Importation of Fresh Commercial Citrus Fruit: Grapefruit (*Citrus* x *paradisi* Macfad.); Lime (*C. aurantiifolia* [Christm.] Swingle); Mandarin Orange or Tangerine (*C. reticulata* Blanco); Sweet Orange (*C. sinensis* [L.] Osbeck); Tangelo (*C.* x *tangelo* J.W. Ingram & H.E. Moore); from Peru into the United States

A Pathway-Initiated Plant Pest Risk Analysis

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Executive Summary

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) prepared this pest risk assessment to examine plant pest risks associated with the importation of the following *Citrus* fruit from Peru into the United States: grapefruit (*C.* x *paradisi* Macfad.); lime (*C. aurantiifolia* [Christm.] Swingle); mandarin orange or tangerine (*C. reticulata* Blanco); sweet orange (*C. sinensis* [L.] Osbeck); tangelo (*Citrus* x *tangelo* J.W. Ingram & H.E. Moore). This is a qualitative risk assessment and estimates of risk are expressed in qualitative terms (high, medium, low) rather than in numerical terms such as probabilities or frequencies. The details of the methodology and rating criteria used to analyze these pests are in the Guidelines for Pathway-Initiated Pest Risk Assessment, version 5.02 (USDA, 2000). A list of pests attacking *Citrus* spp. in Peru was developed based on the scientific literatures and PPQ records of intercepted pests. Based on this list, 68 quarantine pests were identified and 5 quarantine pests likely to follow the pathway were analyzed further. A pathway is any means that allows the entry and spread of a pest. Quarantine pests likely to follow the pathway and selected for further analysis include the insects *Anastrepha fraterculus* (Wiedemann) (Diptera: Tephritidae), *Anastrepha obliqua* Macquart (Diptera: Tephritidae), *Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), and *Ecdytolopha aurantiana* (Lima) (Lepidoptera: Tortricidae). All of these pests pose phytosanitary risks to American agriculture. The Pest Risk Potential was estimated to be High for *A. fraterculus*, *A. obliqua*, *A. serpentina*, and *C. capitata*, and Medium for *E. aurantiana*. The Pest Risk Potential is the summation of the ratings for the Consequences of Introduction and the Likelihood of Introduction. The Consequences of Introduction value was estimated by assessing the Climate/Host Interaction, the Host Range, the Dispersal Potential, the Economic Impact, and the Environmental Impact, which are based on the biology of the pests. The Likelihood of Introduction value was estimated by evaluating the proposed Quantity Imported Annually in combination with the Pest Survival Potential. The Pest Survival Potential evaluates the likelihood that the pests survive post-harvest treatments, survive shipment, avoid detection at the port of arrival, are moved to a suitable habitat, and come into contact with suitable host material. Cold treatment against the fruit flies, *A. fraterculus, A. obliqua, A. serpentina*, and *C. capitata*, should effectively remove these pests from the pathway, but port of entry inspection alone is not considered sufficient to provide phytosanitary security against these pests. Port of entry inspection along with a phytosanitary certificate with Additional Declaration for freedom from *E. aurantiana* should effectively remove this tortricid from the pathway.

1. Introduction

The United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA, APHIS, PPQ) conducted this plant pest risk assessment to assess the potential plant pest risks posed by the importation of the following fresh citrus fruits:

Grapefruit (*C.* x *paradisi* Macfad.);
Lime (*C. aurantiifolia* [Christm.] Swingle);
Mandarin Orange or tangerine (*C. reticulata* Blanco);
Sweet Orange (*C. sinensis* [L.] Osbeck);
Tangelo (*Citrus* x *tangelo* J.W. Ingram & H.E. Moore);

Authority for APHIS to regulate the importation of citrus fruit is derived from the Plant Protection Act (2000) and Title 7 of the Code of Federal Regulations (CFR) Part 319, Subparts 28 and 56. Importation of citrus fruit is generally prohibited except for particular citrus species and varieties grown, packed and shipped under certain conditions from specific areas (*e.g.*, Australia, Japan, Korea, Mexico and the Republic of South Africa) as stated in 7CFR 319.28 and 56. These restrictions are in place to prevent the introduction of a number of citrus pests including, but not necessarily limited to, fruit flies in the genera *Anastrepha* and *Ceratitis*, citrus canker (*Xanthomonas axonopodis* pv. *citri*), citrus black spot (EPPO, 1998) and sweet orange scab (*Elsinoë australis*)

1.1. Initiating Event / Proposed Action

In 1991, the government of Peru requested that the APHIS Administrator initiate the process that would allow the export of tangerines (*Citrus reticulata*) from Peru to all ports of the United States (Vasquez Villanueva, 1991). This request was later modified to include grapefruit (*C.* x *paradisi* Macfad.); lime (*C. aurantifolia* (Christm.) Swingle); mandarin orange or tangerine (*C. reticulata* Blanco); sweet orange (C. sinensis (L.) Osbeck); tangelo (*Citrus x tangelo* J.W. Ingram & H.E. Moore) (Carbonell Torres, 2002). A plant pest risk assessment for Peruvian citrus is necessary before an export program can be formally proposed.

Peru has proposed exporting citrus from several geographically isolated areas along the Pacific coast since 1992. A preliminary APHIS hazard identification report targeted citrus canker, sweet orange scab and citrus black spot as the primary diseases of concern with fruit flies such as Medfly (*Ceratitis capitata*) and other fruit fly species (*Anastrepha* spp.) as the major arthropods of significance. In 1993, the Asociaci∴n de Exportadores (Peru's Export Association, ADEX) in cooperation with the Agency for International Development (AID), engaged Dr. James Stapleton from the University of California to survey the citrus production areas in Peru. Between 1993 and 1996, Dr. Stapleton conducted several exploration trips to the main citrus areas of the coast and jungle of Peru, with the initial participation of APHIS officials (Rizvi, 1994). The objective of these site visits was to make a preliminary determination on the status of the three citrus diseases of quarantine concern in the United States. The field surveys conducted by Dr. Stapleton and the laboratory identifications of collected samples by the laboratory of the Universidad Nacional Agraria at La Molina indicated sweet orange scab (*ElsinoN australis*), citrus black spot (EPPO, 1998) and citrus canker (*Xanthomonas axonopodis* pv. *citri*, =*X.campestris* pv. *citri*) were not detected in the surveyed production areas. The general conclusion of this study was that the three diseases of concern do not occur in the citrus production areas of Peru.

To expedite the import permit application / risk assessment process, a partial draft plant pest risk assessment was prepared by Dr. James Stapleton for the Peruvian government, and submitted to APHIS (Stapleton, 1998). This document incorporates the data from the 1998 draft document and completes the plant pest risk assessment started by Dr. Stapleton.

1.2. Characterization of the Proposed Importation

1.2.1. Geography

The Republic of Peru is the third largest country in South America with an area of approximately 1,285,216 square kilometers, or roughly the size of the State of Alaska. The topography is divided into four natural regions: coast (Costa), highlands (Sierra), jungle (Selva) and territorial waters. The coastal region accounts for approximately 10.5 percent of Peru's area. It is a narrow strip some 2500 km long and 20 to 100 km wide. The altitude along this coastal strip varies from sea level to 1000 km above sea level. The coastal region is primarily arid but seasonal rains do occur in the north and approximately a million hectares are irrigated. Over the course of thousands of years, elaborate irrigation systems have been developed to tap the potential productivity of the coastal valleys. These coastal valleys have been dominated by extensive systems of plantation agriculture centered on cotton and sugarcane with a mixture of other crops such as citrus and grapes also being planted. These coastal farmlands, because of the favorable climate, flat lands and reliable irrigation waters account for 50 percent of the gross agricultural product, despite amounting to only 3.8 percent of the total land area of Peru (1UpInfo, 1992; Silvana Tours, 2001).

The Andean highlands or Sierra runs like a backbone from north to south dividing Peru with the Costa to the west and the jungles to the east. The Sierra makes up approximately 30 percent of the Peruvian land area and ranges from 83 to 250 km wide. The average altitude is about 4000 m. On lower (*ca.* 2500 m) irrigated land, farmers cultivate corn, vegetables and alfalfa. Slightly higher irrigated land may be devoted to grains like wheat, barley and corn as well as legumes (pulses) like broad beans, peas and lentils along with a wide variety of vegetables. At still higher altitudes potato, oca (*Oxalis tuberosa*), other root crops and quinoa are grown. Cattle and sheep are grazed above the cultivated land and on nonirrigated hillsides. In deep, protected gorges and canyons, tropical fruits and crops prosper (Silvana Tours, 2001).

The jungle, or Selva, is Peru's largest region covering nearly 60 percent of the land area. Tropical rainforests extend from the foothills of the eastern Andes Mountains to Peru's borders with Ecuador, Bolivia, Colombia and Brazil. There are two distinct types of jungle, highland (Ceja de Selva) and lowland (Amazonian Plain). The highland jungle is located on the eastern flank of the Andes at an average altitude of approximately 500 to 2800 m. Unlike the arid Andean highlands, the highland jungle has a more temperate, humid climate. Crops grown in this region include a variety of tropical and subtropical commodities including coffee, tea, cocoa, citrus, bananas and pineapple). The lowland jungle is Peru's largest, yet least inhabited region. The lowland jungle ranges in altitude from 75 to 400 m and contains Peru's two largest rivers, the MaraZ∴n and the Ucayali (Silvana Tours, 2001). Traditionally, the native peoples of this region have depended on hunting, fishing and selective gathering from the surrounding rainforest. They have also engaged in a multicropping slash and burn system of farming (1UpInfo, 1992).

1.2.2. General Agriculture

Based on the amount of arable land devoted to given crops, the leading crops in Peru are rice (11.7 percent), potato (10.2 percent), corn grain (9.0 percent) and seed corn (8.3 percent). Coffee (38.5 percent) and asparagus (21.7 percent) are the Peru's most important cash crops (Silvana Tours, 2001). Export crops are grown on approximately 60,000 ha. Approximately 1.2 million ha of Peru's agricultural land is irrigated.

1.2.3. Citrus Production

Peru is not yet considered a major world producer of citrus, and its citrus industry is currently dwarfed by that of neighboring countries like Brazil, Uruguay and Argentina. Peruvian citrus production data for the year 2000 are summarized below in **Table 1**.

Table 1. Citrus Production in Peru (2000)

Crop	Area Harvested (*ha*)	Production (*MT*)
Oranges	23,353	270,673
Tangerine, Clementine, Mandarin, Satsuma	7,375	131,787
Lemons and Limes	23,363	238,179
Grapefruit and Pomelos	1,750	30,500

Source: (World Resources Institute, 2002)

Peruvian officials have identified five areas or zones form which citrus would or potentially could be exported to the United States (Carbonell Torres, 2002). For survey purposes the citrus production areas of Peru are identified by five zones. These citrus zones represent the main citrus production areas of Peru. The five major citrus survey zones are (I) Piura and (II) Lambayeque in Northwestern Peru and (III) Lima, (IV) Ica and (V) Junin in South - central Peru **(Figure 1)**. Export citrus is produced in zones I-IV (Piura, Lambayeque, Lima and Ica). Peru states that there is the potential for exports from the jungle region in zone V (Junin) (Carbonell Torres, 2002). The land area in citrus production, broken down by the proposed export zones, is listed below in **Table 2**.

Table 2. Land Area in Citrus Production - By Export Zone

Zone	Area Planted to Citrus (ha)
I Piura	13,005
II Lambayeque	4,592
III Lima	3,251
IV Ica	1,728
V Junin	8,822

Source: (Carbonell Torres, 2002)

Figure 1. Citrus Export and Potential Export Areas in Peru

In the Lima / Ica area (Zones III and IV), citrus growing is concentrated in three valleys: Huaura-Sayan, Chancay-Huaral and CaZete. The Huaura-Sayan Valley is located in the Huaura River watershed 160 km north of Lima.

The main citrus crops grown here are oranges and mandarins. Thirty-five percent of the crops are grown at moderate altitudes of 400 to 600 m above sea level. The Chancay-Huaral Valley is located in the Chancay River watershed some 60 km north of Lima. The primary citrus crops are oranges, mandarins and tangelos with small amounts of grapefruit and kumquats. The CaZete valley in Ica is located in the CaZete River watershed 150 km south of Lima in Ica. Valencia oranges, tangelos and mandarins are the primary citrus crops.

Citrus growing in Piura (Zone I) is concentrated in four valleys, Chira, San Lorenzo, Alto Piura and Medio-Baio Piura. The main citrus crop is key limes with some lemon and orange production. The Chira Valley is located southeast of Sullana. It is irrigated with water from the reservoir created by the Poechos Dam, 60 km north of Sullana. The valley is divided into five zones: Somate Alto, Somate Bajo, Cienguillo Norte, Cienguillo Centro and Cieneguilla Sur. The valley of San Lorenzo is located northeast of Sullana. It is irrigated with water from the reservoir at the San Lorenzo Dam, 90 km northeast of Sullana. The valley at Alto Piura is located in the Piura River watershed, 80 km northeast of Piura near the town of Chulucanas at 200 m above sea level. Medio-Baja Piura Valley, also in the Piura River watershed, is southwest of Piura city at 80 to 90 m above sea level.

Lambayeque (Zone II) comprises the key lime growing areas of the Motupe and Olmos valleys.

In JunPn (Zone V), citrus growing is concentrated in the Chanchamayo Valley, part of the Chanchamayo River watershed. The main citrus crops are Valencia oranges and mandarins. The citrus orchards are scattered along the river between San Ramon and La Merced.

