Importation of Fresh Apricot, *Prunus armeniaca* (L.) fruit, from Continental Spain into the United States, including Hawaii and U.S. Territories

A Pathway-Initiated Risk Assessment

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Executive Summary

This document assesses the risks associated with the importation of fresh apricot fruit, *Prunus armeniaca* (L.), from continental Spain into the United States. A search of print and electronic resources identified four quarantine-significant pests that occur in Spain and could be introduced into the United States in shipments of the commodity. The quarantine pests were qualitatively analyzed based on international principles and internal guidelines as described in the PPQ guidelines for Pathway-Initiated Pest Risk Assessments version 5.02 (USDA, APHIS, 2000). Quarantine-significant pests likely to follow the pathway (i.e., accompany shipments of apricot) include one fruit fly, one moth, and two fungi.

Type	**Organism**	**Taxonomy**
Fruit fly	*Ceratitis capitata* Wiedemann	Diptera: Tephritidae
Moth	*Cydia funebrana* (Treitschke)	Lepidoptera: Tortricidae
Fungi	*Apiognomonia erythrostoma* (Pers.)	Ascomycetes
	Monilinia fructigena Honey	Discomycetes

All of the quarantine-significant pests identified in this document and deemed likely to follow the pathway pose phytosanitary risks to U.S. agriculture. *Apiognomonia erythrostoma* was assigned a Medium pest risk potential, and the remaining species were assigned High pest risk potentials. Additional phytosanitary measures may be necessary to guard against the introduction and establishment of pests with Medium pest risk potentials and are strongly recommended for pests with High pest risk potentials.

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I. Introduction

This risk assessment was prepared by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), Center for Plant Health Science and Technology (CPHST), Plant Epidemiology and Risk Analysis Laboratory (PERAL) on behalf of the Sub-Director General de Sanidad Vegetal, Ministry of Agriculture, Fisheries and Food, Spain. Plant pest risks associated with the importation of fresh fruit of apricot, *Prunus armeniaca* (L.), from continental Spain into the United States were estimated and assigned the qualitative terms High, Medium or Low in accordance with the template document, *Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02* (USDA, 2000a).

The methods used to initiate, conduct and report the plant pest risks associated with importation of fresh fruits of apricot from continental Spain into the United States meet international standards provided by the International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO) (IPPC, 1996a, 2004). Biological and phytosanitary terms meet the definitions in *International Standards for Phytosanitary Measures*: *Glossary of Phytosanitary Terms* (IPPC, 2002a).

The apricot is native to China and has been cultivated for over 4,000 years (Ogawa et al., 1995). It is an economically important crop in many countries with world production estimated at 3.5 million metric tons annually (CABI, 2003). Production is concentrated in the former U.S.S.R., Turkey, Italy, Spain, Greece, France and the United States (Ogawa et al., 1995).

II. Risk Assessment

A. Initiating Event: Proposed Action

This risk assessment was developed in response to a request by the government of Spain through the Counselor for Agriculture, Fisheries and Food, Embassy of Spain, Washington, D.C. for USDA authorization to import fresh fruit of apricot into the United States. Entry of this commodity into the United States presents a potential pathway for the introduction of plant pests. Title 7, Part 319, Section 56 of the United States Code of Federal Regulations (7 CFR §319.56) provides regulatory authority for the importation of fruits and vegetables from foreign sources into the United States.

B. Assessment of the Weed Potential of Apricot

The potential of the commodity to become a weed after it enters the United States was examined, with analysis indicating that the commodity had negligible weed potential (Table 1).

Table 1. Assessment of the weed potential of apricot (*Prunus armeniaca*) (Rosaceae)

Phase 1: Apricot is cultivated throughout the United States in Hardiness Zones 4-9 (Kuhns and Rupp, 2000). It is commercially grown in Arizona, California, Michigan, Utah and Washington (Ogawa et al., 1995).

Phase 2: Is the species listed in:

- No *Geographical Atlas of World Weeds* (Holm et al., 1979).
- No *World's Worst Weeds* (Holm et al., 1977) or *World Weeds*: *Natural Histories and Distribution* (Holm et al., 1997).
- No Report of the Technical Committee to Evaluate Noxious Weeds: Exotic Weeds for the Federal Noxious Weed Act (Gunn and Ritchie, 1982).
- No *Economically Important Foreign Weeds* (Reed, 1977).
- No Weed Science Society of America Composite List of Weeds (WSSA, 2004).
- No Does any literature indicate weed potential (*e.g.* AGRICOLA, CAB, Biological Abstracts, AGRIS search on "species name" combined with "weed")

Phase 3: Apricot is a common deciduous tree with a wide geographic distribution in the United States. This species and its botanical varieties were not listed as weeds in the United States or any foreign country.

C. Current Status, Previous Decisions, and Pest Interceptions

1. Current status

Title 7, Part 319, Section 56 of the U.S. Code of Federal Regulations (7 CFR §319.56) does not currently permit importation of fresh fruit of apricot from continental Spain into the United States.

2. Previous decisions

Apricot from Spain was denied entry into the United States on 11 May 1988 because there was no acceptable treatment for *Cydia funebrana.*

3. Pest interception records

From 1985 and 2007, in passenger baggage from Spain there have been two interceptions on *Prunus armeniaca* reported in the AQAS database: one interception of a Tortricidae, sp. and one interception of *Ceratitis capitata.*

D. Pest Categorization

1. Pests associated with apricot in Spain

Pests that were associated with apricot and occur in Spain are listed in Table 2. We included information on the geographic distribution of these pests, the affected plant part(s), quarantine status with respect to the United States, and relevant references on distribution and biology. This provided the basis for selecting pests for further analyses.

Table 2. Pests associated with apricot in Continental Spain [1]

Pest	Geographic distribution[2]	Plant part affected [3]	Quaran-tine pest	Follow pathway	References
ARTHROPODS					
ACARI					
Tenuipalpidae					
Brevipalpus californicus (Banks)	ES, US	F, L, S	No	Yes	Childers et al., 2003; Jeppson et al., 1975
Tetranychidae					
Amphitetranyuchus (*Tetranychus*) *viennensis* (Zacher)	ES	F, L, S	Yes	No[16]	Bolland et al., 1998; CABI, 2003; Jeppson et al., 1975; Pucat and Garland, 2003
Bryobia praetiosa Koch	ES, US	L	No	No	Bolland et al., 1998; Jeppson et al., 1975
Bryobia rubrioculus Scheuten	ES, US	F, L	No	Yes	Bolland et al., 1998; Jeppson et al., 1975
Panonychus ulmi (Koch)	ES, US	L	No	No	Bolland et al., 1998; Jeppson et al., 1975
Tetranychus ludeni Zacher	ES, US	L	No	No	Bolland et al., 1998; Jeppson et al., 1975
Tetranychus urticae Koch	ES, US	L	No	No	Bolland et al., 1998; CABI, 2003; Esteruelas, 2001
INSECTA					
Coleoptera: Bostrichidae					
Apate monachus Fabricius	ES	S	Yes	No	Avidov and Harpaz, 1969; CABI, 2003; Lopez-Colon, 1996
Coleoptera: Buprestidae					
Capnodis tenebrionis (Linnaeus)	ES	S	Yes	No	CABI, 2003; Esteruelas, 2001; HYPPZ, 2004
Coleoptera: Curculionidae					
Otiorhynchus cribricollis Gyllenhal	ES, US	L, R	No	No	CABI, 2003;Van Steenwyk et al., 2004
Coleoptera: Nitidulidae					
Carpophilus hemipterus (Linnaeus)	ES, US	F	No	Yes	CABI, 2003; Danielson, 2004; Plaza, 1976

Pest	Geographic distribution[2]	Plant part affected [3]	Quaran-tine pest	Follow pathway	References
Carpophilus mutilatus Erichson	ES, US	I	No	No	CABI, 2003; Danielson, 2004; Plaza, 1976
Coleoptera: Scolytidae					
Scolytus amygdali Guerin-Meneville	ES	S	Yes	No	CABI, 2003; Bright and Skidmore, 1997; Wood and Bright, 1992
Scolytus kirschi Skalitzky	ES	S	Yes	No	CABI, 2003; Bright and Skidmore, 1997; Wood and Bright, 1992
Scolytus mali (Bechstein)	ES, US	S	No	No	CABI, 2003; Bright and Skidmore, 1997; Wood and Bright, 1992
Scolytus rugulosus (Ratzeburg)	ES, US	S	No	No	CABI, 2003
Scolytus scolytus (Fabricius)	ES	S	Yes	No	CABI, 2003; Bright and Skidmore, 1997; Wood and Bright, 1992
Trypodendron signatum (Fabricius)	ES	S	Yes	No	CABI, 2003; Bright and Skidmore, 1997; Wood and Bright, 1992
Xyleborinus saxeseni (Ratzeburg)	ES, US	S	No	No	CABI, 2003; Wood and Bright, 1992
Xyleborus dispar (Fabricius)	ES, US	S	No	No	CABI, 2003
Dermaptera: Forficulidae					
Forficula auricularia Linnaeus	ES, US	F	No	No[4]	Nafria et al., 2003; Van Steenwyk et al., 2004
Diptera: Tephritidae					
Ceratitis capitata Wiedemann	ES, US (HI)	F	Yes	Yes	Avidov and Harpaz, 1969; CABI, 2003; CABI/EPPO, 1999; Esteruelas, 2001; White and Elton-Harris, 1992

