non-quarantine pests. Even if non-quarantine pests are able to follow the pathway, phytosanitary measures against these pests would not be justified, considering the pest already occurs in the United States. Therefore, information on plant part association and whether the pest is likely to follow the pathway is not needed for non-quarantine pests and is indicated with N/A (not applicable).

Table 2. Pests associated with dragon fruit that are also present in Thailand

Pest	Geographical distribution ²	Quaran-tine pest	Plant part affected ³	Follow pathway	References
ARTHROPODS					
ACARI					
Tarsonemidae					
<i>Tarsonemus</i> sp.	TH, US	Yes ⁴	F, S	Yes ⁵	PestID, 2009; CABI, 2007; Lombardero et al., 2000
INSECTA					
Coleoptera: Scarabaeidae					
<i>Protaetia</i> sp.	TH, US (HI)	Yes	S	No	PPD, 2006; Pholboon, 1965; Campora, 2009
Diptera: Tephritidae					
<i>Bactrocera</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Bactrocera correcta</i> (Bezzi)	TH	Yes	F	Yes	World Bank, 2006; CABI, 2007
<i>Bactrocera cucurbitae</i> (Coquillett)	TH	Yes	F	Yes	World Bank, 2006; CABI, 2007
<i>Bactrocera dorsalis</i> (Hendel)	TH	Yes	F	Yes	World Bank, 2006; CABI, 2007

² Specific states are listed only if distribution is limited. Distribution: CA = California; FL = Florida; HI = Hawaii; LA = Louisiana; TX = Texas.

³ Plant Parts: F = Fruit; I = Inflorescence (flower); L = Leaf; R = Root; S = Stem; Sd = Seed.

⁴ This cosmopolitan genus of soft mites contains some species that are specific to a region, while other species in the genus are found worldwide (CABI, 2007). Many species within this genus are quarantine species. With no certainty as to whether the intercepted *Tarsonemus* sp. is of quarantine significance, we made a conservative decision here.

⁵ Only one interception of *Tarsonemus* sp. has been reported on *Hylocereus*; however, *Tarsonemus* sp. has been reported over 1,950 times on various commodities from the world (PestID, 2009). Thus, it is likely to follow the pathway.

Pest	Geographical distribution ²	Quarantine pest	Plant part affected ³	Follow pathway	References
Hemiptera: Aphididae					
<i>Aphis gossypii</i> Glover	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
<i>Pentalonia nigronervosa</i> (Coquerel, 1859)	TH, US (CA, FL, HI)	No	S	N/A	FAO, 2004; CABI, 2007
Hemiptera: Coccidae					
<i>Coccus</i> sp.	TH, US	No	F	N/A	PestID, 2009; CABI 2007
Hemiptera: Coreidae					
<i>Mictis longicornis</i> (Westwood)	TH	Yes	S	No	Pholboon, 1965, PPD, 2006
Hemiptera: Diaspididae					
<i>Diaspis echinocacti</i> (Bouché)	TH, US	No	F	N/A	PestID, 2009; Rojanavongse, et al., 1983; Ben-Dov et al., 2008; CABI, 2007
Hemiptera: Pseudococcidae					
<i>Paraputo</i> sp. Laing syn. <i>Cataenococcus</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Dysmicoccus neobrevipes</i> Beardsley	TH, US [HI]	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Dysmicoccus brevipes</i> (Cockerell 1903) syn. <i>Pseudococcus brevipes</i> (Cockerell)	TH, US (CA, HI, FL, LA)	No	F, I, S	N/A	PestID, 2009; FAO, 2004; CABI, 2007
<i>Dysmicoccus</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007,
<i>Ferrisia virgata</i> Cockerell	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
<i>Maconellicoccus hirsutus</i> (Green)	TH, US (FL, HI, CA)	[Yes] ⁶	F	Yes	PestID, 2009; CABI, 2007
<i>Paracoccus</i> sp.	TH, US	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Planococcus citri</i> (Risso)	TH, US	No	F	N/A	PestID, 2009; CABI, 2007; Mazzeo et al., 2008
<i>Planococcus lilacinus</i> (Cockerell)	TH	Yes	F	Yes	PestID, 2009; Ben-Dov, 1994

⁶ *Maconellicoccus hirsutus* is a quarantine-significant species with limited distribution in the United States (NIS, 2006; PestID, 2009).