Citrus producers exporting to the European Union will be required to comply with EUREPGAP certification by the end of 2003 (de la Rosa Brachowicz, 2002). EUREPGAP is a production system of “Good Agricultural Practices” according to standards developed by a European group of representatives from all stages in the fruit and vegetable sector, the Euro-Retailer Produce Working Group (EUREP). This protocol sets out a framework for Good Agricultural Practice (GAP) on farms which defines standards for practices such as pest management, postharvest treatments, documentation and traceability to name a few. It defines the minimum standard acceptable to the leading retail groups in Europe. The protocol does not, however, provide prescriptive guidance on every method of agricultural production. Growers receive their EUREPGAP approval through independent verification from a verification body that is approved by EUREP. Additional information on the EUREPGAP protocol may be found at the EUREP World Wide Web site, www.eurep.org/sites/index_e.html.

A protocol of “selective” or “directed” harvest is used by export growers in an effort to ensure the quality of export fruit. The start of harvest is determined using a Maturity Index. The index is based on fruit quality indicators, primarily the sugar/acid ratio. The harvested fruit is selected according to several criteria including: color (especially early varieties that need degreening); absence of scars, lesions and other blemishes; absence of visible signs of pests; and size (fruit not meeting export quality size standards are left on the tree to be harvested for the local market) (de la Rosa Brachowicz, 2002).

Table 3 provides a typical spray schedule for commercial citrus in Peru.

Table 3. Typical spray schedule for commercial citrus in Peru				
Application Date	**Phenology**	**Target Pest**		**Pesticide / Concentration**
		Common Name	**Scientific Name**	
Aug-Sept	Blossom	Thrips	*Thrips tabaci*	Abamectin / 0.3%
Aug-Oct	Blossom to Fruit set	Botrytis	*Botrytis cinerea*	Benomyl / 0.1%
Sept-Oct	Fruit set	Alternaria	*Alternaria* sp.	Mancozeb / 0.2%
Oct-Nov	Spring flush	Leafminer	*Phyllocnistis citrella*	Abamectin / 0.3%
Oct-Nov	Spring flush	Aphids	*Toxoptera aurantii*	Dimethoate / 0.1%
Nov-Dec	Fruitlet	Agyrotaenia	*Argyrotaenia* sp.	*Bacillus thuringensis* / 0.05%
Nov-Dec	Fruitlet	White mite	*Polyphagotarsonemus latus*	Sulfur / 0.3%
Nov-Dec	Fruitlet	Scales, Whiteflies	*Lepidosaphes backii, Selenaspidus articulatus, Aleurothrixus floccosus*	Spray oils / 1.2% Buprofezin / 0.1% Chlorpyrifos / 0.2%
Feb-Mar	Fruit enlargement	Rust mite	*Phyllocoptruta oleivora*	Abamectin / 0.02% Sulfur / 0.3% Mancozeb / 0.2%
Dec-Apr	Fruit enlargement	Red mite	*Panonychus citri*	Propargite / 0.2% Piribaden / 0.05%
Jan-Sep	Fruit enlargement	Medfly	*Ceratitis capitata*	Malathion / 0.3% Thriclorfon / 0.4%

Source: (de la Rosa Brachowicz, 2002)

This materials listed in this spray schedule are consistent with citrus pest control recommendations in the United States. Abamectin (known by the brand name Agri-mek in the United States is used for early season (blossom to post blossom) control of a variety of arthropod pests including thrips, mites and leafminers (Browning et al., 2001; Childers et al., 2002; Anonymous, 2002). Benomyl has long been used to control *Botrytis* diseases in the United States (Timmer et al., 2000). The pesticide label for Mancozeb recommends that the pesticide may be applied at petal fall for control of *Alternaria* and later in the season on fruit to control citrus rust mite. Dimethoate is an organophosphate insecticide used to kill mites and insects systemically and on contact. It is used against a wide range of insects, including aphids, thrips, planthoppers and whiteflies on ornamental plants, alfalfa, apples, corn, cotton, grapefruit, grapes, lemons, melons, oranges, pears, pecans, safflower, sorghum, soybeans, tangerines, tobacco, tomatoes, watermelons, wheat and other vegetables (EXTONET, 1993a). *Bacillus thuringensis*, known in the United States by a variety of brand names including Biobit, Dipel and Javeline, has long been used to control various lepidopteran larvae and is registered, for example, for use on citrus in Florida (Timmer, 2003). Sulfur is an accepted chemical control for mites and is among the chemical controls recommended for control of rust mite on Florida citrus (Childers et al., 2002) because it has a short treatment to harvest interval and provides a highly effective means of cleaning up rust mite infestations prior to harvest. Buprofezin, known by the brand name Applaud, is registered for control of red scale on citrus in California, while Chlorpyrifos, brand name Lorsban, is used to control a variety of insects including aphids, grasshoppers, katydids, lepidopteran larvae, mealybugs, scales and thrips on a broad range of crops including citrus (Anonymous, 2002). Summer oil sprays of similar rates as those described in **Table 3** are commonly recommended for control of mites, spider mites, whiteflies, mealybugs and scales (Anonymous, 2002; Browning et al., 2002; Childers et al., 2002). Propargite, known in the United States by the brand name Comite, is recommended in Florida for fall control of rust mites and spider mites (Childers et al., 2002). Malathion is used as a control measure in fruit fly eradication programs in the United States. Trichlorfon, commonly known by the trade name Dylox in the United States, is an organophosphate insecticide used to control cockroaches, crickets, silverfish, bedbugs, fleas, cattle grubs, flies, ticks, leafminers and leafhoppers. It is applied to vegetable, fruit and field crops; livestock; ornamental and forestry plantings (EXTONET, 1993b).

The shipping seasons for the various Peruvian citrus crops proposed for export to the United States are summarized below in **Table 4**.

Table 4. Peru Citrus Shipping Seasons

Species	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Clementine								
Key Lime								
Mandarin								
Orange								
Tangelo								

Source: (Carbonell Torres, 2002)

Mandarins are currently shipped in 10 or 15 kg boxes that contain 70 to 130 fruit per box depending on fruit size. Oranges and tangelos are also shipped in 10 or 15 kg boxes. The 10 kg boxes contain 25 to 60 fruit while 15 kg boxes hold 60 to 110 fruit, depending on fruit size (Carbonell Torres, 2002).

While not all would necessarily to be required if the proposed importation is approved, citrus fruit for export to the United States will receive postharvest treatments according to the standard protocols currently employed by Peruvian exporters for citrus shipped to the European Union. Those procedures are outlined in **Figure 2**.

In addition to the treatments described in **Figure 2**, 0.5 to 1.0 percent of the boxes receive a quality control inspection conducted by the packing house. During these inspections the fruit is examined for pests, quality factors (brix, acidity, solids, etc.) and documentation (lot number, packer number, etc.). A phytosanitary inspection of 1.0 to 2.0 percent of the boxes is conconducted separately by SENASA. The plastic field bins in which fruit arrives are treated with chlorine prior to their return to the field. One consignment at a time is run through the packing line and strict requirements for traceability are maintained (Podleckis, 2002).

1.2.4. Current Citrus Fruit Exports from Peru

Current (2002 data) citrus fruit exports from Peru are summarized in **Table 5**. Five exporters in four packing houses account for 98 percent of the total exports (de la Rosa Brachowicz, 2002). According to Peruvian officials (de la Rosa Brachowicz, 2002), Peru has “Never had rejections or claims due to any pest, including fruit fly, pesticide residues exceeding (Hassan, 1977) MLR or microbiological contamination.” None of Peru’s current trading partners require any special phytosanitary measures beyond a Phytosanitary Certificate.

Initial Chlorine Dip → Fruit arrives from the field in bins; fruit is weighed in the bin; an initial 0.5 to 1.0 percent (by weight) sample is taken and examined to determine brix, cultivar ID, approximate percent of fruit at export quality, etc.; fruit then receives a 20 sec chlorine dip at 120 to 200 ppm

SOPP or Chlorine Dip → Fruit is dipped in 2 percent sodium orthophenylphorate or 200 ppm chlorine (certain SOPP sensitive mandarin cultivars are treated with a lower concentration of SOPP)

Brushing → Fruit is run through roller brushes

Fungicide Treatment → Fruit receives a fungicide treatment (*e.g.*, 300 ppm imazalil at 30C)

Waxing → 100 percent of fruit for export is waxed; because of the preceding fungicide dip, the wax generally does not contain fungicide, except when mid to late season fruit rots become a problem, then fungicides (*e.g*., TBZ at 1500 ppm might be addded to the wax)

Drying → Fruit is dried with hot air in two steps: 1.5 min at 40 to 45C, then 2 min at 45C

Selection → 100 percent of the fruit is visually inspected and classified as to whether it is export or domestic quality based on blemishes, color, etc (generally, because of selective harvesting, about 75 percent of the fruit qualifies as export quality); fruit is then mechanically sized

Hand Packing → Finally, fruit is hand selected and packed into 10 or 15 kg corrugated shipping boxes

Source: (Carbonell Torres, 2002); (de la Rosa Brachowicz, 2002); (Podleckis, 2002)

Table 5. Current Citrus Fruit Exports from Peru	
Destination	**Volume Exported (MT)**
Belgium	412
Canada	1032
Colombia	158
Ecuador	363
Hong Kong	144
Ireland	154
Netherlands	3712
Singapore	20
Spain	282
United Kingdom	3907
Venezuela	1139
Others	16
Total	11,339

1.3. Citrus Disease Survey

Peru has proposed exporting citrus from several geographically isolated areas along the Pacific coast since 1992. A preliminary APHIS hazard identification based on the previous decision history (see **Section 2.3** below); reports in the literature of pests in Peru and surrounding countries; and APHIS pest interception records (see **Section 2.4** below) targeted citrus canker (*Xanthomonas axonopodis* pv. *citri* [= *X. campestris* pv. *citri*]), sweet orange scab (*ElsinoN australis*) and citrus black spot (*Guignardia citricarpa*) as the primary diseases of concern and fruit flies such as Medfly (*Ceratitis capitata*) and *Anastrepha* spp. as the major arthropods of significance. In 1993, the Asociacion de Exportadores (ADEX) in cooperation with (AID), contracted with Dr. James Stapleton from the University of California to survey the citrus production areas in Peru. Between 1993 and 1996 Dr. Stapleton conducted several exploratory trips, with initial participation of APHIS officials, to the main citrus areas of the coast and jungle of Peru. The objective of these site visits was to make a preliminary determination on the presence or absence of the three citrus diseases mentioned above. Samples were collected by Dr. Stapleton then analyzed by the Laboratory of the Universidad Nacional Agraria at La Molina. Sweet Orange Scab, Citrus Black Spot or Citrus Canker were not detected in any of the sampled areas. The preliminary conclusion of this study was that the three diseases of concern do not occur in the citrus production areas of Peru.

In 1995, SENASA, in cooperation with APHIS, prepared a protocol for a Citrus Disease Survey in Peru. Activities relating to the citrus disease survey were coordinated with farmer's associations. Personnel were hire selected and hired to serve as National Technical Affairs Plant Pathologist, Field Survey Coordinator, Plant Pathologist Cooordinator for Laboratory Diagnosis, Chief Agronomist for Survey Teams and the survey team members. SENASA provides disease recognition, laboratory diagnosis and regulatory training to all personnel involved in the program. Survey teams are trained in field level diagnosis, survey methods and identification techniques. Cooperating agencies participating in the survey include: SENASA, APHIS, the Peruvian Citrus Farmers Association and the Peruvian Ministry of Agriculture.

Since August of 1996, SENASA has conducted the disease survey in five proposed citrus export areas as well as citrus producing areas outside the proposed export zones. These five zones (**Table 2, Figure 1**) represent the larger citrus production areas of Peru. They are: Piura and Lambayeque in the northwestern part of the country, and Lima, Junin and Ica in south-central Peru. In addition to these five regions, two main wholesale markets located in Lima were surveyed. Other parts of the country, including the regions bordering Bolivia, Brazil, Colombia and Ecuador, as well as the jungle regions, were also surveyed. Commercial production fields, nurseries, packing plants, fruit markets and urban citrus plantings were surveyed. Surveys were initiated in August, 1996 in Lima and Ica (Zones III and IV) and in 1997 in Piura, Lambayeque and Junin (Zones I, II and V).

Surveys are conducted year-round and monthly reports are provided to APHIS. The sampling design consists of marking off squares of 100 trees (10 rows by 10 trees per row) for every 10 ha of citrus. The four trees representing each corner of the square are visually inspected for symptoms and sampled. Samples consist of four mature or overripe fruit and 10 leaves per tree. The collected samples are labeled and sent to the SENASA Laboratorio de Sanidad Vegetal for identification.

After three years of negative survey results, in August 1999, SENASA declared Peru free from Citrus Canker, Sweet Orange Scab and Citrus Black Spot [Supreme Decree N^{o} 029-99-AG; (Carbonell Torres, 2002)]. The European and Mediterranean Plant Protection Organization had already recognized Peru as free of citrus black spot and citrus canker diseases the previous year (EPPO, 1998). Having made this declaration, Peru continued the Citrus Disease Survey and the sampling from 1996 to 2000 is summarized in **Tables 6** and **7**. None of the over 16,000 field, nursery, packing house or field samples processed contained anything other than common citrus pathogens or secondary invaders; no samples tested positive for citrus canker, citrus black spot or sweet orange scab.