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Hemiptera: Aphididae					
Aphis gossypii Glover	ES, US	L, S	No	No	Avidov and Harpaz, 1969; CABI, 2003
Aphis spiraecola Patch (= *A. citricola*)	ES, US	L, S	No	No	CABI, 2003; Nieto-Nafria et al., 1984
Brachycaudus cardui (Linnaeus)	ES, US	L, S	No	No	Blackman and Eastop, 1994; Nafria et al., 2003
Brachycaudus persicae (Passerini)	ES, US	L, R, S	No	No	Blackman and Eastop, 1994; Nafria et al., 2003
Hyalopterus pruni (Geoffrey)	ES, US	L, S	No	No	Avidov and Harpaz, 1969; Blackman and Eastop, 1994; CABI, 2003; Nieto-Nafria et al., 1984
Myzus persicae Suler	ES, US	L, S	No	No	Avidov and Harpaz, 1969; CABI, 2003; Nieto-Nafria et al., 1984
Pterochloroides persicae (Cholodkovsky)	ES	S	Yes	No	Blackman and Eastop, 1994, CABI, 2003
Hemiptera: Cicadellidae					
Austroagallia sinuata (Mulsant and Rey)	ES	L	Yes	No	Borror et al., 1989; CABI, 2003; Nafria et al., 2003
Neoaliturus fenestratus (Herrich-Schäffer)	ES	L	Yes	No	Borror et al., 1989; CABI, 2003; Llácer and Medina. 1988
Neoaliturus haematoceps (Mulsant and Rey)	ES	L	Yes	No	Borror et al., 1989; CABI, 2003; Llácer and Medina. 1988
Psammotettix striatus (Linnaeus)	ES	L	Yes	No	Borror et al., 1989; CABI, 2003; Llácer and Medina. 1988
Hemiptera: Coccidae					
Ceroplastes floridensis Comstock	ES, US	L, S	No	No	Avidov and Harpaz, 1969; Ben-Dov, 1993; CABI, 2003; IIE, 1982b; Scalenet, 2004

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Coccus hesperidum Linnaeus	ES, US	L, S	No	No	Avidov and Harpaz, 1969; Ben-Dov, 1993; CABI, 2003; Scalenet, 2004
Eulecanium tiliae (Linnaeus)	ES, US	L, S	No	No	Ben-Dov, 1993; CABI, 2003; Scalenet, 2004
Parasaissetia nigra (Nietner)	ES, US	L, S	No	No	Ben-Dov, 1993; CABI, 2003; Scalenet, 2004
Parthenolecanium corni (Bouche)	ES, US	L, S	No	No	Ben-Dov, 1993; CABI, 2003; Scalenet, 2004
Parthenolecanium persicae (Fabricius)	ES, US	L, S	No	No	Ben-Dov, 1993; Scalenet, 2004
Pulvinaria vitis (Linnaeus)	ES, US	L, S	No	No	Ben-Dov, 1993; CABI, 2003; Scalenet, 2004
Saissetia oleae (Olivier)	ES, US	L, S	No	No	Avidov and Harpaz, 1969; CABI, 2003; Scalenet, 2004
Sphaerolecanium prunastri (Boyer de Fonscolombe)	ES, US	L, S	No	No	Avidov and Harpaz, 1969; Ben-Dov, 1993; CABI, 2003; Kosztarab and Kozar, 1988
Hemiptera: Diaspididae					
Diaspidiotus ancylus (Putnam)	ES, US	F, L, S	No	Yes	CABI, 2003; Scalenet, 2004
Diaspidiotus pyri (Lichtenstein)	ES	S	Yes	No	CABI, 2003; Scalenet, 2004
Lepidosaphes ulmi (Linnaeus)	ES, US	F, L, S	No	Yes	CABI, 2003; Scalenet, 2003
Parlatoria oleae (Colvee)	ES, US	F, L, S	No	Yes	CABI, 2003; Scalenet, 2004
Pseudaulacaspis pentagona (Targioni Tozzetti)	ES, US	F, L, S, R	No	Yes	CABI, 2003; Kosztarab and Kozar, 1988; Scalenet, 2004
Quadraspidiotus (*Aspidiotus*) *perniciosus* (Comstock)	ES, US	F, L, S	No	Yes	CABI, 2003; Esteruelas, 2001

Pest	Geographic distribution[2]	Plant part affected [3]	Quaran-tine pest	Follow pathway	References
Hemiptera: Lygaeidae					
Oxycarenus hyalinipennis (Costa)	ES	F	Yes	No[4]	Avidov and Harpaz, 1969; CABI, 2003; Henry, 1983; IIE, 1982c
Hemiptera: Pentatomidae					
Nezara viridula (Linnaeus)	ES, US	F, I, L, S, Sd	No	No[4]	Avidov and Harpaz, 1969; CABI, 2003
Hemiptera: Tingidae					
Stephanitis pyri (Fabricius)	ES	L	Yes	No	Avidov and Harpaz, 1969; Hill, 1994; HYPPZ, 2004; IIE, 1983
Hymenoptera: Tenthredinidae					
Caliroa cerasi Linnaeus (= *C. limacina*)	ES, US	L	No	No	CABI, 2003; Mansilla et al., 1987
Hoplocampa flava Linnaeus	ES	L	Yes	No	CABI, 2003; HYPPZ, 2004; IIE, 1963a
Hoplocampa minuta (Christ)	ES	L	Yes	No	CABI, 2003; HYPPZ, 2004; IIE, 1963b
Lepidoptera: Gelechiidae					
Anarsia lineatella Zeller	ES, US	F, I, L, S	No	Yes	CABI, 2003; Carter, 1984; Esteruelas, 2001; Zhang, 1994
Parachronistis albiceps Zeller	ES	I, L	Yes	No	Carter, 1984; Zhang, 1994
Lepidoptera: Geometridae					
Operophtera brumata Linnaeus	ES, US (OR, WA)	F, I, L	[Yes][5]	No[6]	CABI, 2003; Carter, 1984; Hill, 1994; Zhang, 1994
Erannis defoliaria (Clerck)	ES	L	Yes	No	CABI, 2003; Carter, 1984
Lepidoptera: Lymantriidae					
Euproctis chrysorrhoea (Linnaeus)	ES, US (MA, ME)	L	[Yes][5]	No	CABI, 2003; Carter, 1984; IIE, 1976; USDA, 2002a

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Lymantria dispar Linnaeus	ES, US (CT, DE, IL, IN, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, RI, VA, VT, WI, WV)	I, L	Yes	No	CABI, 2003; Hill, 1994; USDA, 2000b; USDA, 2000c; Zhang, 1994
Lepidoptera: Noctuidae					
Acronicta psi (Linnaeus)	ES	L	Yes	No	CABI, 2003; Carter, 1984; Zhang, 1994
Diloba caeruleocephala (Linnaeus)	ES	F, L	Yes	No[6]	Carter, 1984
Helicoverpa armigera (Hübner)	ES	F, I, L, S	Yes	No[17]	CABI, 2003; Robinson et al., 2004
Peridroma saucia (Hübner)	ES, US	F, L, S	No	No[7]	CABI, 2003; Carter, 1984; Zhang, 1994
Phlogophora meticulosa (Linnaeus)	ES	I, L	Yes	No	CABI, 2003; Carter, 1984
Xylena exsoleta (Linnaeus)	ES	L	Yes	No	Carter, 1984; Luque, 2003
Lepidoptera: Notodontidae					
Phalera bucephala	ES	L	Yes	No	Carter, 1984; Luque, 2003
Lepidoptera: Nymphalidae					
Hypolimnas misippus (Linnaeus)	Canary Islands, US (FL, MS, NC)	L	No	No	CABI, 2003; Opler et al., 2004; Padron and Hernandez, 1988; Robinson et al., 2004
Lepidoptera: Papilionidae					
Iphiclides podalirius (Scopoli)	ES	L	Yes	No	CABI, 2003; Mansilla et al., 1987; Zhang, 1994
Lepidoptera: Pieridae					
Aporia crataegi Linnaeus	ES	L	Yes	No	CABI, 2003; Carter, 1984; Zhang, 1994
Lepidoptera: Pyralidae					
Cadra cautella Walker	ES, US	F, R, Sd	No	No[8]	Avidov and Harpaz, 1969; CABI, 2003; Zhang, 1994