Pest	Geographical distribution ²	Quaran-tine pest	Plant part affected ³	Follow pathway	References
<i>Planococcus minor</i> Maskell	TH	Yes	F	Yes	PestID, 2009; Cox, 1981; Ben-Dov et al., 2008
<i>Planococcus</i> sp.	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
<i>Pseudococcus cryptus</i> Hempel	TH	Yes	F	Yes	PestID, 2009; Panyasiri et al., 2007; CABI, 2007
<i>Pseudococcus jackbeardsleyi</i> Gimpel	TH, US (HI, FL, TX)	No	L	N/A	PestID, 2009; CABI, 2007
<i>Pseudococcus</i> sp.	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
Hymenoptera: Formicidae					
<i>Cardiocondyla wroughtoni</i>	TH, US	No	S, I, F	N/A	Mackay, 1995; PPD, 2006
<i>Paratrechina longicornis</i> (Latreille)	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
<i>Pheidole megacephala</i> (Fabricius)	TH, US	No	F	N/A	FAO, 2004
<i>Solenopsis geminata</i> (Fabricius)	TH, US	No	F, I, S	N/A	FAO, 2004; PPD, 2006
Lepidoptera: Crambidae					
<i>Conogethes</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
Lepidoptera: Gracillariidae					
<i>Conopomorpha</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
Lepidoptera: Pyralidae					
<i>Ephestia elutella</i> (Hubner)	TH, US	No	Sd	N/A	PestID, 2009; Charernsom, 2004; CABI, 2007
Lepidoptera: Lymantriidae					
<i>Orgyia</i> sp.	TH	Yes	L	No	PestID, 2009; CABI, 2007
BACTERIA					
<i>Xanthomonas campestris</i> (Pammel 1895) Dowson 1939	TH, US	No	F, S	N/A	Jacobs, 1999; CABI, 2007
FUNGI					
<i>Alternaria</i> sp.	TH, US	Yes	F	Yes	PestID, 2009; CABI, 2007

Pest	Geographical distribution ²	Quarantine pest	Plant part affected ³	Follow pathway	References
<i>Alternaria alternata</i> (Fr: Fr) Kessel	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
<i>Cercospora</i> sp.	TH	No	L	N/A	PestID, 2009; Kawabe et al., 2002; Sherf, 1975
<i>Botryosphaeria dothidea</i> (Moug.: Fr.) Ces. & De Not	TH, US	No	S	N/A	FAO, 2007; Farr et al., 2010; Valencia-Botín, 2003
<i>Cladosporium herbarum</i> (Pers.Fr.) Fr. = <i>C. epiphyllum</i> (Pers.Fr.) Fr.	TH, US	No	L	N/A	PestID, 2009; CABI, 2007
<i>Cladosporium</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Colletotrichum capsici</i> (Syd.) E.J. Butler & Bisby	TH, US	No	F	N/A	CABI, 2007; Sontirat, 1994
<i>Colletotrichum coccodes</i> (Wallr.) S. Hughes	TH, US	No	F	N/A	CABI, 2007; Sontirat, 1994
<i>Colletotrichum</i> sp.	TH, US	No	F	N/A	PestID, 2009; CABI, 2007
<i>Fusarium oxysporum</i> (Schlechtendahl)	TH, US	No	F	N/A	CABI, 2007; Suwanarit, 2005
<i>Fusarium</i> sp.	TH, US	No	F	N/A	FAO, 2004; Suwanarit, P. et al., 2005
<i>Gibberella moniliformis</i> Wineland = <i>G. fujikuroi</i> (Sawada) Ito; Anamorph: <i>Fusarium verticillioides</i> (Sacc.) Nirenberg, = <i>F. moniliforme</i> Sheld.	TH, US	No	I, F, R, S, Sd	N/A	CABI, 2007; Miller, 1993; Sontirat, 1994
<i>Glomerella cingulata</i> (Stonem.) Spauld. & Schrenk [teleomorph] = <i>Colletotrichum gloeosporioides</i> (Spauld. & Schrenk)	TH, US	No	F	N/A	PestID, 2009; CABI, 2007; Palmateer and Ploetz, 2007
<i>Lasiodiplodia theobromae</i> (Pat.) Griffin & Maubl. = <i>Botryodiplodia theobromae</i> (Pat.) Griffin & Maubl.	TH, US	No	F, S	N/A	PestID, 2009; CABI, 2007; Dethoup et al., 2007