Table 6. Summary of Peru Citrus Disease Survey Field Sampling, 1996-2000

Zone	Area Planted to Citrus (ha)	Area Surveyed (ha)	Area Surveyed (%)	Number of Samples 1996	1997	1998	1999	2000	Total
I) Piura	13,005	4011	31	0	1171	1319	703	415	3608
II) Lambayeque	4592	2943	64	0	863	914	594	474	2845
III) Lima	3251	2289	70	261	497	636	455	103	1952
IV) Ica	1728	1631	94	50	462	524	513	146	1695
V) Junin	8822	3836	43	0	570	638	452	226	1886
Total	31,398	14,709	47	311	3563	4031	2717	1364	11,986
Other		708		0	216	64	9	617	906

Source: (Carbonell Torres, 2002)

Table 7. Summary of Peru Citrus Disease Survey Sampling Other Than Fields, 1996-2000

Location Sampled	Number of Samples 1996	1997	1998	1999	2000	Total
Nursery stock	379	637	225	143	55	1439
Packing and Processing Plants	34	217	195	204	141	791
Fruit Markets	20	254	197	415	116	1002
Total	433	1108	617	762	312	3,232

Source: (Carbonell Torres, 2002)

In 2001, the focus of the Citrus Disease Survey shifted from establishing the absence of Canker, Black Spot and Sweet Orange Scab to monitoring Peru's freedom from these three diseases [Supreme Decree N^{o} 002-2001-AG; (Carbonell Torres, 2002)]. In 2001 and 2002, an additional 3,515 samples were processed and all were negative for citrus canker, citrus black spot and sweet orange scab. Citrus Disease Survey sampling for 2001 and 2002 is summarized in **Table 8**.

Table 8. Peru Citrus Disease Survey Summary of Sampling, 2001-2002

Year	Samples by Origin				
	Field	Nursery	Packing House	Fruit Market	Total
2001	1523	63	120	107	1813
2002	1611	38	44	13	1706
Total	3134	101	164	120	3519

Source: (Carbonell Torres, 2002); 2002 Monthly reports supplied APHIS, Santiago, Chile

1.4. Fruit Fly Survey

SENASA's National Program for Fruit Flies (PNMF) maintains the National System of Detection (SINADE), which currently monitors for fruit flies with the purpose of eliminating phytosanitary barriers to export of Peruvian fruits and vegetables (Carbonell Torres, 2002). SINADE uses McPhail traps (baited with hydrolized protein) and Jackson traps (baited with either trimed lure or cue lure and methyl eugenol) installed and geographically referenced in established quadrants of host and non-host crops as well as areas with commercial and tourist traffic (airports, seaports, embassies, etc.) to detect the entry of exotic fruit flies. In 2002, SENASA monitored 20 ha quadrants for hosts and 180 ha quadrants for non-hosts covering a total of 437,511. One or more of the fruit fly species of concern (*Anastrepha fraterculus, A. obliqua, A. serpentina,* and *Ceratitis capitata*) are present in all five of the departments from which export of citrus is proposed (Junin, Ica, Lambayeque, Lima, Piura; **Table 9**). In addition to the fruit fly trapping activities by SENASA, fruit sampling activities are conducted to determine the

Table 9. The distribution of the fruit flies of concern in the Peruvian departments from which citrus fruit is proposed for export to the United States.

Fruit fly species	Distribution
Anastrepha fraterculus	Ica, Lambayeque, Piura
Anastrepha obliqua	Lambayeque, Piura
Anastrepha serpentina	Junin
Ceratitis capitata	Ica, Lambayeque, Lima, Piura

Source: (Carbonell Torres, 2002)

infestation rate and damage caused by fruit flies. Integrated Pest Management (IPM) activities to establish Fruit Fly Free Areas are being carried out in pilot areas of Ica, Lima, Lambayeque, and Piura (Carbonell Torres, 2002). These IPM activities include cultural, etiological, biological, chemical, sterile release, and regulatory control methods for eradication of the fruit flies (Carbonell Torres, 2002).

Details of Peru's national fruit fly survey program for *Ceratitis capitata* and *Anastrepha* spp. can be found (in English and in Spanish) in SENASA's online Manual of National System of Fruit Flies Detection (http://www.senasa.gob.pe/Moscas/manual%20deteccion%20ingles.pdf). This manual has very detailed descriptions with color diagrams of how the program is run, including information on: the biology of the fruit flies, determination of trap location, preparation of the traps, trap servicing, trap coding, processing fruit samples, etc. During a site visit by APHIS to citrus producing areas (see **Appendix 5**) SENASA provided the following information about the fruit fly survey:

- The density for each type of trap (Jackson and McPhail) is 1 trap per 20 hectares in host areas and 1 trap per 180 hectares in nonhost areas. A McPhail trap is placed in the center of each quadrant and a Jackson trap is placed on each corner of each quadrant. Placed in this fashion, the distance between two traps of the same type is 447 meters, and the distance between two different types of trap is 315m. In the Santa Rosa Valley (Department of Lima), for example, there are a total of 408 traps (200 McPhail and 208 Jackson). Traps are placed in host and non-host commercial orchards as well as small gardens located beside orchards, but they are not placed in urban areas. All the traps are geographically referenced using GPS.

- Both types of trap (Jackson and McPhail) are serviced every 7 days. In the Canete valley, for example, there are 5 inspectors that cover 24,000 hectares with 667 total traps (367 Jackson, 300 McPhail). An inspector will service approximately 30 traps per day. SENASA inspectors demonstrated and explained the procedure they use for servicing both types of traps. For McPhail traps: The lid is taken off the trap and the water + bait solution poured through a funnel. All the insect specimens are caught on a screen and then transferred with forceps into a bottle with 70% alcohol. The sediments in the bottom of the trap are rinsed out, and the trap is refilled with 250cc of fresh bait solution. The used bait solution is taken back to the lab to be discarded. For Jackson traps: The sticky trap is taken out of the trap, folded, and signed with the date. The cardboard trap housing is cleaned with a dry cloth and is signed by the inspector with his name and the date serviced. A new sticky trap, on which the trap code and date are written, is signed and placed into the housing. The traps (both types) are not relocated to a new tree after each inspection but instead stay in the exact same GPS georeferenced location. The SENASA inspector records information for each trap serviced in a chart (*e.g.*, fruit flies detected in trap, presence of fruit on trees, condition of orchard, hosts present, number of days since trap last serviced, etc.). Insect specimens are taken to the area SENASA office for identification. If identification cannot be made by the area office, the specimens are then sent to the national fruit fly taxonomy laboratory in Lima. The information collected from the trap survey is entered into a database and submitted to the SENASA headquarters in Lima.

- Fruit samples are also collected for the detection of fruit flies. Fruit samples are taken at the same time as when traps are inspected. The number of fruit collected per trap varies and depends on the host (*i.e.*, the risk of the host), the fruit phenology, the number of fruit flies being trapped, and the number of trees present. Usually each fruit sample represents approximately 1-2 kg. Using each trap as a reference, the most damaged fruit are collected from both trees and off the ground at approximately 40-60 meters from the McPhail traps and 100-120 meters from the Jackson traps. The fruit in one sample can come from different hosts. The same code used for the trap is used to identify each fruit sample collected. The SENASA inspector records information for each fruit sample collected in a chart (*e.g.*, presence of fruit on trees, condition of orchard, hosts present, number of days since trap last serviced, etc.). The fruit are then taken back to the area SENASA office for dissection, and any fruit fly larvae collected from the fruit are reared to the adult stage for identification. According to information presented by Rafael Guillen Encinas (Director National Fruit Fly Program, SENASA), the percent infestation of citrus fruit depends on the host and the geographical area. The ranges of infestation rates for 2002 were the following in the Pilot Fruit Fly Free Areas: 0.01percent in Chira to 0.56 percent in Canete for oranges (*Citrus sinensis*), 0.04 percent in San

Lorenzo and Motupe to 0.42 percent in Chancay-Huaral for mandarins, and 0.012 percent in Chira to 0.16 percent in Chicha for tangelo. These infestation rates are for damaged fruit only.

- A “visit sheet” is provided by SENASA to the farmer with the total number and identification of the fruit flies trapped/detected along with recommendations as to what type and amount of mitigation measures are needed.

- For each survey area, color coded maps are produced each week showing the number of *Ceratitis capitata* and *Anastrepha* sp. fruit flies trapped in each trap. SENASA personnel provided the most up-to-date version of these maps for the different areas during the orchard visits.

- In the Motupe Valley of the Department of Lambayeque, the weekly mean number of fruit fly captures per trap per day (MTD) was reported to be 0.054 for *C. capitata* and 0.4 for *Anastrepha* sp.. Fruit flies have never been trapped in key lime orchards. Grapefruit is the only citrus fruit in which fruit flies (*Anastrepha* sp. only) have been recovered. Fruit flies have been recovered from other fruit, however (*e.g.*, *Anastrepha* sp. in mango). In the Department of Piura, fruit flies have never been found in fruit samples in 10 years of sampling, and they have never been found in traps located in key lime orchards. In the Canete Valley, Department of Lima, the weekly MTD was reported to be 0.8 for McPhail traps (0.3 for *Anastrepha*, 0.5 for *Ceratitis capitata*) and 0.6 for Jackson traps. In this valley, Medflies have been detected in both type of traps in citrus and in citrus fruit, and *Anastrepha* (*A. fraterculus* and *A. distincta*) have been found in mango and loquat but not citrus (including traps and fruit samples). Detections in this valley have been more numerous in small gardens/fields compared to commercial orchards (for both traps and fruit samples). In the Santa Rosa Valley (Department of Lima), the MTD is 0.04 for *Ceratitis capitata* and 0.001 for *Anastrepha* (*A. frateruculus* and *A. distincta*).

- SENASA survey inspectors are required to posess a certain level of agricultural and technical knowledge. Their training consists of learning theory and gaining practical field experience by accompanying more experienced inspectors. It takes about 1-2 months for an inspector to become fully trained and ready to conduct inspections on their own. All inspectors then receive training on a continual basis after the initial training.

- Fruit fly identifications are carried out using morphology. SENASA has a very rigorous training and certification program for the fruit fly identifiers. Training is provided for each fruit fly species, and the identifiers receive a certificate giving them authorization to identify only those fruit flies for which they have received training and have successfully passed an examination. The certificates are only valid for one year, after which the identifiers have to receive additional training and examination.

2. Risk Assessment

2.1. The Risk Analysis Process

International plant protection organizations, e.g., North American Plant Protection Organization (NAPPO) and the International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO), provide guidance for conducting pest risk analyses. The methods we used to initiate, conduct and report this plant pest risk assessment are consistent with guidelines provided by the IPPC (FAO, 1996); (FAO, 2001a). Our use of biological and phytosanitary terms conforms with the NAPPO *Compendium of Phytosanitary Terms* (Hopper, 1996), the IPPC *Glossary of Phytosanitary Terms* (FAO, 2001a) and the *Definitions and Abbreviations* (Introduction Section) in *International Standards for Phytosanitary Measures, Guidelines for Pest Risk Analysis for Quarantine Pests* (FAO, 2001b).

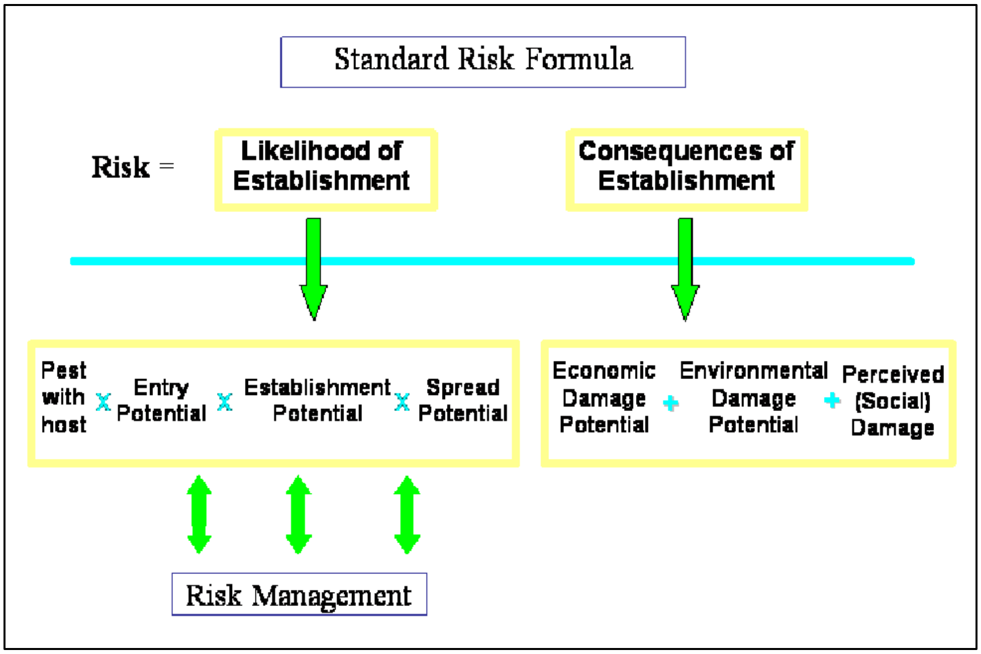
As used in this document, pest risk assessment is the determination of whether a pest is a quarantine pest and evaluation of its introduction potential (FAO, 2001a), pest risk management is the decision-making process of reducing the risk of introduction of a quarantine pest (FAO, 2001a), and pest risk analysis is the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures taken against it. Pest risk analysis encompasses risk assessment plus risk management (FAO, 2001a). The relationship among these different activities is illustrated in **Figure 2**.