Pest	Geographic distribution[2]	Plant part affected [3]	Quaran-tine pest	Follow pathway	References
Ephestia elutella Hübner	ES, US	F, Sd	No	No[8]	CABI, 2003; Carter, 1984; Robinson et al., 2004
Ephestia figulilella Gregson	ES, US	F, Sd	No	No[8]	CABI, 2003; Carter, 1984; Robinson et al., 2004
Plodia interpunctella (Hübner)	ES, US	F, Sd	No	No[8]	CABI, 2003; Carter, 1984; Riudavets et al., 2002; Robinson et al., 2004
Lepidoptera: Tortricidae					
Adoxophyes orana Fischer von Röeslerstamm	ES	F, L	Yes	No[4]	CABI, 2003; Carter, 1984; Hill, 1994; IIE, 1982a; USDA, 2000b; Whittle, 1985; Zhang, 1994
Archips rosana Linnaeus (= *A. rosanus* (Linnaeus))	ES, US	L	No	No	CABI, 2003; Hill, 1994; Zhang, 1994
Archips xylosteanus Linnaeus	ES	L	Yes	No	CABI, 2003; Carter, 1984; Hill, 1994; Zhang, 1994
Cnephasia longana (Haworth)	ES, US	I, L	No	No	CABI, 2003; Carter, 1984; Robinson et al., 2004
Cydia funebrana (Treitschke)	ES	F	Yes	Yes	CABI, 2003; Carter, 1984; Esteruelas, 2001; Hill, 1994; HYPPZ, 2004; Whittle, 1984; Zhang, 1994
Cydia (*Grapholita*) *molesta* (Busck)	ES, US	F, S	No	Yes	CABI, 2003; Carter, 1984; Esteruelas, 2001; Hill, 1994; Zhang, 1994
Cydia pomonella Linnaeus	ES, US	F	No	Yes	CABI, 2003; Carter, 1984; Hill, 1994; Zhang, 1994
Pandemis heparana Denis and Schiffermüller	ES	F, L	Yes	No [6]	CABI, 2003; Carter, 1984; Ribes-Dasi et al., 2001; Robinson et al., 2004

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Tortricidae, sp. of	ES	F	Yes [9]	No [9]	PestID, 2004
Lepidoptera: Saturniidae					
Saturnia pyri (Denis and Schiffermuller)	ES	L	Yes	No	CABI, 2003; Zhang, 1994
Lepidoptera: Sessiidae					
Synanthedon myopaeformis (Borkhausen)	ES	S	Yes	No	Bosch et al., 2001; CABI, 2003; Carter, 1984
Lepidoptera: Zygaenidae					
Aglaope infausta (Linnaeus)	ES	F, L	Yes	No [10]	CABI, 2003; Carter, 1984; Schmitt and Seitz, 2004
Thysanoptera: Thripidae					
Frankliniella occidentalis (Pergande)	ES, US	F, I, L	No	Yes	CABI, 2003; Gonzalez et al., 1994
Thrips flavus Schrank	ES	I	Yes	No	CABI, 2003
FUNGI and CHROMISTANS					
Ascomycetes					
Alternaria alternata (Fr.: Fr.)	ES, US	F	No	Yes	CABI, 2003; Farr et al, 1989; Ogawa et al., 1995
Apiognomonia (*Gnomonia*) *erythrostoma* (Pers.)	ES	F, L	Yes	Yes	CABI, 2003; EPPO, 1993; Fé de Andrés et al., 1998; Ogawa et al., 1995
Aspergillus niger Tiegh	ES, US	F	No	Yes	CABI, 2003; Farr et al., 2003; Ogawa et al., 1995
Blumeriella jaapii (Rehm) (= *Coccomyces hiemalis*)	ES, US	L	No	No	CABI, 2003; Farr et al.,1989; Fé de Andrés et al., 1998; Ogawa et al., 1995
Botrytis cinerea Pers.: Fr.	ES, US	F, I, L, S	No	Yes	Alfieri et al., 1994; CABI, 2003; Farr et al.,1989; Fé de Andrés et al., 1998; Ogawa et al., 1995
Cladosporium sp.	ES	F, L, S	Yes [9]	No [9]	Fé de Andres et al., 1998; Ogawa et al., 1995

Pest	**Geographic distribution**[2]	**Plant part affected** [3]	**Quaran-tine pest**	**Follow pathway**	**References**
Colletotrichum acutatum J.H. Simmonds	ES, US	F, L, S	No	Yes	CABI, 2003; Farr et al.,1989; Fé de Andrés et al., 1998; Ogawa et al., 1995
Colletotrichum gloesporioides (Penz.)	ES, US	F, L, S	No	Yes	CABI, 2003; Farr et al.,1989; Fé de Andrés et al., 1998; Ogawa et al., 1995
Eutypa lata (Pers.: Fr.)	ES, US	F, I, S	No	Yes	CABI, 2003; Carter and Moller, 1974; Farr et al., 2003; Fé de Andrés et al., 1998; Ogawa et al., 1995
Gibberella baccata (Wallr.)	ES, US	L, S	No	No	CABI, 2003; Farr et al., 1989; Farr et al., 2003; Fé de Andrés et al., 1998
Leucostoma cincta (Fr.: Fr.)	ES, US	S	No	No	CABI, 2003; Farr et al., 1989; Farr et al., 2003; Fé de Andrés et al., 1998; Ogawa et al., 1995
Leucostoma persoonii Höhn.	ES, US	S	No	No	Alfieri et al., 1994; CABI, 2003; Farr et al.,1989; Farr et al., 2003; Fé de Andrés et al., 1998; Ogawa et al., 1995
Macrophomina phaseolina (Tassi)	ES, US	L, R, S	No	No	CABI, 2003; Fé de Andrés et al., 1998
Monilinia fructigena Honey	ES	F, I, L, S	Yes	Yes	CABI, 2003; Chang, 1986; Esteruelas, 2001; Fé de Andrés et al., 1998; Ogawa et al., 1995
Monilinia laxa (Aderhold and Ruhland)	ES, US	F, I, L, S	No	Yes	CABI, 2003; Farr et al.,1989; Farr et al., 2003; Ogawa et al., 1995
Phoma pomorum Thuem.	ES, US	F, L	No	Yes	CABI, 2003; Farr et al., 1989; Fé de Andrés et al., 1998; Ogawa et al., 1995

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Podosphaera leucotricha (Ellis and Everh.)	ES, US	F, I, L, S	No	Yes	CABI, 2003; Farr et al., 1989
Podosphaera tridactyla (Wallr.)	ES, US	F, L	No	Yes	Farr et al., 2003; Ogawa et al., 1995
Rosellinia (*Dematophora*) *necatrix* Prill.	ES, US	R, S	No	No	CABI, 2003; Farr et al., 2003; Ogawa et al., 1995; Sztejnberg and Madar; 1980
Sclerotinia sclerotiorum (Lib.)	ES, US	F, I, L, R, S, Sd	No	Yes	CABI, 2003; Farr et al., 1989
Sphaerotheca pannosa (Wallr.: Fr.)	ES, US	F, L, S	No	Yes	CABI, 2003; Esteruelas, 2001; Farr et al.,1989; Farr et al., 2003; French, 1989; Ogawa et al., 1995
Verticillium dahliae Kleb.	ES, US	F, I, L, R, S, Sd	No	Yes	CABI, 2003; Fé de Andrés et al., 1998; French, 1989; Ogawa et al., 1995
Wilsonomyces carpophilus (Lév.) (= *Stigmina carpophila*)	ES, US	F, L, S	No	Yes	CABI, 2003; Farr et al., 2003; Fé de Andrés et al., 1998; Kirk, 1999; Ogawa et al., 1995
Basidiomycetes					
Armillaria mellea (Vahl: Fr.)	ES, US	R	No	No	CABI, 2003; Farr et al., 2003; Fé de Andres et al., 1998; Ogawa et al., 1995
Athelia rolfsii (Curzi) [anamorph = *Sclerotium rolfsii*]	ES, US	F, L, R, S, Sd	No	Yes	CABI, 2003; Farr et al., 2003; Fé de Andres et al., 1998; Ogawa et al., 1995
Chondrostereum purpureum (Pers.: Fr.)	ES, US	L, S	No	No	CABI, 2003; Farr et al.,1989; Fé de Andrés et al., 1998; French, 1989; Ogawa et al., 1995

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Oomycetes					
Phytophthora cactorum (Lebert and Cohn)	ES, US	F, L, R, S	No	Yes	CABI, 2003; Farr et al., 2003; Fé de Andrés et al., 1998
Phytophthora cambivora (Petri)	ES, US	F, L, R, S	No	Yes	CABI, 2003; Farr et al., 1989; Ogawa et al., 1995
Phytophthora citrophthora (R.E. Sm. and E.H. Sm.)	ES, US	F, L, R, S, Sd	No	Yes	CABI, 2003; Farr et al., 1989; Farr et al., 2003
Phytophthora cryptogea Pethybr. and Lafferty	ES, US	F, L, R, S	No	Yes	CABI, 2003; Farr et al., 2003; Fé de Andrés et al., 1998; Ogawa et al., 1995
Pythium irregulare Buisman	ES, US	R, S	No	No	CABI, 2003; Farr et al., 2003
Phytophthora megasperma Dreschs.	ES, US	F, L, R, S	No	Yes	CABI, 2003, Farr et al., 1989 Fé de Andrés et al., 1998; Ogawa et al., 1995
Phytophthora nicotianae Breda de Haan	ES, US	F, L, R, S, Sd	No	Yes	CABI, 2003; Farr et al. 1989; Farr et al., 2003
Taphrinomycetes					
Taphrina deformans (Berk.)	ES, US	F, I, L, S	No	Yes	CABI, 2003; Farr et al.,1989; Farr et al., 2003; Fé de Andres et al., 1998; French, 1989; Ogawa et al., 1995
Urediniomycetes					
Tranzschelia pruni-spinosae (Pers.: Pers.)	ES, US	F, L, S	No	Yes	Alfieri et al., 1994; CABI, 2003; Farr et al., 1989; Fé de Andrés et al., 1998; Ogawa et al., 1995
BACTERIA					
Pseudomonadales					
Pseudomonas fluorescens (Trevisan)	ES, US	F, I, L, R, S	No	Yes	Bradbury, 1986; CABI, 2003; Fé de Andrés et al., 1998;