Pest	Geographical distribution ²	Quarantine pest	Plant part affected ³	Follow pathway	References
<i>Leptosphaeria</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Mycosphaerella</i> sp.	TH	Yes	L ⁷	No	PestID, 2009; CABI, 2007
<i>Pestalotiopsis</i> sp.	TH	Yes	F	Yes	PestID, 2009; Ploetz et al., 1997; Sittigul et al., 2005
<i>Phoma</i> sp.	TH	Yes	F	Yes	PestID, 2009; Likhitekaraj et al., 2007
<i>Phomopsis</i> sp.	TH	Yes	F	Yes	PestID, 2009; CABI, 2007
<i>Phytophthora cactorum</i> (Lebert & Cohn) J. Schröt.	TH, US	No	F, R, S	N/A	CABI, 2007; Erwin, 1996; Sontirat, 1994
<i>Thanatephorus cucumeris</i> (Frank) Donk. [Anamorph: <i>Rhizoctonia solani</i> Kühn]	TH, US	No	R, S	N/A	Alfieri et al., 1984; Farr et al., 2010
NEMATODES					
<i>Cactodera cacti</i> Filipjev & Stekhoven	TH, US	No	R	No	CABI, 2007, Charernsom, 2004
<i>Helicotylenchus dihystra</i> (Cobb)	TH, US	No	R	No	CABI, 2007; Buriticá, 1999; Castaña et al., 1991
<i>Meloidogyne incognita</i> (Kofoid & White) Chitwood	TH, US	No	R	No	PestID, 2009; CABI, 2007
<i>Rotylenchulus reniformis</i> Linford & Oliveira	TH, US	No	R	No	CABI, 2007; Inserra, 1999

⁷ Interception record indicates the fungi was found on the plant, but no specifics were given (PestID, 2009). Typically, fungi affect the leaf, flower, and/or stem.

2.1. Pest list discussion

We did not list some quarantine pests as being likely to follow the pathway, for a variety of reasons (e.g., a lack of specific identification). Should any of these pests be intercepted in shipments of the commodity, however, quarantine action may be taken and additional risk analyses may be done.

Biological hazards associated with organisms not identified to the species level were not assessed because often there are many species within a genus, and it is not reasonable to assume that the biology of all organisms within a genus is identical. In this risk assessment, the above statement applies to *Alternaria* sp., *Cercospora* sp., *Cladosporium* sp., *Fusarium* sp. (Anamorphic fungi); *Aphis* sp. (Hemiptera: Aphididae); *Cataenococcus* sp., *Dysmicoccus* sp., *Planococcus* sp., and *Pseudococcus* sp. (Hemiptera: Pseudococcidae); *Coccus* sp. (Hemiptera: Coccidae); *Colleotrichum* sp. (Ascomycetes: Phyllachorales); *Conopomorpha* sp. (Lepidoptera: Gracillariidae); *Gloeosporium* sp. (Ascomycetes: Helotiales); *Orgyia* sp. (Lepidoptera: Lymantriidae); *Pheidole* sp. and *Technomyrmex* sp. (Hymenoptera: Formicidae), *Phoma* sp., and *Phomopsis* sp. (Ascomycetes: Dothideales); and *Tarsonemus* sp. (Acari: Tarsonemidae).

2.2. Quarantine Pests Likely to Follow the Pathway

The quarantine pests that are likely to follow the pathway are listed below (Table 4).

Table 4. Quarantine Pests Likely to Follow the Pathway

Organism	Taxonomy
<i>Bactrocera correcta</i> (Bezzi)	Diptera: Tephritidae
<i>Bactrocera cucurbitae</i> (Coquillett)	Diptera: Tephritidae
<i>Bactrocera dorsalis</i> (Hendel)	Diptera: Tephritidae
<i>Dysmicoccus neobrevipes</i> (Beardsley)	Homoptera: Pseudococcidae
<i>Maconellicoccus hirsutus</i> (Green)	Homoptera: Pseudococcidae
<i>Planococcus lilacinus</i> (Cockerell)	Homoptera: Pseudococcidae
<i>Planococcus minor</i> (Maskell)	Homoptera: Pseudococcidae
<i>Pseudococcus cryptus</i> (Hempel)	Homoptera: Pseudococcidae

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