The *Guidelines for Pest Risk Analysis* provided by (FAO, 2001b) describes three stages in pest risk analysis. This document satisfies the requirements of FAO Stages 1 (initiation) and 2 (risk assessment). The Risk Assessment process analyzes factors such as the biology, host range, distribution, entry potential, establishment potential, spread potential and economic damage potential of the pests and diseases that may be associated with importations of fresh citrus fruits from Peru. The estimates of risk are expressed qualitatively (high, medium or low). Details of the risk assessment method may be found in the document: *Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, Version 5.0* (United States Department of Agriculture, 2000). This document is available from the Agency contact listed on this document or on the Internet at:

http://www.aphis.usda.gov/ppq/pra/commodity/cpraguide.pdf

This Guidelines document is a constantly evolving one. Major revisions are designated by version numbers. The version published at the above named web site, Version 5, represents the fifth major revision of these Guidelines and the last major revision. The process used to complete this risk assessment is based on Version 5 with some modifications that may eventually be incorporated into the next major revision of the Guidelines.

Figure 2. The Pest Risk Analysis Process



PPQ conducts pathway-initiated pest risk assessments at "routine" and "nonroutine" levels using qualitative and quantitative methods (Federal Register, 2001). This document follows the process for qualitative pest risk assessments (United States Department of Agriculture, 2000). PPQ completes the same basic steps, as required, in all routine or non-routine pathway-initiated pest risk assessments as outlined in **Figure 3**.

2.2. Assessment of Weediness Potential of Citrus spp.

Appendix 1 shows the results of our weediness screening for *Citrus* spp. Our findings did not require us to initiate a pest-initiated pest risk assessment for *Citrus* spp. If the species considered for import had posed a risk as a weed pest, then a "pest-initiated" pest risk assessment may have been initiated. Because *Citrus* spp. passed the weediness screening, the pathway-initiated pest risk assessment continued.

2.3. Relevant Regulatory Decision History

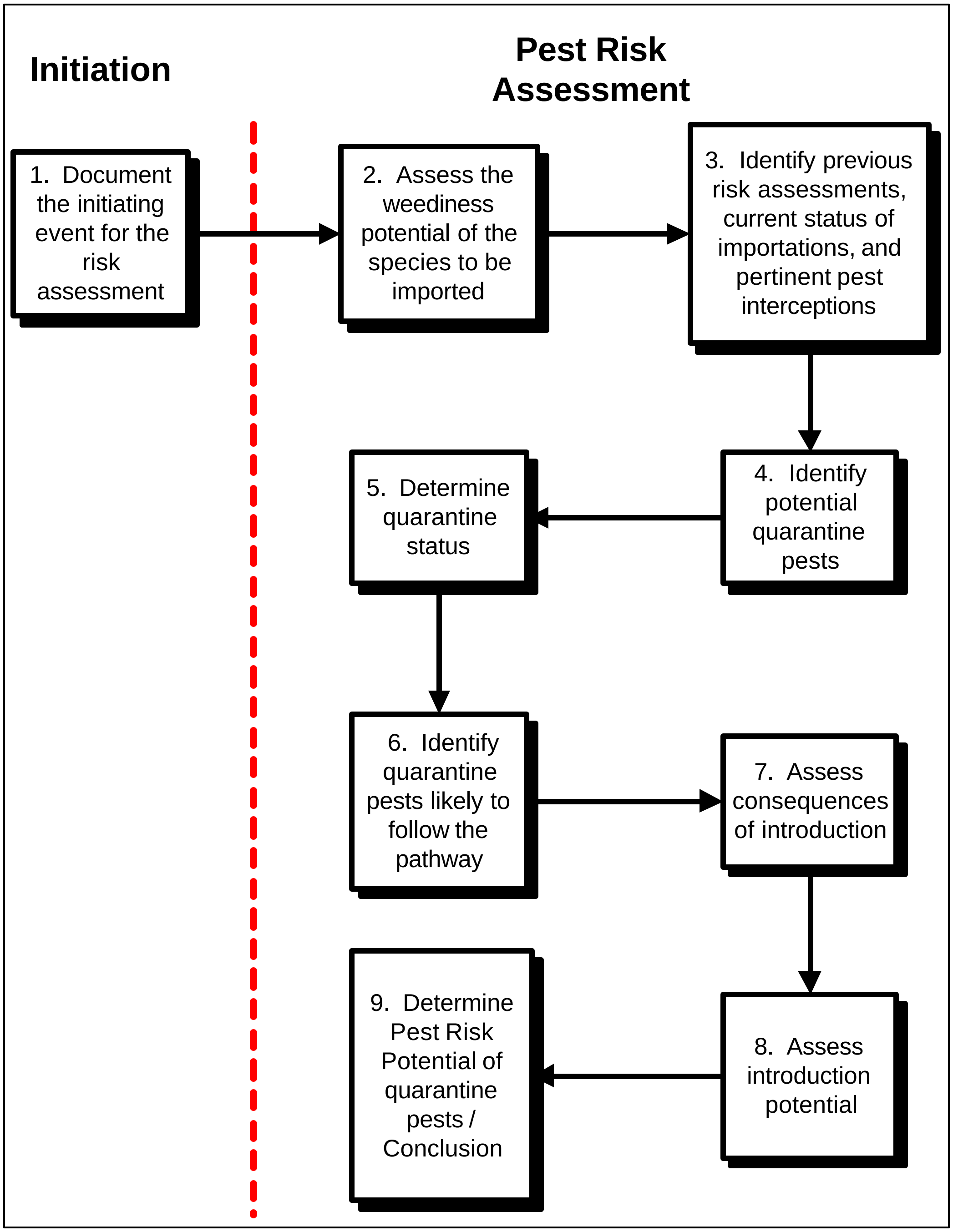
The regulatory decision record on import requests for fresh fruit of selected *Citrus* spp. from South and Central America are summarized in **Appendix 2**. Between 1924 and 1997 there were approximately 28 requests. The bulk of these requests (18) were either denied or approved subject to a mandatory cold treatment for fruit flies. During this period, there were five requests made to import fresh citrus fruit from Peru. As noted in **Table 10**, all five requests were denied either because of the lack of an approved treatment for South American fruit flies (*i.e., Anastrepha fraterculus*) or a report (since accepted as erroneous; (EPPO, 1998)) in the literature of the presence of the citrus black spot fungus (*Guignardia citricarpa*).

Table 10. Decision History for Citrus from Peru		
***Citrus* x *paradisi* (Grapefruit)**	**1928**	Denied because of the presence of several different fruit flies especially *Anastrepha peruviana* (=*A. fraterculus*)
***Citrus sinensis* (Orange)**	**1928**	Denied because of the presence of several different fruit flies especially *Anastrepha peruviana* (=*A. fraterculus*)
Multiple *Citrus* species	**1969**	Disapproved. No approved treatments for South American *Anastrepha* fruit flies
Multiple *Citrus* species	**1974**	Disapproved. *Guignardia citricarpa* (citrus black spot) reported in the literature to occur in Peru
Multiple *Citrus* species	**1988**	Disapproved. No acceptable treatment or inspection for *Guignardia citricarpa* (citrus black spot)

2.4. Pest Interception Records

Selected pest interception data, as gathered from the APHIS Port Information Network 309 Database, is shown in **Appendix 3**. The three citrus diseases, citrus canker (*Xanthomonas axonopodis* pv. *citri* = *X. campestris* pv. *citri*), sweet orange scab (*Elsinoë australis*) and citrus black spot (*Guignardia citricarpa*), are quarantine pests that have been intercepted on citrus from Peru by APHIS on multiple occasions (**Appendix 3**). However, all of those interceptions were made from passenger baggage and ship's stores or quarters. As such, the true origin of the fruit is difficult to determine. The three diseases have been reported from surrounding countries (Farr et al., 2003);(Ooi et al., 2002);(CAB International, 2002; Ooi et al., 2002) and flights from some of these countries (*e.g.*, Argentina, Bolivia and Uruguay) to the United States do connect through Peru (Solano, 2003).

Figure 3. The Qualitative Commodity Risk Assessment Process in PPQ



Interviews with plant quarantine officers at selected ports indicated that when most officers intercept citrus from a passenger on a flight from Peru, they assume the citrus is from Peru (Levy, 2003). However, this assumption may not be correct for connecting passengers originating in other countries. Because of the uncertainty surrounding these interceptions and, as discussed under **Section 1.3** (**Citrus Disease Survey**), surveys have indicated that these three diseases do not occur in Peru, these pathogens are not included on the pest list (**Table A4- 1**).

2.5. Pests Associated with Citrus and Reported in Peru

The pests associated with citrus and reported in Peru are listed in **Appendix 4**.

Of note: five pests (*Pseudococcus neomaritimus*, *Xanthomonas axonopodis* pv. *citri* [= *X. campestris* pv. *citri*], *Elsinoë australis, Guignardia citricarpa,* citrus leprosis virus) were not included on this pest list as they were determined to not be present in Peru.

Pseudococcus neomaritimus (Homoptera: Pseudococcidae) is a quarantine pest that is known to attack citrus fruit. It has been recorded from Peru (Salazar, 1972); however, it is thought that the specimens reported in (Salazar, 1972) were probably *P. jackbeardsleyi* (Williams and Watson, 1988; Ooi et al., 2002).

The three citrus diseases, citrus canker (*Xanthomonas axonopodis* pv. *citri* = *X. campestris* pv. *citri*), sweet orange scab (*Elsinoë australis*) and citrus black spot (*Guignardia citricarpa*), are quarantine pests that have been reported from Peru and/or surrounding countries (Farr et al., 2003; Ooi et al., 2002) and have been intercepted on citrus from Peru by APHIS on multiple occasions (**Appendix 3**). These pathogens are not included on the pest list, however, because, as discussed under **Section 1.3** (**Citrus Disease Survey**), surveys have indicated that these three diseases do not occur in Peru.

Citrus leprosis virus is a quarantine pest that can affect citrus fruit and is reported to be in Peru by (Lovisolo, 2001). Subsequent investigation, however, confirmed that this virus is not present in Peru (Ochoa, 2003; Rodrigues, 2003); therefore, this virus is not included on the pest list. Of note: citrus leprosis was reported in Florida in the late 1800's, but has not been reported there since the 1960's (Childers et al., 2001; Childers et al., 2003).

2.6. Quarantine Pests Associated with Citrus and Reported in Peru

As defined by international standards (FAO, 2001a), a quarantine pest is, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled. The pests listed below in **Table 11** have been determined to meet this standard and are regarded as quarantine pests by APHIS.

Table 11. Quarantine Pests Associated with Citrus and Reported in Peru	
Arthropods	
Acromyrex hispidus *Aleurodicus dispersus* *Anestrepha distincta* *Anastrepha fraterculus* *Anastrepha grandis* *Anastrepha minensis* *Anastrepha obliqua* *Anastrepha serpentina* *Anastrepha striata* *Ancistrosoma klugi* *Aonidia* spp. *Argyrotaenia sphaleropa* *Arvelius acutispinus* *Asterolecanium* sp. *Atta cephalotes* *Atta sexdens* *Aulacaspis tubercularis* *Carales astur* *Ceratitis capitata* *Ceroplastes* sp. *Coccus viridis* *Compsus* sp. *Diabrotica speciosa* *Ecdytolopha aurantiana* *Euryophthalmus balteatus* *Gymnetosoma mathani* *Inga lacunata*	*Lecanodiaspis* sp. *Macropophora acentifer* *Macrostylus puberulus* *Melipona* sp. *Microcentrum laurifolium* *Nyctobates gigas* *Oiketicus kirbyi* *Orthezia citricola* *Orthezia olivicola* *Orthezia praelonga* *Papilio isidorus isidorus* *Papilio paeon paeon* *Parlatoria cinerea* *Parlatoria ziziphi* *Phyllocnistis citrella* *Planococcus minor* *Pseudaonidia trilobitiformis* *Pulvinaria* sp. *Rhynchophorus palmarum* *Schistocerca cancellata* *Sibine* sp. *Tetreuaresta punctipennata* *Toxoptera citricidus* *Trigona hyalinata* *Trigona testacea cupira* *Trigona trinidadensis*
Fungi	
Alternaria sp. *Cercospora* sp. *Fusarium* sp.	*Mycena citricolor* *Rosellinia bunodes*
Nematodes	
Criconemella spp. *Hemicriconemoides mangiferae* *Meloidogyne exigua* *Radopholus similis* *Trichodorus* spp.	*Xiphinema brasiliense* *Xiphinema brevicolle* *Xiphinema paritaliae* *Xiphinema peruvianum* n.sp.
Mollusks	
Helix aspersa	

2.7. Quarantine Pests Selected for Further Analysis

The quarantine pests selected for further analysis are summarized in **Table 12**. Only those quarantine pests that can be reasonably expected to follow the pathway of commercial shipments of export citrus are analyzed further. Other quarantine pests not included in this summary have the potential to be detrimental to U.S. agriculture; however, there were a variety of reasons for not subjecting them to further analysis. Examples include: they are associated mainly with plant parts other than the commodity; they may not be associated with the fruit during transport or processing because of their inherent mobility; sexually immature insect stages can be transported in a shipment but are unable to establish viable populations; they may be associated with the fruit as incidental biological contaminants and would be expected to be present with only occasional shipments.