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
Pseudomonas syringae pv. *syringae* van Hall	ES, US	F, I, L, R, S	No	Yes	Bradbury, 1986; CABI, 2003; Fé de Andrés et al., 1998; Ogawa et al., 1995
Pseudomonas viridiflava (Burkholder)	ES, US	F, I, L, S, Sd	No	Yes	Bradbury, 1986; CABI, 2003
Rhizobiales					
Agrobacterium tumefaciens (E. F. Smith and Townsend)	ES, US	R, S	No	No	Bradbury, 1986; CABI, 2003; Fé de Andrés et al., 1998; López et al., 1988; Ogawa et al., 1995
VIRUSES					
Apple chlorotic leafspot trichovirus	ES, US	F, I, L, S	No	No [11]	CABI, 2003; Dominguez et al., 1998; Fé de Andrés et al., 1998; Llácer, 1995; Ogawa et al., 1995
Apple mosaic ilarvirus (Bromoviridae)	ES, US	F, I, R, S	No	No [11]	CABI, 2003; Dominguez et al., 1998; Fé de Andrés et al., 1998
Apple stem grooving capillovirus	ES, US	I, L, R, S, Sd	No	Yes [11]	CABI, 2003; Fé de Andrés et al., 1998
Cherry leaf roll nepovirus (Comoviridae)	ES, US	Sd	No	Yes [11]	CABI, 2003; Fé de Andrés et al., 1998; Nemeth, 1986; Ogawa et al., 1995; Rowhani and Mircetich, 1988
Cucumber green mottle mosaic virus	ES	F, I, L, R, S, Sd	Yes	No [12]	CABI, 2003; Brunt et al., 1996; Fé de Andrés et al., 1998

Pest	Geographic distribution[2]	Plant part affected [3]	Quaran-tine pest	Follow pathway	References
Plum pox virus (Potyviridae) (strain D)[18]	ES, US (PA)	F, I, L, R, S, Sd	Yes	No[19]	Amai et al., 1999; CABI, 2003; Chang, 1987; Damsteegt et al., 2001; Gildow, 2001; Gildow et al., 2002; Levy et al., 2000; Llácer, 1995; Llácer and Cambra, 1998; Németh, 1986; Ogawa et al., 1995; Pasquini and Barba, 2006
Prune dwarf ilarvirus (Bromoviridae)	ES, US	Sd	No	Yes [11]	Dominguez et al., 1998; Fé de Andrés et al., 1998; Németh, 1986; Ogawa et al., 1995
Prunus necrotic ringspot ilarvirus (Bromoviridae)	ES, US	I, L, R, S, Sd	No	Yes [11]	CABI, 2003; Dominguez et al., 1998; Fé de Andrés et al., 1998; Németh, 1986; Ogawa et al., 1995
Strawberry latent ringspot nepovirus (Comoviridae)	ES, US	L, S, F, Sd	Yes[13]	No [13]	Brunt et al., 1996; CABI, 2003; Čech et al., 1980; Martin et al, 2004; Ogawa et al., 1995; Postman et al., 2004; USDA, 2000b
VIROIDS					
Hop stunt hostuviroid (= Peach dapple fruit viroid) (Pospiviroidae)	ES, US (AZ, CA, FL, TX)	Ws	No	Yes [14]	Amari et al., 2001; CABI, 2003; Canizares et al., 1998; Ogawa et al., 1995; Šutić et al., 1999
Peach latent mosaic viroid (Avsunviroidae)	ES, US	Ws	No	Yes [14]	Badenes and Llácer, 1998; CABI, 2003; Fé de Andres et al., 1998; Llácer, 1998; Ogawa et al., 1995
PHYTOPLASMAS					
Aster yellows phytoplasma group (Acholeplasmatales)	ES, US	Ws	No	No [15]	CABI, 2003; Carraro et al, 2001

Pest	Geographic distribution[2]	Plant part affected [3]	Quarantine pest	Follow pathway	References
European stone fruit yellows phytoplasma (= Apricot chlorotic leafroll phytoplasma) (Acholeplasmatales)	ES	Ws	Yes	No [15]	CABI, 2003; Carraro et al, 2001; Fé de Andrés et al., 1998; Llácer, 1995; Nemeth, 1986; USDA, 2000b
Peach rosette mycoplasma (Acholeplasmatales)	ES, US	Ws	No	No [15]	CABI, 2003; Ogawa et al., 1995; Scott and Zimmerman, 2001
NEMATODES					
DORYLAIMIDA					
Longidoridae					
Xiphinema americanum Cobb	ES, US	R	No	No	Anonymous, 1984; CABI, 2003
Xiphinema index Thorne and Allen	ES, US	R	No	No	Anonymous., 1984; CABI, 2003
TYLENCHIDA					
Heteroderidae					
Meloidogyne incognita (Kofoid and White)	ES, US	R	No	No	CABI, 2003; Goodey et al., 1965
Meloidogyne javanica (Treub.)	ES, US	R	No	No	CABI, 2003; Goodey et al., 1965
Hoplolaimidae					
Rotylenchulus reniformis Lindford and Olivera	ES, US	R	No	No	Anonymous, 1984; CABI, 2003
Pratylenchidae					
Pratylenchus coffeae (Zimmermann)	ES, US	R	No	No	CABI, 2003; Goodey et al., 1965
Pratylenchus penetrans (Cobb)	ES, US	R	No	No	Anonymous, 1984; CABI, 2003; Nyczepir and Halbrendt, 1993
Pratylenchus vulnus Allen and Jensen	ES, US	R	No	No	Anonymous, 1984; CABI, 2003; Nyczepir and Halbrendt, 1993

[1] Data were included for some pests that occur only in the Canary Islands, which are not part of continental Spain. These data were included because some literature lists these pests as occurring in Spain without specification. Because these species were assumed to not occur in continental Spain, they

were not likely to follow the pathway.

[2] ES = Spain; US = United States (specific states were listed only if the distribution was limited; AZ = Arizona; CA = California, CT = Connecticut, DE = Delaware, FL = Florida, HI = Hawaii, IL = Illinois, IN = Indiana, MA = Massachusetts, ME = Maine, MI = Michigan, MS = Mississippi, NC = North Carolina, NH = New Hampshire, NJ = New Jersey, NY = New York, OH = Ohio, OR = Oregon, PA = Pennsylvania, RI = Rhode Island, VA = Virginia, VT = Vermont, WA = Washington, WI = Wisconsin, WV = West Virginia).

[3] F = Fruit; I = Inflorescence; L = Leaf; R = Root; S = Stem; Sd = Seed; Ws = Systemic.

[4] Large or highly mobile arthropods that feed externally and only occasionally on fruit were highly unlikely to follow the pathway because minimal processing of the commodity would remove these pests prior to shipment.

[5] Species with a limited distribution in the United States and deemed actionable by APHIS because it is being considered for an official control program (personal communication, USDA APHIS National Identification Services).

[6] Species was considered unlikely to follow the pathway because its larvae are primarily leaf feeders that occasionally attack immature fruit (Carter, 1984).

[7] Species is highly unlikely to follow the pathway because it spends the day below ground and feeds on plant material at night (CABI, 2003). It is, therefore, not associated with the commodity during harvest.

[8] Species is a stored product pest (CABI, 2003; Carter, 1984) that is unlikely to accompany shipments of fresh apricot.

[9] Pest not identified to the specific level in this document belong to genera that are present in the United States (CABI 2003; Farr et al 2003). These pests may or may not be quarantine pests. Those that were associated with fruit were not analyzed because their risk is reasonable encompassed in the analysis of another pest in the same taxon or there was no evidence of other pests in the taxon being associated with the commodity in the region examined. If pests identified to higher taxa are intercepted in the future, APHIS may take action at the port of entry and a reevaluation of risk may occur.

[10] *Aglaope infausta* was considered unlikely to follow the pathway because apricot is not a preferred host (HYPPZ, 2004), and larvae only attack immature fruit (Carter, 1984).

[11] Viruses are typically transmitted from plant to plant through sap, seed, pollen, dodder (*Cuscuta* sp.), fungi, nematodes, or arthropod vectors (Agrios, 1997). Only those viruses that are seed transmissible or spread by aerial arthropods and detected in fruit were considered likely to follow the pathway.