The following quarantine pests mainly attack parts other than the fruit: *Acromyrex hispidus, Ancistrosoma klugi, Atta cephalotes, Atta sexdens, Ceroplastes* sp., *Macropophora acentifer, Macrostylus puberulus, Oiketicus kirbyi, Orthezia citricola, Orthezia olivicola, Orthezia praelonga, Papilio isidorus isidorus, Papilio paeon paeon, Phyllocnistis citrella*, *Schistocerca cancellata*, *Toxoptera citricidus*, *Fusarium* sp., *Rosellinia bunodes, Criconemella* spp., *Hemicriconemoides mangiferae, Meloidogyne exigua, Radopholus similes, Trichodorus* spp., *Xiphinema brasiliense, Xiphinema brevicolle, Xiphinema paritaliae,* and *Xiphinema peruvianum* n. sp.

The following quarantine pests may feed, inhabit, or be associated with citrus fruit but are not likely to follow the pathway because they are highly visible during harvest and are often easily removed or disturbed during the growing season, at harvest or during packing procedures by hand, or they may escape from the commodity by flying away, falling to the ground or rapidly crawling from fruit to foliage: *Arvelius acutispinus* (Hemiptera: Pentatomidae), *Diabrotica speciosa* (Coleoptera: Chrysomelidae), *Euryophthalmus balteatus* (Hemiptera: Pyrrhocoridae), *Gymnetosoma mathani* (Coleoptera: Scarabaeidae), *Melipona* sp. (Hymenoptera: Meliponidae), *Rhynchophorus palmarum* (Coleoptera: Curculionidae), *Trigona hyalinata* (Hymenoptera: Apidae), *Trigona testacea cupira* (Hymenoptera: Apidae), *Trigona trinidadensis* (Hymenoptera: Apidae), and *Helix aspersa* (Mollusca: Helicidae).

Anastrepha grandis and *A. minensis* (Tephritidae) are not likely to follow the pathway, and therefore are not selected for further analysis, because *Citrus* is considered to be a doubtful host (Norrbom and Kim, 1988; Ooi et al., 2002) or is not included in their reported host ranges (White and Elson-Harris, 1992; Weems, 1990). The primary hosts of *A. grandis* are cucurbits (White and Elson-Harris, 1992; Weems, 1990; CAB International, 2002), and the recorded hosts of *A. minensis* include *Psidium guajava*, *Eriobotrya japonica, Myrciaria* sp., and *Prunus persica* (White and Elson-Harris, 1992; Norrbom and Kim, 1988).

Additionally, *A. distincta* is not likely to follow the pathway. (Norrbom and Kim, 1988) list only laboratory and questionable reports of *A. distincta* on citrus. Based on this evidence, it is estimated that this fruit fly species is not likely to be associated with commercial citrus for export (Miller, 2003a).

Anastrepha striata is not likely to follow the pathway. The primary records of this species on citrus are questionable, and, therefore, this fruit fly probably does not attack citrus (Norrbom, 2003). Based on this evidence, it is estimated that this fruit fly species is not likely to be associated with commercial citrus for export (Hennessey, 2003).

Coccus viridis (Homoptera: Coccidae) was not selected for further analysis, because, although this scale is reported to attack fruit (CAB International, 2002), it mainly attacks the leaves of its hosts (Dekle, 1976; Miller, 2003b)

(**Appendix 5**). Since 1985, *C. viridis* has been intercepted a total of 10,252 times, of which only 170 of those interceptions were on fruit; and it has been intercepted 1,249 times on citrus, of which only 55 of those interceptions were on fruit and only 6 on fruit in cargo (PIN309, 2003). Based on this evidence, it is estimated that the commercial processing and culling of the citrus fruit should eliminate this pest from the pathway (Miller, 2003b).

Argyrotaenia sphaleropa (Lepidoptera: Tortricidae) is unlikely to follow the pathway and, therefore, not selected for further analysis. Although this tortricid is reported to attack fruit (Manfredi-Coimbra et al., 2001; Bentancourt, 1988), it only attacks citrus during fruit set, causing premature fruit drop (Salazar Torres, 1999; Carbonell Torres, 2003) (**Appendix 5**). It is, therefore, not a problem on fruit at harvest. The fact that this genus has never been intercepted by PPQ (PIN309, 2003) is further evidence that this species is unlikely to follow the pathway.

Planococcus minor (Homoptera: Pseudococcidae) was not selected for further analysis because the only evidence of it possibly being present in Peru are baggage interceptions. Since 1985, this species was intercepted from Peru by PPQ 4 times in baggage on *Annona* spp. fruit, which is reported as a host (PIN309, 2003; Ben-Dov, 1994). The literature does not report its distribution as including Peru (ScaleNet, 2002; Ben-Dov, 1994).

Additionally, the following armored scales (Diaspidae) are not selected for further analysis: *Aonidia* sp, *Aulacaspis tubercularis*, *Parlatoria cinerea*, *Parlatoria ziziphi* and *Pseudaonidia trilobitiformis.* PPQ does not take action on armored scales found on certain fruit for consumption (including *Citrus*) in commercial shipments at ports of entry (Courneya, 2003b) because of their low risk of establishment (Miller, 1985).

Mycena citricolor is reported as present in Florida (CAB International, 2002). However, expert opinion from Florida indicates that it has not been detected there since 1926 (Schubert, 2002). Also, this species is not listed as attacking citrus or occurring in the United States by (Farr et al., 1989; Alfieri et al., 1993; Timmer et al., 2000). The ability of *M. citricolor* to follow the pathway is questionable, as no reference has been found that indicates it attacks citrus fruit specifically. (Mariau, 2001) and (Wellman, 1972) report *M. citricolor* infecting the fruit of coffee, but do not report infection of citrus fruit. Most references refer to *M. citricolor* as a pest of coffee, e.g., (Mariau, 2001; CAB International, 2001; Thurston, 1989; Wellman, 1972). Citrus is only listed as a secondary host (CAB International, 2002). On coffee, subcircular spots initially brown becoming pale-brown to straw-coloured are produced mainly on leaves. Similar spots may be produced on stalks and berries. The main effect is to cause leaf fall with a consequent reduction in growth and yield of the coffee tree (CAB International, 2002). Symptoms on other hosts are broadly similar (Wellman, 1972). Although it has been reported in Peru (Farr et al., 2003; CAB International, 2002) on coffee, it has not been reported to attack citrus in Peru (Carbonell Torres, 1999). And although *M. citricolor* has been reported on citrus in Puerto Rico and the Virgin Islands (Farr et al., 2003), it has not been intercepted on citrus fruit from any country since at least 1985, the earliest APHIS computerized interception data available (PIN309, 2003). Because *M. citricolor* is primarily a leaf spotting disease, primarily a disease of coffee (*Coffea* spp.) and has not been intercepted on citrus fruit by APHIS during the nearly 20 years covered by the PIN 309 database, this pathogen was not considered likely to follow the pathway and was not selected for further analysis

Finally, the following organisms identified only to genus are not selected for further analysis because the genera are reported to be present in the U.S.: *Asterolecanium* (Kosztarab, 1996; Hamon, 1977; Hill, 1983; CAB International, 2002), *Compsus* (Arnett et al., 2002), *Lecanodiaspis* (Kosztarab, 1996), *Pulvinaria* (ScaleNet, 2002), *Sibine* (Zhang, 1994), *Alternaria* (CAB International, 2002; Farr et al., 2003), *Cercospora* (CAB International, 2002; Farr et al., 2003). Additionally, the biological hazard of organisms not identified to the species level is generally 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. Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. By necessity, pest risk assessments focus on the organisms for which biological information is available. The lack of identification at the specific level does not rule out either the possibility that a high risk quarantine pest was intercepted or that the intercepted pest was not a quarantine pest. Conversely, development of detailed assessments for known pests that inhabit a variety of ecological niches, such as internal fruit feeders or foliage pests, allow effective mitigation measures to eliminate the known organisms as well as similar but incompletely identified organisms that inhabit the same niche.

Table 12. Quarantine Pests Selected for Futher Analysis	
Arthropods	
Anastrepha fraterculus *Anastrepha obliqua* *Anastrepha serpentina*	*Ceratitis capitata* *Ecdytolopha aurantiana*

2.8. Consequences of Introduction—Economic/Environmental Importance

This portion of the analysis considers negative outcomes that may occur when the quarantine pests identified as following the pathway of *Citrus* spp. from Peru are introduced into the entire continental United States. Potential consequences of introduction are rated using five risk elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These elements reflect the biologies, host ranges and climatic/geographic distributions of the pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points) or High (3 points) based on the criteria as stated in the Guidelines (United States Department of Agriculture, 2000). A Cumulative Risk Rating is then calculated by summing all risk element values. For each pest, the sum of the five risk elements produces a cumulative risk rating for the consequences of introduction. This cumulative rating is considered the biological indicator of the pest's potential to cause economic and environmental impacts. The ratings are summarized in **Table 13**.

2.8.1. Host / Climate Interaction

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants are present and the climates are similar. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (United States Department of Agriculture, 1990) where the pest could establish based on its known climatic range. Low (1), if suitable host and climate occur in a single plant hardiness zone; Medium (2), if suitable host and climate occur in two or three plant hardiness zones; and High (3), if suitable host and climate occur in four or more plant hardiness zones.

Evidence	**Risk Value**
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** *A. fraterculus* has greater morphological variation than related species and represents an unresolved species complex (Aluja, 1994; CAB International, 2002). (Baker et al., 1944; Baker, 1945; Baker,	Medium (2)

Evidence	Risk Value
1962) consider the Mexican form a distinct species from the South American form based on differences in morphology and host utilization. This group occurs from the south of Texas to Argentina (Foote et al., 1993). More specifically, its reported distribution includes: Mexico, Panama, Tobago, Trinidad, Argentina, Bolivia, Brazil, British Guiana, Colombia, Ecuador, Peru, Uruguay, and Venezuela (C.I.E., 1958; United States Department of Agriculture, 1982). It is also reported from the Rio Grande Valley of Texas (United States Department of Agriculture, 1982), Costa Rica, Guatemala, Guyana, Paraguay, and Surinam (CAB International, 2002). (CAB International, 2002) reports its distribution in Mexico, Ecuador, and Argentina as restricted. This reported distribution of *A. fraterculus* corresponds to the U.S. Plant Hardiness Zones 5-11 (United States Department of Agriculture, 1990; BackyardGardner.com, 2003). *Prunus*, which is reported as a primary host, is present in all States within the continental U.S. (USDA-NRCS, 2002). Other primary hosts (*Eugenia, Citrus, Psidium guajava,* and *Syzygium*) are found in Florida, Georgia, Louisiana, Texas, California, and/or Hawaii (USDA-NRCS, 2002), which includes the U.S. Plant Hardiness Zones 8-11 (United States Department of Agriculture, 1990). It is estimated that the species could become established in areas of the U.S. corresponding to 3 Plant Hardiness Zones (9-11) and is given a Medium (2) rating for this risk element. This conservative estimate does not include Plant Hardiness Zones 5-8, as these zones only occur in northern Mexico, southern Argentina, and other isolated areas of some of the other countries (e.g., Andean regions of Bolivia and Peru) from which *A. fraterculus* is reported. As stated above, the distribution of *A. fraterculus* is reported as restricted in both Mexico and Argentina, and it is thought that *A. fraterculus* in Mexico may be a separate species from that in South America.	
***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** One of the most widespread of *Anastrepha* species (Foote et al., 1993), *A. obliqua* ranges from Mexico to Argentina and through the Caribbean (CAB International, 2002). Its reported distribution includes: Belize, Bermuda, Costa Rica, Cuba, Dominica, Domican Republic, Guadeloupe, Haiti, Jamaica, Martinique, Mexico, Montserrat, Nevis, Panama, Puerto Rico, St. Kittis, St. Lucia, Trinidad and Tobago, Argentina, Brazil, Guyana, Colombia, Ecuador, Venezuela (C.I.E., 1988), as well as Bahamas, British Virgin Islands, Guatemala, Honduras, Nicaragua, Paraguay, Peru, Surinam, U.S. Virgin Islands (CAB International, 2002). Its distribution is considered restricted in Ecuador, Mexico, and Paraguay (CAB International, 2002). It has been reported from Florida, Texas (C.I.E., 1988), and California (Foote et al., 1993), but is currently considered absent from these States (CAB International, 2002). This reported distribution of *A. obliqua* corresponds to the U.S. Plant Hardiness Zones 5-11 (BackyardGardner.com, 2003). Its primary hosts (*Spondias* spp. and *Mangifere indica*) are found in Florida (both hosts) and Hawaii (*M. indica*) (USDA-NRCS, 2002), which includes the U.S. Plant Hardiness Zones 8-11 (United States Department of Agriculture, 1990). Other secondary hosts (e.g., *Pyrus communis*) have wider distributions in the U.S. (USDA-NRCS, 2002). It is estimated that the species could become established in areas of the U.S. corresponding to 4 Plant Hardiness Zones (8-11) and is given a High (3) rating for this risk element. This estimate does not include Plant Hardiness Zones 5-7, as these zones only occur in isolated areas of some of the countries (e.g., Andean regions of Argentina and Peru) from which *A. obliqua* is reported (BackyardGardner.com, 2003).	High (3)
***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** *Anastrepha serpentina* occurs in most countries of Central America and in South America south to Brazil and Argentina (Foote et al., 1993; CAB International, 2002). More specifically, it is reported as widespread in Brazil, Costa Rica, Guatemala, Guyana, Mexico, Nicaragua, Panama, Peru, Suriname, Trinidad and Tobago (CAB International, 2002). It is also reported as present in Argentina,	High (3)

Evidence	Risk Value
Colombia, Dominica, Ecuador, French Guiana, Netherlands Antilles and Venezuela (CAB International, 2002). The establishment status of this species in the U.S. is unclear. (Foote et al., 1993) report that it has seldom been found in Texas since about 1959 and that it was trapped in southern California in 1989. Weems (Weems, 1969) reports that large numbers of adults have been trapped in the Rio Grande Valley of Texas, but except for one record it has not been found infesting fruit. This reported distribution of *A. serpentina* corresponds to the U.S. Plant Hardiness Zones 5-11 (United States Department of Agriculture, 1990; BackyardGardner.com, 2003). The majority of the U.S. has one or more of *A. serpetina*'s host plants (*e.g., Pyrus communis, Prunus persica, Malus, Citrus*) present (USDA-NRCS, 2002). It is estimated that the species could become established in areas of the U.S. corresponding to 4 Plant Hardiness Zones (8-11) and is rated High (3) for this risk element. This estimate does not include Plant Hardiness Zones 5-7, as these zones only occur in isolated areas of some of the countries (e.g., Andean regions of Argentina and Peru) from which *A. serpentina* is reported (BackyardGardner.com, 2003). Additionally, Sequeira et al (Sequeira et al., 2001) estimate that the following areas of the U.S. have a high risk of establishment by *Anastrepha* spp., including *A. serpentina*: California, southern Arizona, southern Texas, southern Louisiana, southern Alabama, southern Georgia, Florida, and southern South Carolina, which corresponds to the U.S. Plant Hardiness Zones 8-11. Sequeira et al (Sequeira et al., 2001) assessed risk using a combination of temperature requirements, generation potential, and commercial host availability.	
***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** *Ceratitis capitata* is found in southern Europe and west Asia, throughout Africa and South and Central America (CAB International, 2002), and in northern Australia (Hassan, 1977). This species has the capacity to tolerate colder climates better than most other species of fruit fly (Weems, 1981). The area in which it survives is of Mediterranean climate, virtually coinciding with where citrus is grown (CAB International, 2002). It is estimated that the species could become established in areas of the United States corresponding to four Plant Hardiness Zones (8-11) and is rated High (3) for this risk element. One or more hosts of *C. capitata* are present in these Plant Hardiness Zones in the United States (USDA-NRCS, 2002).	High (3)
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** Geographical records include most neotropical areas, including Brazil, Argentina, Costa Rica, and Trinidad-Tobago (Bento et al., 2001; CAB International, 2002). It is also reported from Venezuela (Zhang, 1994), Peru (Escalante et al., 1981; Adamski and Brown, 2001), Belize and Dominica (White, 1999); Ecuador, Colombia, French Guiana, Surinam, Cuba, and Puerto Rico (Adamski and Brown, 2001); and it ranges north in Central America to Mexico (Adamski and Brown, 2001). (Adamski and Brown, 2001) provide a detailed map of its distribution, which shows its range as going from southern Mexico to northern Argentina and through the Carribbean. This reported distribution corresponds to Plant Hardiness Zones 9-11 (BackyardGardner.com, 2003). One of more of its potential hosts occurs in these Zones (USDA-NRCS, 2002). Therefore, it is estimated that this species could become established in areas of the United States corresponding to three Plant Hardiness Zones (9-11), and is rated Medium (3) for this risk element.	Medium (2)

2.8.2. Host Range

The risk posed by a plant pest is determined by both its ability to establish a viable, reproductive population and its potential for causing plant damage. This risk element assumes that the consequences of pest introduction are positively correlated with the pest's host range. Aggressiveness, virulence and pathogenicity also may be factors. The consequences are rated as a function of host range and consider whether the pest can attack a single species or multiple species within a single genus, a single plant family, or multiple families. Low (1), if the pest attacks a single species or multiple species within a single genus; medium (2), if the pest attacks multiple species within a single plant family; and High (3), if the pest attacks multiple species among multiple plant families.

Evidence	Risk Value
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** *Anastrepha fraterculus* is extremely polyphagous. Primary hosts are *Citrus* (Rutaceae), *Eugenia* (Myrtaceae), *Prunus* (Rosaceae), *Psidium guajava* (Myrtaceae), *Syzygium* (Myrtaceae) (CAB International, 2002). Peferred hosts are Myrtaceae, particularly *Psidium guajava* (CAB International, 2002). In South America, *A. fraterculus* attacks various fruits including *Prunus persica, Citrus, Psidium, Spondias* (Anacardiaceae), and *Eugenia* (Weems, 1980). A few of the species' many other hosts are *Terminalia catappa* (Combretaceae), *Malus pumila* and *Prunus* spp. (Rosaceae), *Annona* spp. (Annonaceae), *Citrus* spp. (Rutaceae), *Coffea* spp. (Rubiaceae), *Ficus carica* (Moraceae), *Juglans* spp. (Juglandaceae), *Diospyros kaki* (Ebenaceae), *Manilkara zapota* (Sapotaceae), *Persea americana* (Lauraceae), *Solanum quitoense* (Solanaceae), *Theobroma cacao* (Sterculiaceae), *Olea europaea* (Oleaceae), and *Vitis vinifera* (Vitaceae) (CAB International, 2002). Because this species attacks multiple species among multiple plant families, it is rated High (3) for the Host Range risk element.	High (3)
***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** This species has been recorded on more than 60 plant species in 24 families (Norrbom and Kim, 1988). The main native hosts are *Spondias* spp. (Anacardiaceae), while *Mangifera indica* (Anacardiaceae) is the major commercial host (CAB International, 2002). Citrus and guava are only occasional hosts (CABI, 2002). Other reported hosts include *Annona* spp. (Annonaceae), *Eugenia* spp. (Myrtaceae), *Inga* spp. (Fabaceae), *Malus* sp. (Rosaceae), *Prunus* spp. (Rosaceae), *Psidium* spp. (Myrtaceae), *Pyrus* spp. (Rosaceae), *Syzygium* spp. (Myrtaceae) (Norrbom and Kim, 1988). Because this species attacks multiple species among multiple plant families, it is rated High (3) for the Host Range risk element.	High (3)
***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** About 40 plant species in 13 plant families are reported as hosts of *A. serpentina* (Norrbom and Kim, 1988). The preferred host plants are members of Sapotaceae, in particular *Chrysophyllum cainito* and *Achras zapota* (Weems, 1969). Other hosts include *Citrus* spp. (Rutaceae), *Eugenia uniflora* (Myrtaceae), *Mammea americana* (Clusiaceae), *Spondias* spp. (Anacardiaceae), *Malus pumila* (Rosaceae), *Persea americana* (Lauraceae), *Prunus persica* (Rosaceae), *Pyrus communis* (Rosaceae), *Annona* sp. (Annonaceae), *Ficus* sp. (Moraceae), and *Byrsonima* sp. (Malpighiaceae) (Norrbom and Kim, 1988; CAB International, 2002). Because this species attacks multiple species among multiple plant families, it is rated High (3) for the Host Range risk element.	High (3)

Evidence	**Risk Value**
***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** This pest has been recorded from a wide variety of host plants in several families, including *Coffea* sp. (Rubiaceae), *Capsicum annuum* (Solanaceae), *Citrus* spp. (Rutaceae), *Malus pumila*, *Prunus* spp. (Rosaceae), *Ficus carica* (Moraceae), *Psidium guajava* (Myrtaceae), *Theobroma cacao* (Sterculiaceae), *Phoenix dactylifera* (Arecaceae), and *Mangifera indica* (Anacardiaceae) (CAB International, 2002). Because this species attacks multiple species among multiple plant families, it is rated High (3) for the Host Range risk element.	High (3)
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** Primary hosts of *E. aurantiana* are *Citrus sinensis* (Rutaceae), *Citrus reticulata* (CAB International, 2002). Other reported hosts include *Citrus* spp., *Psidium guajava* (Myrtaceae) (CAB International, 2002; Zhang, 1994; Bento et al., 2001); *Litchi chinensis* (Sapindaceae), *Macadamia* (Proteaceae) (CAB International, 2002; Leal et al., 2001); *Theobroma cacao* (Sterculiaceae) (CAB International, 2002); *Cocos nucifera* (Arecaceae), *Annona cherimolia* (Annonaceae), *Annona squamosa* (Bento et al., 2001); *Prunus persica* (Rosaceae) (Adamski and Brown, 2001). Additional hosts are listed in Adamski and Brown (2001). Because this species attacks multiple species among multiple plant families, it is rated High (3) for the Host Range risk element.	High (3)

2.8.3. Dispersal Potential

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pest's economic and environmental impact may be expressed within the importing country or region and is related to the pest's reproductive potential, inherent mobility, and dispersal facilitation. Factors for rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance. Low (1), if pest has neither high reproductive potential nor rapid dispersal capability; Medium (2), if pest has either high reproductive potential OR the species is capable of rapid dispersal; and High (3), if pest has high biotic potential, e.g., many generations per year, many offspring per reproduction ("r-selected" species), AND evidence exists that the pest is capable of rapid dispersal, *e.g.*, over 10 km/year under its own power; via natural forces, wind, water, vectors, *etc.*, or human-assistance.

Evidence	**Risk Value**
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** The biology of this species varies by season as well as by country (United States Department of Agriculture, 1982). In Peru, one egg at a time is usually laid by a female, and up to 50 eggs may be laid in a single fruit (United States Department of Agriculture, 1982). Adults live for about a month, and six to seven generations develop annually (United States Department of Agriculture, 1982). Females deposit from 200 to 400 eggs in host fruits (White and Elson-Harris, 1992). Reproduction is continuous, adults occurring throughout the year (CAB International, 2002). In international trade, the major means of dispersal is the transport of fruit containing live larvae. Since 1985, *Anastrepha* fruit flies have been intercepted over 55,000 times by PPQ at ports of entry, the	High (3)

Evidence	Risk Value
majority of which were with fruit (PIN309, 2003), which is evidence of this species' ability to be transported long distances with infested fruit. For most regions, the most important fruits liable to carry *A. fraterculus* are mangoes, guavas, *Citrus*, *Malus*, and *Prunus* (CAB International, 2002). This species may also be dispersed via puparia in soil or packaging with plants which have already fruited (CAB International, 2002). Natural movement is also considered an important means of spread, as there is evidence that adults of *Anastrepha* spp. can fly for as far as 135 km (Fletcher, 1989). However, (Aluja, 1994) emphasizes that wind affects the displacement of the flies and that overall fly mobility is low. As this species has both high biotic potential (many generations per year and many offspring per reproduction) and capability for rapid dispersal (over 10 km/year via human-mediated means and perhaps natural means), it is rated High (3) for the Dispersal Potential risk element.	
***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** Fecundity may exceed 1300 eggs per female in the laboratory (Liedo, 1996), but 500-700 is the normal range under field conditions (Toledo and Lara, 1996). Reproduction is continuous, adults occurring throughout the year (CAB International, 2002). As in other *Anastrepha* species, the major means of dispersal to previously uninfested areas is the transport of fruit containing larvae (CAB International, 2002). Since 1985, *Anastrepha* fruit flies have been intercepted over 55,000 times by PPQ at ports of entry, the majority of which were with fruit (PIN309, 2003), which is evidence of this species' ability to be transported long distances with infested fruit. This species may also be dispersed via puparia in soil or packaging with plants which have already fruited (CAB International, 2002). Natural movement is also considered an important means of spread, as there is evidence that adults of *Anastrepha* spp. can fly for as far as 135 km (Fletcher, 1989). However, (Aluja, 1994) emphasizes that wind affects the displacement of the flies and that overall fly mobility is low. As this species has both high biotic potential (many offspring per reproduction) and capability for rapid dispersal (over 10 km/year via human-mediated means and perhaps natural means), it is rated High (3) for the Dispersal Potential risk element.	High (3)
***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** (Weems, 1969) reports that females can oviposit up to 600 eggs in about 1 ½ months, and that females have continued oviposition over periods of 21 to 29 weeks under laboratory conditions. A maximum of almost 900 eggs per female has been recorded (Liedo, 1996). Like other species of *Anastrepha* (White and Elson-Harris, 1992), there probably are several generations per year. As with other *Anastrepha* species, the major means of dispersal to previously uninfested areas is the transport of fruit containing larvae (CAB International, 2002). Since 1985, *Anastrepha* fruit flies have been intercepted over 55,000 times by PPQ at ports of entry, the majority of which were with fruit (PIN309, 2003), which is evidence of this species' ability to be transported long distances with infested fruit. This species may also be dispersed via puparia in soil or packaging with plants which have already fruited (CAB International, 2002). Natural movement is also considered an important means of spread, as there is evidence that adults of *Anastrepha* spp. can fly for as far as 135 km (Fletcher, 1989). However, (Aluja, 1994) emphasizes that wind affects the displacement of the flies and that overall fly mobility is low. As this species has both high biotic potential (many generations per year and many offspring per reproduction) and capability for rapid dispersal (over 10 km/year via human-mediated means and perhaps natural means), it is rated High (3) for the Dispersal Potential risk element.	High (3)
***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** Females may deposit up to 22 eggs per day and as many as 800 eggs in a lifetime, although 300 is the	High (3)