[12] The association of CGMMV with *Prunus* was made from two related studies/papers published in the same volume of Acta Horticulturae (Blattny and Janeckova, 1980; Čech et al., 1980). Publications thereafter do not cite this publication nor confirm a host range for Cucumber green mottle mosaic virus in the Rosaceae plant family (Brunt et al., 1996 onwards; Celix et al., 1996; Varveri, et al., 2002). Most references state the virus is restricted to the Cucurbitaceae plant family (Hollings et al., 1975; Celix et al., 1996; Varveri, et al., 2002). The papers by Blattny and Janeckova, 1980 and Čech et al., 1980 report that one of the symptoms of infection by the virus in apricot is "unfruitfulness" or lack of fruit production. However this type of symptom was found in apricots when Strawberry latent ringspot virus was also present and long term studies were not conducted to see if CGMMV alone would cause "unfruitfulness". Host association and symptoms aside, CGMMV is reported to be seed transmitted in Cucurbitaceae hosts (CABI, 2006; Hollings et al., 1975) however this has not been tested or demonstrated in *Prunus.* Even if CGMMV were seed transmissible in *Prunus* most commercial cultivars of *Prunus* species are hybrids and propagation from seed does not guarantee conservation of the parent hybrid's traits, therefore it is not the preferred method for propagation. Germination of most *Prunus* seed also requires a minimum of 2-6 months moist chilling and other dormancy problems may need to be breached for successful germination (Hartmann et al., 1990). Because the host association for CGMMV and *Prunus* is not strong, infection may cause "unfruitfulness", seed transmission for *Prunus* has not been documented, and seed propagation is not straightforward, *Prunus* fruits for consumption are considered an unlikely pathway of introduction for CGMMV and the pathogen will

not be analyzed in this document.

[13] Due to the recent U.S. detections of SLRSV by Martin et al., 2004 and Postman et al., 2004, the quarantine status for Strawberry latent ringspot virus is under review. At the time of writing this risk assessment it is still considered a regulated pest (USDA, 2000b). Even though SLRSV may be associated with *Prunus* fruit and seed, it will not be analyzed in this assessment for reasons stated in the Appendix of this document.

[14] Viroids are not well understood, but they are typically transmitted from plant to plant through mechanical inoculation (*e.g*. pruning and grafting) (Agrios, 1997). Only those viroids isolated from fruit and spread by aerial vectors were considered likely to follow the pathway.

[15] Phytoplasmas are typically present in only a few phloem elements of an infected plant, and they are usually transmitted from plant to plant by aerial arthropods (Agrios, 1997). Phytoplasmas were considered unlikely to follow the pathway because the commodity contains few phloem elements and vectors are not likely to gain access to these elements.

[16] *Amphitetetranychus viennensis* has been reported to be associated with fruit, but it does not feed on fruit (Lee and Lee, 1997). Females may incidentally attach during autumn as it enters diapause, which does not correspond to the time of apricot harvest.

[17] *Helicoverpa armigera* larvae may feed on immature or developing fruit of host crops (Bedford, 1978; Butani, 1993; Hely, 1982; Van den Berg, 2001). Larvae can cause the immature fruit to abort, or cause damage that would render the fruit unmarketable (Bedford, 1978). In some fruits, like mango, the larvae can only insert its head and thorax into fruit leaving a portion of its body visible on the exterior of the fruit (Butani, 1993). Since 1985, there has only been one port interception of *H. armigera* on *Prunus* sp. (from baggage/Asia) (PestID, 2010). The larvae are unlikely to be associated with commercial fruit destined for the United States.

[18] At the time of writing this assessment, only strain D of plum pox virus is reported in Spain. Strain M of PPV was reported in Spain but has since been eradicated (Cambra et al. 2004).

[19] Seed transmission of plum pox virus (PPV) was reported by Németh and Kölber (1983), but was discredited by Pasquini and Barba (2006). Certain aphids (that are present in the United States) have been shown to acquire PPV from *Prunus* fruit and transmit the virus to healthy *Prunus* seedlings under artificial conditions (Labonne and Quiot, 2001; Gildow, 2001; Gildow et al., 2002; Gildow et al., 2004); however the virus is non-persistent in the aphids. With this type of transmission, there is a very small window of time for the aphid to be able to successfully move the virus to new hosts (Ng and Perry, 2004). The aphid loses the virus with its next probe or when it molts (Gildow et al., 2004; Ng and Perry, 2004). PPV positive fruit, intended for consumption, would need to be discarded outdoors, aphid would need to find and probe this fruit, aphid would need to acquire sufficient amount of virus and retain it at requisite sites, aphid would need to immediately move to a susceptible *Prunus* host adjacent to the culling location, and finally the aphid would need to successfully transfer PPV to that susceptible *Prunus* host. We feel the likelihood of this sequence of events is low enough to negate further assessment. The movement of apricot fruit from Spain is not anticipated to introduce PPV to the United States.

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2. Pests likely to follow the pathway

Quarantine pests that were reasonably likely to follow the pathway (i.e., accompany shipments of apricot) were identified (Table 3) and subjected to further analyses (i.e., steps 5-7 in USDA, 2000a). Numerous pests in Table 2 were not subjected to further analyses for various reasons: they were widely established in the United States, they were associated mainly with plant parts other than the commodity, or they were not likely to remain with the commodity during processing.

Pests listed in Table 3 were selected for further analyses because they were quarantine pests of the United States that were considered likely to follow the pathway (*i.e.* accompany shipments of apricot). Justifications for considering these pests as reasonably likely to follow the pathway are presented below.

Ceratitis capitata and *Cydia funebrana* were considered likely to follow the pathway because they can lay eggs in or on, and develop inside fresh fruit (CABI, 2003; Carter, 1984; McQuate et al., 2000; Meijerman and Ulenberg, 2000; Van der Geest and Evenhuis, 1991). These species have been intercepted by U.S. agriculture inspectors on a variety of fruit, including those of *Prunus* species.

Apiognomonia (*Gnomonia*) *erythrostoma* was considered likely to follow the pathway because reports of fruit infection are contradictory; some state that fruit is not infected (Diekmann and Putter, 1996; Ivanova and Karov, 1999), while others state that fruit is infected (EPPO, 1993; Ogawa et al., 1995). These contradictory reports may be an indication that the fungus is capable of producing quiescent infections.

Monilinia fructigena was considered likely to follow the pathway because it produces quiescent infections in fruit that may become active sometime after harvest (CABI, 2003; Ogawa et al., 1995).

Table 3. Quarantine pests likely to follow the pathway and therefore selected for further analyses

Type	Organism	Taxonomy
Arthropods	*Ceratitis capitata* Wiedemann	Diptera: Tephritidae
	Cydia funebrana (Treitschke)	Lepidoptera: Tortricidae
Fungi	*Apiognomonia erythrostoma* (Pers.)	Ascomycetes
	Monilinia fructigena Honey	Discomycetes

E. Consequences of Introduction

Consequences of Introduction were estimated using five risk elements: climate-host interaction, host range, dispersal potential, economic impact and environmental impact. Pests were assigned a rating of Low (1 point), Medium (2 points), or High (3 points) for each risk element, and a Cumulative Risk Rating was calculated by summing all risk elements for each pest analyzed (USDA, 2000a). Consequences of Introduction values for each pest are summarized in Table 4.

***Apiognomonia erythrostoma* (Pers.)**	**Risk rating**
Risk Element #1: Climate/Host Interaction *A. erythrostoma* occurs in Russia and Europe, including the United Kingdom and Norway (CABI, 2003). Based on this distribution, it is estimated that *A. erythrostoma* could establish in U.S. Hardiness Zones 5-9. One or more of its hosts occur in these Zones (USDA-NRCS, 2002).	High (3)

Apiognomonia erythrostoma **(Pers.)**	**Risk rating**
Risk Element #2: Host Range *A. erythrostoma* infects plants in the genus *Prunus*; reported hosts include apricot (*P. armeniaca*), plum (*P. domestica*), sweet cherry (*P. avium*) and sour cherry (*P. cerasus*) (CABI, 2003; Diekmann and Putter, 1996; EPPO, 1993).	Low (1)
Risk Element #3: Dispersal Potential *A. erythrostoma* produces numerous ascospores, which act as primary inoculum, during a two month period in the spring (Ivanova and Karov, 1999; Ogawa et al., 1995; Stejerean and Bobes, 1982). Conidia, which cause secondary infections, are released from the time that ascospore production ends until leaf drop in the fall (Stejerean and Bobes, 1982). Fungal spores can be dispersed over long distances by animals (including man), wind and water (Agrios, 1997).	High (3)
Risk Element #4: Economic Impact *A. erythrostoma* causes reddish leaf spots that expand and turn brown as the disease progresses (Diekmann and Putter, 1996; EPPO, 1993; Ogawa et al., 1995). In severe cases, infected trees may lose their leaves and fruit may show symptoms that range from superficial blemishes to necrosis and premature drop (Diekmann and Putter, 1996; EPPO, 1993; Ogawa et al., 1995). Three to five fungicide applications are usually required each year to control this disease (Ogawa et al., 1995), which is considered an A1 quarantine pest ion some African nations (IAPSC, 2003). *Apiognomonia erythrostoma* may, therefore, reduce crop yield, lower the value of the commodity by requiring chemical controls and cause a loss of markets. Severe economic damage is, however, not typical (Ogawa et al., 1995), so we reduced the risk rating to Medium.	Medium (2)
Risk Element #5: Environmental Impact *A. erythrostoma* could potentially attack plants that are listed as Threatened or Endangered in the United States (*e.g. Prunus geniculata*). Establishment of this fungus in the United States is likely to stimulate chemical control programs because it infects economically important species, and fungicides are routinely used for control in infected areas (Ogawa et al., 1995).	High (3)

Ceratitis capitata **Wiedemann**	**Risk rating**
Risk Element 1: Climate-Host Interaction *Ceratitis capitata* is widely distributed in the Mediterranean, South and Central America, west Asia (CABI, 2003) and northern Australia (Hassan, 1977). Based on this distribution and the geographic range predicted by Vera et al. (2002), it is estimated that *C. capitata* could establish in U.S. Hardiness Zones 8-11. One or more of its hosts occur in these Zones (USDA-NRCS, 2002).	High (3)
Risk Element 2: Host Range *Ceratitis capitata* has been recorded on hosts from numerous plant families, including Anacardiaceae, Arecaceae, Moraceae, Myrtaceae, Rosaceae, Rubiaceae, Rutaceae, Solanaceae and Sterculiaceae (CABI, 2003).	High (3)
Risk Element 3: Dispersal Potential Female *C. capitata* can mature and deposit up to 800 eggs during their life	High (3)

***Ceratitis capitata* Wiedemann**	**Risk rating**
(Weems, 1981), and the species has several overlapping generations each year (Hassan, 1977). Adult *C. capitata* can fly up to 20km during their life, and larvae can be transported over long distances in infested commodities (CABI, 2003).	
Risk Element 4: Economic Impact In some Mediterranean countries, *C. capitata* infestation of stone fruit hovers near 100 percent (Weems, 1981). *Ceratitis capitata* lowers crop values by requiring controls, and its presence in the United States would cause a loss of foreign and domestic markets (Weems, 1981).	High (3)
Risk Element 5: Environmental Impact *Ceratitis capitata* is extremely polyphagous and could potentially attack plants listed as Threatened or Endangered in the United States (*e.g. Opuntia treleasei* and *Prunus geniculata*). Establishment of this pest in the continental United States would initiate chemical or biological control programs (Weems 1981).	High (3)

***Cydia funebrana* (Treitschke)**	**Risk ratings**
Risk Element 1: Climate-Host Interaction *Cydia funebrana* is found throughout the Palearctic region, including Siberia, and in Japan (CABI, 2003; Carter, 1984). Based on this distribution, it is estimated that *C. funebrana* could establish in U.S. Hardiness Zones 5-9. One or more of its hosts occur in these Zones (USDA-NRCS, 2002).	High (3)
Risk Element 2: Host Range *Cydia funebrana* is primarily a pest of plants in the genus *Prunus* (Rosaceae), but it also attacks apple, *Malus pumila* (Rosaceae), and the chestnut, *Castanea sativa* (Fagaceae) (CABI, 2003).	High (3)
Risk Element 3: Dispersal Potential Compared to some other arthropods, *C. funebrana* has low fecundity: first generation females deposit about 13 eggs and females of subsequent generations deposit about 34 eggs (Deseo, 1973). *Cydia funebrana* can, however, have up to three generations per year (CABI, 2003). Adults can fly, and larvae may be transported long distances in shipments of infested commodities (CABI, 2003).	Medium (2)
Risk Element 4: Economic Impact In Europe, the second and third generations of *C. funebrana* damage more than 50 percent of stone fruit (CABI, 2003). Such extensive damage would lower the commodity value by stimulating chemical and/or biological control programs. Establishment of this species in the United States is likely to cause a loss of markets.	High (3)
Risk Element 5: Environmental Impact *Cydia funebrana* could potentially attack the Endangered plant, *Prunus geniculata*. As mentioned above, its presence in the United States could stimulate chemical and/or biological control programs.	High (3)

***Monilinia fructigena* Honey**	**Risk rating**
Risk Element 1: Climate-Host Interaction *Monilinia fructigena* is widely distributed across Europe (including Finland, the United Kingdom, Ireland, Norway, and Sweden), the Middle East, Russia, China and Japan (CABI, 2003). Based on this distribution, it is estimated that *M. fructigena* could establish in U.S. Hardiness Zones 5-9. One or more of its hosts occur in these Zones (USDA-NRCS, 2002).	High (3)
Risk Element 2: Host Range *Monilinia fructigena* infects a wide variety of plants in the families Berberidaceae, Betulaceae, Ebenaceae, Ericaceae, Cornaceae, Moraceae, Myrtaceae, Rosaceae, Solanaceae and Vitaceae (CABI, 2003).	High (3)
Risk Element 3: Dispersal Potential *Monilinia fructigena* produces numerous spores that can be disseminated over long distances by animals (including man), wind, and water (CABI, 2003; Chang, 1986).	High (3)
Risk Element 4: Economic Impact Fruit decay caused by *M. fructigena* can significantly reduce yield, but losses rarely initiate control programs (CABI, 2003). Establishment of *M. fructigena* in the United States could cause a loss of markets.	Medium (2)
Risk Element 5: Environmental Impact *Monilinia* species cause fruit rot, blossom blight, leaf infections and stem cankers (Ogawa et al., 1995). *Monilinia fructigena* is known to infect hosts in the genera *Berberis*, *Rhododendron* and *Prunus* (CABI, 2003). It could, therefore, potentially reduce the vigour and reproductive efforts of the Endangered plants *P. geniculata*, *R. chapmanii*, *B. nevinii, B. pinnata* ssp. *insularis*, and *B. sonnei*. As mentioned above, *M. fructigena* rarely initiates control programs (CABI, 2003).	Medium (2)

Table 4. Risk Ratings for Consequences of Introduction

Pest	**Climate-host interaction**	**Host range**	**Dispersal potential**	**Economic impact**	**Environ-mental impact**	**Cumulative risk rating**
Apiognomonia erythrostoma	High (3)	Low (1)	High (3)	Med (2)	High (3)	Medium (12)
Ceratitis capitata	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Cydia funebrana	High (3)	High (3)	Med (2)	High (3)	High (3)	High (14)
Monilinia fructigena	High (3)	High (3)	High (3)	Med (2)	Med (2)	High (13)

F. Likelihood of Introduction

Cumulative Risk Ratings for the Likelihood of Introduction were estimated from the quantity of the commodity that was expected to be imported annually and the probabilities that a pest would survive postharvest treatment and shipment, enter the United States undetected, and arrive in an area with a climate and host plants capable of supporting reproduction (USDA, 2000a).

Cumulative Risk Ratings for the Likelihood of Introduction are summarized in Table 5.

1. Quantity Imported Annually

Communication with a Spanish NPPO official, reported Spain's intention to export approximately four 40-foot-long shipping containers of apricot fruit in a letter on 29 October 2001. This quantity was assigned a risk rating of Low in accordance with the template document, *Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02* (USDA, 2000a).

2. Survive Post-Harvest Treatment

Arthropods that feed internally and pathogens that produce latent or symptomless infections were expected to survive minimal postharvest treatments, such as washing and culling. The fruit fly, *C. capitata*, the moth, and *C. funebrana*, were, therefore, rated High for this sub-element. The fungi, *A. erythrostoma* and *M. fructigena*, were assigned Medium risk ratings because they may produce latent infections or subtle symptoms on the fruit (CABI, 2003; Ogawa et al., 1995), but dormant spores and obviously infected fruit would likely be removed by washing and culling prior to shipment.

3. Survive Shipment

Apricots are stored at 1-3ºC (CABI, 2003). Even if the temperature was maintained in this range while transporting the commodity via a modern cargo ship, which should take about eight days to cross the Atlantic Ocean, assuming fair weather, a distance of 3,589 miles and a constant speed of 16 knots, some individuals of each pest would likely survive. For example, *C. capitata* is one of the least cold-hardy pests analyzed here, and USDA (2007) currently recommends that fruit be stored at 1.11ºC or lower for 14 days to kill all *C. capitata* larvae. *Ceratitis capitata* was, therefore, assigned a High risk rating for this sub-element. The remaining pests have been reported in areas that regularly experience sub-zero winter temperatures and were, therefore, also given High risk ratings.