Evidence	Risk Value
more typical number (Weems, 1981). Eggs are inserted into host fruit in small batches of one to 10 (Weems, 1981). In Australia, breeding is continuous throughout the year, the species exhibiting several overlapping generations (Hassan, 1977). Adult flight, with a range of 20 km or more (Fletcher, 1989), and the transport of infested fruits are the major means by which this fruit fly is able to move and disperse to previously uninfested areas (CAB International, 2002). Since 1985, *Ceratitis capitata* has been intercepted 2,366 times by PPQ at ports of entry, the majority of which were with fruit (PIN309, 2003), which is evidence of this species' ability to be transported long distances with infested fruit. This species may also be dispersed via puparia in soil or growing medium accompanying plants (CAB International, 2002). As this species has both high biotic potential (several generations per year and many offspring per reproduction) and capability for rapid dispersal (over 10 km/year via natural and/or human-mediated means), it is rated High (3) for the Dispersal Potential risk element.	
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** Females of *E. aurantiana* will usually deposit one egg per fruit and will lay 150-200 eggs during their life (Garcia, 1999), as cited by (Bento et al., 2001). The life cycle (egg to adult) can be completed in 36 days (Blanco et al., 1993). In Trinidad, the adults are thought to probably not travel long distances (White, 1999). On the other hand, this species (CAB International, 2002; Leal et al., 2001; White and Tuck, 1993; White, 1999) is reported to be an internal fruit feeder with some larvae penetrating the core of citrus fruit and entering the seed (White, 1999; Adamski and Brown, 2001), making it more likely to be dispersed by the transport of fruit. Together, *Ecdytolopha* sp. and *Gymnandrosoma* sp. have been intercepted a total of 393 times on fruit by PPQ at ports of entry since 1985 (**Table 15**), which indicates that this insect could be dispersed via the transport of infested fruit. However, these genera were never intercepted by PPQ on commercial citrus fruit, which would be the most likely route of spread for this species. As this species has high biotic potential (relatively short life cycle, many offspring per female) but not an obvious capability for rapid dispersal, it is rated Medium (2) for the Dispersal Potential risk element.	Medium (2)

2.8.4. Economic Impact

Introduced pests cause a variety of direct and indirect economic impacts such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included whether the pest would: affect yield or commodity quality, cause plant mortality, act as a disease vector, increase costs of production including pest control costs, lower market prices, affect market availability, increase research or extension costs, or reduce recreational land use or aesthetic value. Pests are rated as follows: Low (1), if the pest causes any one or none of the above impacts; Medium (2), if the pest causes any two of the above impacts; and High (3), if the pest causes all three of the above impacts.

Evidence	Risk Value
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** *Anastrepha fraterculus* is of great economic importance because of its wide host range and its extensive distribution, and all forms of this species complex attack economically important plants (Weems, 1980). It is the most economically important *Anastrepha* species in South America (Foote et al., 1993; Weems, 1980). It is an important pest of guavas, mangoes, and to some extent of	High (3)

Evidence	Risk Value
Citrus and *Prunus* spp. (CAB International, 2002). In Argentina, it is considered the most important pest of citrus (United States Department of Agriculture, 1982). In Brazil, where it causes severe yield losses in apple, the pest is of major concern to growers, and represents a significant constraint to fresh fruit export into countries with quarantine barriers (Sugayama et al., 1996). Hot water has been tested as a quarantine treatment for mango exported from Peru to the United States (Sharp and Picho Martinez, 1989). Based on this evidence, its wider establishment in the U.S. likely would lead to lower yield of host crops, lower value of host crop commodities, and loss of foreign or domestic markets. It is, therefore, rated High (3) for the Economic Impact risk element.	
***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** *Anastrepha obliqua* is one of the most important fruit fly pests of mango, and it will attack many other fruits (i.e., other species of Anacardiaceae, guava, rose apple) (Foote et al., 1993). However, it apparently is not a significant pest of citrus (CAB International, 2002; Foote et al., 1993). In Costa Rica, *A. obliqua* is one of the most common *Anastrepha* in commercially important fruit (Jiron and Hedstrom, 1988). This fruit fly infested over 90% of *M. indica* fruit in Costa Rica in one study, which is in agreement with other studies (Jiron and Hedstrom, 1988). In Brazil, infestations ranging from 7-88% in commercial crops of *Malpighia punicifolia* (Malpighiaceae) were observed, leading to a downgrading of fruit quality (Ohashi et al., 1997). The fly is a major pest of *Eugenia stipitata* in Peru, causing reductions in yield and fruit quality (Couturier et al., 1996). Based on this evidence, its establishment in the United States likely would lead to lower yield of host crops, lower value of host crop commodities, and loss of foreign or domestic markets. It is, therefore, rated High (3) for the Economic Impact risk element.	High (3)
***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** *Anastrepha serpentina* is an important pest of sapote (*Calocarpum* spp.), sapodilla (*Manilkara zapota*), *Lucuma salicifolia* and other fruits in Mexico; infestations in tree-ripened fruit are said frequently to be so high that growers are forced to harvest early and ripen fruit artificially, which lowers its quality (Weems, 1969). It has been stated that it could become a serious pest of tropical fruit in southern Florida were it to become established in that area (Weems, 1969). Based on this evidence, its establishment in the United States likely would lead to lower yield of host crops, lower value of host crop commodities, and loss of foreign or domestic markets. It is, therefore, rated High (3) for the Economic Impact risk element.	High (3)
***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** *Ceratitis capitata* is one of the world's most destructive fruit pests (Weems, 1981). Because of its wide distribution (almost every other continent), ability to tolerate colder climates compared to most other fruit flies, and its wide host range, it is ranked as the most important among economically important fruit flies (Weems, 1981; CAB International, 2002). It is a major pest of citrus, but is often an even more serious pest of some deciduous fruits, such as peach, pear, and apple (Weems, 1981). In Mediterranean countries, it is particularly damaging to citrus and peach crops (CAB International, 2002). It may also transmit fruit-rotting fungi (CAB International, 2002). The species is of quarantine significance throughout the world, especially for Japan and the United States Its presence, even as temporary adventive populations, can lead to severe additional constraints for export of fruits to uninfested areas in other parts of the world. In this respect, *C. capitata* is one of the most significant quarantine pests for any tropical or warm temperate areas in which it is not yet established (CAB International, 2002). Based on this evidence, *C. capitata* is rated High (3) for the Economic Impact risk element.	High (3)
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)**	High (3)

Evidence	Risk Value
E. aurantiana has caused reduced citrus production in Brazil (Prates and Pinto, 1988; Prates and Pinto, 1991), as cited by (Bento et al., 2001), and is considered perhaps one of the most important pest species of oranges in Brazil (Faria et al., 1998). Yield losses to citrus up to 50% have been estimated in infested areas in the State of Sao Paulo, Brazil (Garcia et al., 1998), as cited by (Bento et al., 2001), and the latest estimated crop losses for the country are US$ 50 million per year (Anonymous, 2000), as cited by (Bento et al., 2001). It has recently become a major pest of citrus in Trinidad (White, 1999; White and Tuck, 1993), causing up to 40 percent damage to fruit of orange trees (White and Tuck, 1993). In Trinidad, economic loss occurs through direct fruit loss, loss of consumer confidence, cost of control measures, and increased harvesting costs because of increased fruit inspection (White, 1999; White and Tuck, 1993). And it is reported as an important pest of macadamia in Costa Rica (Masis and Soto Manitiu, 1992) (English summary). This pest is reported as difficult to control (Bento et al., 2001). Once the larvae penetrate inside the fruit, the control of this insect is impossible and the fruit becomes unfit for consumption (Bento et al., 2001). Larvae penetrating the fruit not only cause direct damage but also cause secondary invasion by fungi, bacteria, and other arthropods (Adamski and Brown, 2001), including beetles and fruit flies (White and Tuck, 1993). There is evidence that if introduced into the United States, this insect could have an impact on foreign or domestic markets. In Brazil, this pest species prevented the export of 45 thousand boxes of grape fruits in 1994 (Faria et al., 1998), and the use of irradiation as a quarantine treatment for this pest after harvesting has been studied (Faria et al., 1998). Based on this evidence, *E. aurantiana* is rated High (3) for the Economic Impact risk element.	

2.8.5. Environmental Impact

The ratings for environmental impact were based on three aspects. The first aspect is whether there may be an interaction with species that are listed as Threatened or Endangered (Title 50 Part 17 Section 11-12, United States Code of Federal Regulations). The second aspect is whether the pest appears capable of disrupting native plants based on the pest's habits exhibited within its current geographic range. The third aspect is whether the pest's presence will stimulate the need for chemical or biological control programs. Pests are rated as follows: Low (1), if none of the above would occur (it is assumed that introduction of a nonindigenous pest will have some environmental impact– by definition, introduction of a nonindigenous species affects biodiversity); Medium (2): if one of the above would occur; and High (3), if two or more of the above would occur.

Evidence	Risk Value
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** ***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** ***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** The extreme polyphagy of these species predisposes them to attack plants in the United States listed as Threatened or Endangered in 50 CFR §17.12. Examples of potential host plants listed as Threatened or Endangered are: *Eugenia haematocarpa*, *E. koolauensis*, *E. woodburyana*, *Prunus geniculata*, *Solanum drymophilum*, *S. incompletum*, *S. sandwicense*, and *Juglans jamaicensis*. Because these species are reported as pests of commercial crops (see Risk Element #4), their establishment in the United States could stimulate chemical and/or biological control programs.	High (3)

Evidence	Risk Value
Biological control is employed in Brazil to suppress populations of *A. obliqua* in mango orchards, *e.g.*, (Montoya et al., 2000). Consequently, they are rated High (3) for the Environmental Impact risk element.	
***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** Its broad host range predisposes this species to attack plants in the United States listed as Threatened or Endangered in 50 CFR §17.12. Examples of potential host plants listed as Threatened or Endangered are: *Opuntia*, *Prunus*. As it represents a significant economic threat, the wider establishment of *C. capitata* in the United States undoubtedly would trigger the initiation of chemical or biological control programs, as has occurred in California and Hawaii. Consequently, it is rated High (3) for the Environmental Impact risk element.	High (3)
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** The potential host *Prunus geniculata* (Rosaceae) is listed as Endangered in 50 CFR §17.12. Also, the following plant families contain hosts of *E. aurantiana* as well as plant species listed as Threatened and Endangered: Rutaceae, Myrtaceae, Sapinaceae, Sterculiaceae, Arecaceae. Preference tests on the listed Threatened and Endangered plants in these families are not known; therefore, it is assumed that *E. aurantiana* would be able to use one or more of these plants as hosts. As this insect has been shown to cause economic losses (see Risk Element #4), its establishment in the United States would probably trigger the initiation of chemical or biological control programs. Various biological control agents have been studied for the control of this insect pest, such as *Beauvaria bassiana* in Costa Rica (Gonzalez et al., 1996) (English summary) and *Trichogramma* in Brazil (Garcia et al., 1998) (English summary). Chemical insecticides have been studied for the control of this pest (Scarpellini et al., 1997) (English summary). Consequently, it is rated High (3) for the Environmental Impact risk element.	High (3)

Table 13. Risk Rating for Consequences of Introduction (*Citrus* from Peru)

Pest	Risk Element 1: Climate/ Host Interaction	Risk Element 2: Host Range	Risk Element 3: Dispersal Potential	Risk Element 4: Economic Impact	Risk Element 5: Environmental Impact	Cumulative Risk Rating
Anastrepha fraterculus	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
Anastrepha obliqua	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Anastrepha serpentina	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Ceratitis capitata	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Ecdytolopha aurantiana	Medium (2)	High (3)	Medium (2)	High (3)	High (3)	High (13)

2.9. Likelihood of Introduction

We rate each pest with respect to introduction (i.e., entry and establishment) potential. We consider two separate components. First, we estimate the amount of commodity likely to be imported. More imports lead to greater risk; the result is a risk rating that applies to the commodity and country in question and is the same for all quarantine pests considered and is rated as follows: Low (1): < 10 containers/year; Medium (2): 10 - 100 containers/year; and High (3): > 100 containers/year. Second, we consider five biological features (i.e., sub-elements) concerning the pest and its interactions with the commodity. The resulting risk ratings are specific to each pest. These five biological features are rated as follows: Low (1): < 0.1% (less than one in one thousand chance of occurring); Medium (2), between 0.1% - 10% (between one in one thousand to one in ten chance of occurring); and, High (3): > 10% (greater than one in tenchance of occurring). Details of elements and rating criteria are provided in (United States Department of Agriculture, 2000). For each pest, the sum of the sub-elements produces a cumulative risk rating for likelihood of introduction. The cumulative risk rating for introduction is considered to be an indicator of the likelihood that a particular pest would be introduced. These ratings and the value for the Likelihood of Introduction are summarized in **Table 16**.

2.9.1 Quantity imported annually

Peruvian exporters estimate that exports of citrus would total 5,100 metric tons a year (**Table 14**). This translates to a predicted volume of approximately 255 standard 40-foot shipping containers annually, based on a conversion factor of 20 metric tons per 40-foot shipping container (Cargo Systems, 2001). The quantity of commodity imported is estimated to fall above 100 containers per year, so the Quantity Imported Annually is rated **High (3)** for all of the pests.

Table 14. Projected annual volume of Peruvian citrus exportations in 2004 (Carbonell Torres, 2003).