4. Not Detected at Port of Entry

The probability that an arthropod pest is detected at the port of entry is a function of their size and degree of concealment. Internal feeders have a high probability of escaping detection because they are well concealed. *Ceratitis capitata*, *C. funebrana*, were, therefore, given High risk ratings for this sub-element. The probability of pathogens being detected at the port of entry depends on how well the symptoms are expressed in the commodity. *Monilinia fructigena* produces symptoms on fruit that are easily detected by visual inspection, but can cause latent infections where no symptoms would be present (CABI, 2003; Ogawa et al., 1995). *Apiognomonia erythrostoma* may or may not infect fruit without producing obvious symptoms. Reported symptoms range from superficial blemishes to complete necrosis (Diekmann and Putter, 1996; EPPO, 1993; Ogawa et al., 1995). Due to the potential of latent infections or infection without obvious symptoms *Monilinia fructigena* and *A. erythrostoma* were given High pest risk ratings.

5. Moved to Suitable Habitat

Apricots have widespread acceptance among consumers in the United States. Widespread acceptance means that markets exist in all parts of the United States, and infested fruit is likely to arrive in areas that are suitable for pest survival. Risk ratings for this sub-element were, therefore, based on the area of the United States where each pest could potentially establish. For example, those pests having the potential to establish in U.S. Hardiness Zones 5-9 or 5-10 (*e.g. A. erythrostoma*, *C. funebrana*, and *M. fructigena* were rated High because these zones represent about 80 percent of the United States. The remaining pest, *C. capitata*, was rated Medium because it was estimated as having the potential to establish in U.S. Hardiness Zones 8-11, which represents less than an estimated 33 percent of the United States.

6. Contact with Host Material

Pests and pathogens that had wide host ranges and were capable of long distance aerial dispersal (*i.e. C. capitata*, *C. funebrana*, and *M. fructigena*) were considered likely to come into contact with suitable hosts and were assigned High pest risk ratings. *Apiognomonia erythrostoma* was given a Medium pest risk rating because of a limited host range but ability to aerially disperse considerable distances.

Table 5. Risk Ratings for Likelihood of Introduction

Pest	Quantity imported annually	Survive postharvest treatment	Survive shipment	Not detected at port-of-entry	Moved to suitable habitat	Contact host material	Cumulative risk ratings
Apiognomonia erythrostoma	Low (1)	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	Medium (14)
Ceratitis capitata	Low (1)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (15)
Cydia funebrana	Low (1)	High (3)	High (3)	High (3)	High (3)	High (3)	High (16)
Monilinia fructigena	Low (1)	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (15)

G. Conclusion: Pest Risk Potential and Pests Requiring Phytosanitary Measures

Pest Risk Potentials, which are summations of the Consequences of Introduction and Likelihood of Introduction values, are recorded in Table 6. Pest Risk Potentials are estimations of the risk in the absence of mitigation. According to the template document, *Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02* (USDA, 2000a), port of entry inspection provides sufficient phytosanitary security for pests assigned Low pest risk potentials, while specific phytosanitary measures may be necessary for Medium pest risk potentials and are strongly recommended for High pest risk potentials.

Table 6. Pest Risk Potentials

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
Apiognomonia erythrostoma	Medium (12)	Medium (14)	Medium (26)
Ceratitis capitata	High (15)	High (15)	High (30)
Cydia funebrana	High (14)	High (16)	High (30)
Monilinia fructigena	High (13)	High (15)	High (28)

III. Risk Management

This section of the risk analysis describes risk management options and discusses their efficacy. The development of a detailed risk management plan is beyond the scope of this document. The present document emphasizes the identification of phytosanitary measures included in existing USDA APHIS manuals or that are described in international standards.

A single phytosanitary measure, such as inspection, quarantine treatment, or a combination of measures, may provide phytosanitary security for a country importing agricultural commodities. Specific measures may include pre- and post-harvest treatments. The strength of a measure may be increased, or additional measures may be added to compensate for uncertainty. A measure intended for use in a systems approach must be clearly defined, efficacious, mandated, and monitored by the responsible national plant protection organization (IPPC, 2002b).

A combination of different measures (e.g., 'systems approach') for apricot from Spain might include pest-free areas, pest-free places of production, areas of low pest prevalence, cultural, chemical, or biological control programs, pre-clearance oversight by USDA-APHIS, clearly defined harvest and packing procedures, quarantine treatments, port-of-entry inspection, and limits on commodity distribution and transit within the United States. We have summarized possible mitigation options by pest below (Table 7).

1. Management Prior to Harvest

Pest-free areas or **Pest-free places of production** can provide an acceptable level of phytosanitary protection (IPPC, 1996b, 1999). The establishment and maintenance of these areas are described in ISPM Nos. 4 and 10 (IPPC, 1996b, 1999).

An **Area of low pest prevalence,** which may encompass all or part of a country or countries where a pest occurs at a low level and is subject to surveillance, control, or eradication efforts, can provide an acceptable level of phytosanitary protection when used as part of a systems approach (IPPC, 2002b, 2005). The establishment and maintenance of areas of low pest prevalence are described in ISPM No. 22 (IPPC, 2005).

Phytosanitary certificates may provide an acceptable level of protection when used as part of a systems approach. The crop should be sampled and periodically inspected during the growing season and after harvest. Survey results must be negative for issuance of a certificate. Statistical procedures are available to verify confidence in declaring an area pest-free, based on negative survey results (Barclay and Hargrove, 2005; Venette et al., 2002).

Control programs can eliminate pests from fields or prevent commodity infestation. Successful control programs typically include monitoring, cultural, biological, and chemical components (Dreistadt, 1994). The components of the control program must be clearly defined for use in a systems approach (IPPC, 2002b).

Monitoring

Traps baited with ammonia or parapheromones are typically used to monitor fruit fly populations (White & Elson-Harris, 1992). Lure type determines the spacing between traps, and the traps should be emptied every few days to prevent specimen decay (White & Elson-Harris, 1992). Visual inspection, light traps, and pheromone traps are commonly used to monitor pest moth populations (Dreistadt, 1994). Researchers have identified pheromones for *C. funebrana*, (CABI, 2006, El-Sayed, 2007). In addition to monitoring, pheromones can be used to disrupt communication and mating (Capinera, 2001).

Molecular techniques, like ELISA probes, can be used to monitor plant pathogen populations (Agrios, 1997; Erwin & Ribeiro, 1996). These methods can detect latent infections in plant parts, contaminated soil, and contaminated irrigation water (Erwin & Ribeiro, 1996). In addition to these sophisticated methods, lesions on leaves, stems and fruit can be monitored by visual inspection (CABI, 2006).

Cultural

Few cultural controls are available for fruit flies. Michaels (2005) recommends removing and destroying fruit with dimples or those leaking sap. These fruit may contain fruit fly eggs or larvae (Michaels, 2005).

Caterpillars can be hand-picked into buckets of alcohol, while egg masses can be scraped into buckets of soapy water (Dreistadt, 1994). Controlling weeds in and around crops may also reduce invasion, as these sites often serve as refugia and mating areas for Lepidoptera pests (Capinera, 2001).

Sanitation is extremely important to control plant pathogens (Agrios, 1997; Pirone, 1978). Sanitation typically includes: using disease free stock for propagation, sterilizing soil, pruning and destroying diseased plant parts, and disinfecting tools used for pruning and cultivation (Agrios, 1997; Pirone, 1978). Ideally, parent stock should be tested for disease prior to using cuttings or seed for propagation (Pirone, 1978). Soil should be sterilized to kill disease causing organisms that spend a portion of their life in the soil (Pirone, 1978). Soil infested with fungi can be sterilized using heat or chemicals (Agrios, 1997). Heating soil to 180˚F for 30 minutes will destroy all phytoparasitic organisms (Pirone, 1978). One pint of commercial formalin, a 37-40 percent solution of formaldehyde and water, diluted with 6.25 gallons of water and applied to the soil at a rate of 0.5 gallons per square foot can control fungi (Agrios, 1997; Pirone, 1978). The treated soil should be covered for 24 hours to confine the fumes and then left fallow for 10-14 days before planting (Pirone, 1978). Diseased foliage should be pruned from the infected plant and burnt or carried away from the growing area and buried or sterilized by one of the methods described for soil (Pirone, 1978). Tools used for pruning and cultivation should be frequently disinfected in a 5 percent formalin solution, a 0.525 percent sodium hypochlorite solution or 70 percent denatured alcohol (Howell, 2004; Pfleger & Gould, 1998; Pirone, 1978).

Chemical and Biological

Fruit flies are typically controlled using cover or bait sprays (White & Elson-Harris, 1992). Bait sprays have a few advantages over cover sprays (White & Elson-Harris, 1992). For example, they have a lower impact on existing natural enemies because they are not spread throughout the environment (White & Elson-Harris, 1992).

Insecticidal soaps and narrow-range oils are effective against moth eggs (Dreistadt, 1994). Augmentive releases of commercially available natural enemies may severely reduce pest populations (Dreistadt, 1994; Rosen, 1990). A narrow spectrum or systemic insecticide may be needed when all else fails (Capinera, 2001; Dreistadt, 1994).

Cydia funebrana is commonly controlled using organophosphates and insect growth-regulators (CABI, 2006).

Systemic fungicides, copper compounds, and sulfur are all used to control *Apiognomonia erythrostoma* and *Monilinia fructigena* (CABI, 2006; EPPO, 2004).

2. Management After Harvest and Before Shipping

Washing the commodity and removing obviously infected or infested material reduces the likelihood of introducing quarantine organisms into the United States via importation.

The post-harvest and packhouse procedures for apricots in Spain were not communicated but are likely similar to those used in the United States.

3. Management During Shipping and at U.S. Ports-of-entry

Temperature and moisture levels in the shipping container may reduce the risk of introducing certain quarantine pests into the United States. For example, USDA (2007) currently recommends storing fruit at 1.11ºC or lower for 14 days to kill all *Ceratitis capitata* larvae. Apricots are shipped at 1-3ºC (CABI, 2003). This temperature is not expected to provide adequate quarantine security (see Survive Shipment under the Likelihood of Introduction).

Port-of-entry inspection may provide an acceptable level of protection against obvious or not so obvious pests, when used as part of a systems approach. A random sample from each consignment should be inspected to detect a pest infestation rate of 10 percent or greater (USDA, 2003).

Quarantine treatments provide probit-9 security by killing 99.9968 percent or more of the quarantine organisms.

Specific treatments are not available for *Cydia funebrana*, *Apiognomonia erythrostoma*, or

Monilinia fructigena on apricot (USDA, 2007). The methyl bromide treatment for external pests on apricot (USDA, 2007) should, however, provide an appropriate level of phytosanitary security against *Cydia funebrana.*

Storing apricots at 1.1˚C or lower for at least 14 days according to T107-a cold treatment requirements provides an appropriate level of phytosanitary security against *Ceratitis capitata* (USDA, 2007).

The minimum generic dose of gamma irradiation (400 Gy) that was published as a final rule in the Federal Register on 27 January 2006 would provide an appropriate level of phytosanitary security against *Ceratitis capitata* and *Cydia funebrana*.

Table 7. Summary of Risk Management Options for Apricot from Spain

Measure(s)	**Pests**	**Efficacy**
Pest-free areas or places of production	All	Provides appropriate level of protection
Pre-harvest control program	All	Research required to demonstrate efficacy
Post-harvest and packinghouse procedures	All	Unknown
Shipping conditions	All	Not effective
Point-of-entry sampling and inspection	All	Provides appropriate level of protection when used as part of a systems approach
Methyl bromide	*Cydia funebrana*	Accepted APHIS treatment
Cold treatment	*Ceratitis capitata*	Accepted APHIS treatment
Irradiation	*Ceratitis capitata* *Cydia funebrana*	Accepted APHIS treatment

4. Conclusions

The diversity of pests that are expected to follow the pathway on apricot from Spain makes it unlikely that a single measure will address the risks identified here.
This section of the risk analysis does not establish a work plan, or describe a pest management program. It simply provides information regarding known pest management strategies. A written agreement between the government of Spain and the U.S. Department of Agriculture, which is called a bilateral work plan, will describe the details of any resulting importation program, including all applicable phytosanitary measures.

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Appendix 1. Rationale for not analyzing Strawberry latent ringspot virus in the risk assessment for the Importation of Fresh *Prunus armeniaca* Fruit from Continental Spain into the United States

Strawberry latent ringspot virus (SLRSV) is currently considered a regulated pest in the United States (USDA-APHIS, 2000). Title 7 of the U.S. Code of Federal Regulations Section 319, Part 37 (7 CFR §319.37) lists specific regulations for propagative *Prunus* species (almond, cherry, cherry laurel, English laurel, nectarine, peach, plum, prune) and *Vitis* spp. (grape) from Canada.

The following information is presented to explain why it was not analyzed in the risk assessment for the "Importation of fresh Apricot, *Prunus armeniaca* (L.) fruit from Continental Spain into the United States including Hawaii and U.S. Territories".

General Background

Strawberry latent ringspot virus is a nematode vectored, mechanically transmitted, and seedborne virus with a wide host range encompassing many economically important plant families (Hanson and Campbell, 1979; CABI/EPPO, 2004). It is considered a Sadwavirus but lacks consensus for a family level designation and remains unassigned (ICTVdB Management, 2006). For many years it was considered a nepovirus due to its transmission via nematodes; however this classification has now been disputed (Tzanetakis et al., 2006).

Depending on the host and titer of the virus within the plant SLRSV can cause stem and fruit deformations, leaf chlorosis or mottling, bunchy growth, reduced fruit or seed set (Čech et al., 1980; Everett et al., 1994; Faggioli et al*.,* 2002; Hicks et al., 1986; Thomas, 1984). Some hosts remain symptomless (latent infection) (CABI/EPPO, 2004). A number of studies have shown that SLRSV is commonly found in association with other viruses such as Arabis mosaic virus (CABI/EPPO, 2004; Thomas, 1984), Cucumber green mottle mosaic virus (Čech et al, 1980), or Apple chlorotic leaf spot virus (Marenaud and Dunez, 1969).

The association of SLRSV with *Prunus* species is well documented (Čech et al., 1980; Everett et al*.,* 1994; Marenaud and Dunez, 1969) however research on certain aspects of the virus in *Prunus*, such as seed transmission, was not found.

Geographic Distribution

SLRSV is reported from many European countries and, with dispute, in parts of Oceania, Asia, and North America (CABI/EPPO, 2003, 2004; ICTVdB Management, 2006).

In 1979, SLRSV was reported in three imported cultivar 'Plain' parsley seedlots in California (Hanson and Campbell, 1979). The parsley seed, for two of the infected lots, originated from Europe and was unknown for the third (Hanson and Campbell, 1979). This was published as the first U.S. detection of the virus. Hanson and Campbell (1979) noted that because parsley is not an economically important crop in California, the chance for establishment from planting seed originating in Europe seemed "slight".

It was not until additional research in 2004 that Martin et al. (2004) found 17 percent of the strawberries tested in a California study were infected in SLRSV. That same year Postman et al. (2004) found SLRSV in variegated mint (*Mentha* x *gracilis* 'Variegata') sold by wholesale and mail-order nurseries in Maryland, Ohio, and Nebraska. Viral infection produced chlorosis of the leaves and the infected plants were being sold as a "variegated" mint, desired by many gardeners as an ornamental feature of the herb. Postman et al. (2004) concluded that this pathway has likely spread the virus throughout the United States.

With this new information for its widespread presence in the United States, the U.S. regulations for SLRSV are under review.

Biological Features Affecting Likelihood of Introduction

The main concern with SLRSV and importation of host fruit, is that it is reported to be seed transmitted, and to a high degree, for some hosts (CABI-EPPO, 2004; Hicks et al*.,* 1986; Murant, 1974). Seed transmission has been reported for *Rosa* sp. (a member of the same plant family) (Thomas, 1984). No research was found for seed transmission of *Prunus* species.

Prunus species are more commonly propagated by budding or grafting onto rootstocks rather than propagation from seed (Hartmann et al., 1990). Most commercial cultivars of *Prunus* species are hybrids and propagation from seed does not guarantee conservation of the parent hybrid's traits. Germination of most *Prunus* seed also requires a minimum of 2-6 months moist chilling and there may be other dormancy problems where in commercial production techniques such as embryo excision or tetrazolium tests need to be used to determine germinative capacity (Hartmann et al., 1990).

The intent of importing this commodity is for consumption and the likelihood for propagation from seed resides at the consumer level after consumption or in discarded food waste. If the consumer is able to get the seed to germinate or the discarded seed germinates in the environment, the likelihood for natural transmission to other hosts is also limited. This is primarily because the only known vectors for the virus are the nematodes *Xiphinema diversicaudatum* and *X. coxi* (Murant, 1974). *Xiphinema diversicaudatum* is present in the United States, but is not widely distributed (CABI, 2006; NGDC, 1984) and movement from plant to plant with nematodes is slow and limited (CABI/EPPO, 2004).

Xiphinema coxi was first described by Tarjan in 1964 as occurring in parts of Florida, however no further records of U.S. distribution were found (Tarjan, 1964 via Cho and Robbins, 1990; Lehman, 2002; NGDC, 1984). It is reported that not all populations of *X. diversicaudatum* are equally efficient in transmitting the virus; in one study a peach isolate of SLRSV was only transmitted by three out of nine *X. diversicaudatum* populations tested (Brown, 1985 via CABI/EPPO, 2004). Transmissibility via aphid and beetle vectors was also recently investigated by Tzanetakis et al. (2006) and the results were negative.

There were also two papers published in the same volume of Acta Horticulturae (1980) that report a mixed infection of SLRSV and Cucumber green mottle mosaic virus in South Moravia apricot trees caused them to cease bearing fruit (Čech et al., 1980; Blattny and Janeckova, 1980).

These early reports are notable for considering the possibility that infected trees might not produce fruit suitable for export, however subsequent published research or references to the observed results in other *Prunus* species were not found.

Summary

The analysis of SLRSV in the pest risk assessment for *Prunus armeniaca* from Spain is not warranted or justified for the following reasons:

1) SLRSV is present in the United States (regulations under review)
2) Commodity is for consumption and seed propagation is not the preferred or easiest method of propagation
3) Vectors are not widely distributed in the United States and do not possess ability to move the pathogen long distances

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