Commodity	Metric Tons	Number of 40-foot Shipping Containers[1]
Clementine	500	25
Key Lime	600	30
Tangerine/Mandarin	2,000	100
Washington Navel Orange	300	15
Tangelo	1,500	75
Grapefruit	200	10
Total	**5,100**	**255**

[1] A conversion factor of 20 metric tons per 40-foot shipping container (Cargo Systems, 2001) is used.

2.9.2 Survive post-harvest treatment

This sub element evaluates the efficacy of postharvest treatments in terms of the mortality of pests exposed to the treatments. Peruvian citrus harvests are, in general, selective; pickers selectively pick fruit for export that meets quality standards for shape, rind blemishes, etc. (de la Rosa Brachowicz, 2002). Once it reaches the packinghouse, the treatments outlined in **Figure 2** are considered standard packing procedures (Carbonell Torres, 2002; de la Rosa Brachowicz, 2002; Podleckis, 2002). Post-harvest treatments that may impact pest survival include: initial chlorine dip, SOPP or chlorine dip, brushing, fungicide treatment, waxing, drying, selection, and manual packing (**Figure 2**)

Evidence	Risk Rating
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** ***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** ***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** ***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** Among the arthropod pests, all of the tephritid fruit flies (*Anastrepha* species and *Ceratitis capitata*), as internal feeders, would be expected to survive these post-harvest treatments, especially if infestation of the fruit was not of such great age that damage was obvious. Fruit attacked by *Anastrepha* can show signs of oviposition punctures; however, "these, or any other symptoms of damage, are often difficult to detect in the early stages of infestation" (CAB International, 2002)	High (3)
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** The tortricid *Ecdytolopha aurantiana* is an internal feeder as well (White, 1999); (Adamski and Brown, 2001), which protects it from most of these post-harvest treatments (e.g., chlorine dip, brushing); however, it has characteristics that probably make it less likely than the fruit flies to survive the post-harvest culling phase. Fruit attacked by *E. aurantiana* gradually develop a necrotic area around the entrance hole caused by the larva in the rind of the fruit, and then the fruit either drops prematurely or develops a bright orange color distinct from healthy fruit (White and Tuck, 1993). These symptoms caused by infestation by *E. aurantiana* should decrease the chance of infested fruit being selected during post-harvest processing (as well as during harvest). Based on this evidence, it is theorized that only fruit infested by early instar larvae would go undetected and survive the post-harvest treatments. Further evidence that this tortricid probably has a low chance of surviving post-harvest processing is presented below under "survive shipment."	Low (1)

2.9.3 Survive shipment

This sub-element evaluates the mortality of the pest population during shipment of the commodity. The standard method of shipping citrus internationally is under refrigeration with the temperature varying from 35 to 37E F (1.67 to 2.78EC), and shipment from Peru to the United States will probably take somewhere between two and four weeks (Van Dersal, 2003).

Evidence	Risk Rating
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** ***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** ***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** ***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** The current (as of 3/24/03) USDA approved cold treatment schedule (T107-a-1) for *Ceratitis capitata* and species of *Anastrepha* (other than *A. ludens*) in grapefruit, oranges, and clementines is either 34E F (1.11E C) or below for 15 days or 35E F (1.67E C) or below for 17 days (PPQ, 2003a). Consequently, it is assumed that at least some of the larvae and eggs of *C. capitata* and the *Anastrepha* species would be expected to survive the standard shipping method, for which the refrigeration temperatures are above that of the USDA approved cold treatment schedule. The larvae and eggs are inside the fruit and, therefore, protected somewhat from the refrigeration temperatures. Both *Anastrepha* sp. and *C. capitata* have been	Medium (2)

Evidence	Risk Rating
intercepted by PPQ at ports of entry with citrus fruit in cargo (**Table 15**), which is evidence that at least a small percentage of these fruit flies have the ability to survive the transport conditions of citrus.	
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** Similarly, the larvae of *Ecdytolopha aurantiana* are inside the fruit and, therefore, protected to some extent from the low temperatures. The use of cold treatment to impede the spread of *E. aurantiana* in oranges is said to be inadequate (Faria et al., 1998); therefore, it seems very likely that at least a small percentage of the larvae would survive shipment under the standard refrigeration. Since 1985, this tortricid genus has never been intercepted by PPQ with citrus fruit in cargo (and has only been intercepted 6 times in non-citrus fruit cargo and 10 times in non-cargo citrus fruit) (**Table 15**), despite the fact that fruit are dissected for fruit fly inspection (as evidenced by the interceptions of *Anastrepha* spp. and *Ceratitis capitata*; **Table 15**) and the fact that citrus fruit is permitted importation from most of the countries within *E. aurantiana*'s distribution (Costa Rica, Dominica, Trinidad, Venezuela, Belize, Dominica, Ecuador, Colombia, French Guiana, Mexico) (PPQ, 2003b). This lack of detection of *E. ecdytolopha* in commercial citrus is more likely a result of the tortricid not being selected during the harvest and post-harvest processes (see under "survive post-harvest treatment") than a lack of ability to survive refrigeration.	Medium (2)

Table 15. Selected PPQ interceptions with fruit since 1985 (PIN309, 2003). [1]

Pest	w/ fruit	w/ fruit in cargo	w/ citrus fruit	w/ citrus fruit in cargo
Anastrepha sp.	55,644	726	6,358	57
Ceratitis capitata	2,338	20	190	10
Ecdytolopha sp.[1]	393	6	10	0

[1] Interceptions include both *Ecdytolopha* sp. and *Gymandrosoma* sp., as *Gymnadrosoma aurantianum* is a synonym of *Ecdytolopha aurantiana.* The interceptions for these genera were not identified to the species level.

2.9.4 Not detected at port-of-entry

Unless specific protocols are required at port of entry, we assume that standard inspection protocols (*e.g.*, visual inspection) are employed.

Evidence	Risk Rating
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** ***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** ***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** ***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** The eggs and larvae of the fruit flies (*Ceratitis capitata, Anastrepha* spp.) are borne internally and, therefore, would be difficult to detect by officers at the port of arrival, especially if infestation of the fruit was not of such great age that damage was obvious. Fruit fly-infested fruit can go unrecognized (White and Elson-Harris, 1992). The fruit can show signs of oviposition punctures; however, these are often difficult to detect in the early stages of infestation (CAB International, 2002). The fruit flies may easily go undetected even if the fruit is dissected. (Gould, 1995)examined inspectors' ability to detect *Anastrepha*	High (3)

Evidence	Risk Rating
suspensa infesting a variety of fruit, including grapefruit. He found that the inspectors were not able to detect infested grapefruit in most cases.	
***Ecdytolopha aurantiana* (Lepidoptera: Tortricidae)** *Ecdytolopha aurantiana*, also an internal pest, similarly could evade detection in fruit if the infestation is relatively recent and not very heavy. The fact that irradiation has been recently studied as a possible quarantine treatment for this pest in oranges after harvest (Faria et al., 1998)indicates that visual inspection for infested fruit is not completely adequate. However, because of the relatively obvious symptoms created by this tortricid once the infestation has progressed past the early stage (see under "survive post-harvest treatment"), fruit infested by *E. aurantiana* are probably easier to detect than fruit infested by the fruit flies.	Medium (2)

2.9.5 Moved to suitable habitat

This sub element considers the geographical location of likely markets and the chance of the commodity to move to locations suitable for the pest's survival. Fruit that arrives in the United States does not normally arrive at a single port, and instead, it is distributed according to market demand. Demographics derived from United States Census data may be useful in predicting the distribution of imported citrus fruit by indicating population centers where demand may be greatest. Three of the four most populous States in the United States, Florida, Texas, and California, are in the southern tier of States where the climate most closely resembles the native climates for the pests analyzed (U.S. Census, 2000). These three States account for approximately 25 percent of the total U.S. population (U.S. Census, 2000). If we assume that Peruvian citrus is distributed proportionally across the United States according to population, the rating for all the pests for this sub element is High (3).

2.9.6 Contact with host material

Even if the final destination of infested commodities is suitable for pest survival, suitable hosts must be available in order for the pest to survive. This sub-element considers the likelihood that the pest species come in contact with host material for reproduction. The complete host range of the pest should be considered. According to the FAO standard for pest risk analysis (FAO, 2001b), other factors that may considered are:

- Dispersal mechanisms, including vectors to allow movement from the pathway to a suitable host
- Whether the imported commodity is to be sent to a few or many destination points in the PRA area.
- Proximity of entry, transit and destination points to suitable hosts
- Time of year at which import takes place
- Intended use of the commodity (e.g. for planting, processing and consumption)
- Risks from by-products and waste.

Evidence	Risk Rating
***Anastrepha fraterculus* Wiedemann (Diptera: Tephritidae)** ***Anastrepha obliqua* (Macquart) (Diptera: Tephritidae)** ***Anastrepha serpentina* (Wiedemann) (Diptera: Tephritidae)** ***Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)** Hosts of the extremely polyphagous species, *Anastrepha fraterculus*, *A. obliqua*, *A. serpentina*, and *Ceratitis capitata*, include temperate-zone or widely cultivated plants (USDA-NRCS, 2002; USDA-	High (3)

Evidence	Risk Rating
NASS, 1997), and should be available throughout the potential range. Peru's proposed shipping season extends from February to September. Based on commercial fruit phenology data compiled by (Sequeira et al., 2001), suitable hosts would be available throughout this shipping season in the southern States and would be available during most of the shipping season (approximately April through September) in the rest of the United States. The dispersal ability of all the pests is described under "Dispersal Potential" in the "Consequences of Introduction" section above. All of these fruit flies were given a High rating for dispersal potential based on the fact that they have high biotic potential and could be transported long distances on infested plant material. All of these species could probably spread locally, as there is evidence that adults of *Anastrepha* spp. can fly for as far as 135 km and adults of *Ceratitis capitata* can fly 20 km or more (Fletcher, 1989).	
Ecdytolopha aurantiana **(Lepidoptera: Tortricidae)** Hosts of the extremely polyphagous species *Ecdytolopha aurantiana* include temperate-zone or widely cultivated plants (USDA-NRCS, 2002; USDA-NASS, 1997), and should be available throughout the potential range. Based on commercial fruit phenology data compiled by (Sequeira et al., 2001), suitable hosts would be available throughout this shipping season in the southern States and would be available during most of the shipping season (approximately April through September) in the rest of the United States. The dispersal ability of all the pests is described under "Dispersal Potential" in the "Consequences of Introduction" section above. The evidence suggests that *E. aurantiana* has a lower ability to be transported naturally or via the transport of infested plant materials and is, therefore, given a Medium (2) for dispersal potential. Based on its biology, *Ecdytolopya aurantiana* has a lower capability than the fruit flies to disperse naturally and, therefore, would be less likely to be able to find host material locally.	Medium (2)

Table 16. Risk Rating for Likelihood of Introduction (*Citrus* from Peru).

Pest	Quantity Imported Annually	Survive Post-harvest Treatment	Survive Shipment	Not Detected at Port of Entry	Moved to Suitable Habitat	Contact with Host Material	Cumulative Risk Rating
Anastrepha fraterculus	High (3)	High (3)	Medium (2)	High (3)	High (3)	High (3)	High (17)
Anastrepha obliqua	High (3)	High (3)	Medium (2)	High (3)	High (3)	High (3)	High (17)
Anastrepha serpentina	High (3)	High (3)	Medium (2)	High (3)	High (3)	High (3)	High (17)
Ceratitis capitata	High (3)	High (3)	Medium (2)	High (3)	High (3)	High (3)	High (17)
Ecdytolopha aurantiana	High (3)	Low (1)	Medium (2)	Medium (2)	High (3)	Medium (2)	Medium (13)

2.10. Pest Risk Potential

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction yields the baseline Pest Risk Potential (PRP) value. This is an estimate of the risks associated with this importation and is expressed on the following scale: Low = 11-18 points, Medium = 19 to 26 points, and High = 27 to 33 points. The PRP for each pest is summarized in **Table 17**.

Table 17. Pest Risk Potential.

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
Anastrepha fraterculus	High (14)	High (17)	High (31)
Anastrepha obliqua	High (15)	High (17)	High (32)
Anastrepha serpentina	High (15)	High (17)	High (32)
Ceratitis capitata	High (15)	High (17)	High (32)
Ecdytolopha aurantiana	High (13)	Medium (13)	Medium (26)

The following guidelines are offered as an interpretation of the Low, Medium and High Pest Risk Potential ratings:

Low: Pest will typically not require specific mitigations measures; the port of entry inspection to which all imported commodities are subjected can be expected to provide sufficient phytosanitary security.

Medium: Specific phytosanitary measure may be necessary.

High: Specific phytosanitary measures are strongly recommended. Port of entry inspection is not considered sufficient to provide phytosanitary security.

Identification and selection of appropriate sanitary and phytosanitary measures to mitigate risk for particular Pest Risk Potential ratings is undertaken as part of the risk management phase, FAO Stage 3 (FAO, 2001b).

3. Risk Management

3.1. Introduction

Pest risk management is the decision-making process of reducing the risk of introduction of a quarantine pest (FAO 1996). The reduction of phytosanitary risk occurs through the use of mitigation measures that are designed to eliminate, reduce, or prevent the presence of pest populations in shipments of commodities primarily in the country of origin. The appropriate risk management strategy for a particular pest depends on the risk posed by that pest. APHIS risk management programs are risk-based and dependent on the availability of appropriate mitigation methods.

The pest risks identified in the risk assessment section of this document (Section 2) represent a baseline risk associated with the unmitigated importation of fresh fruit of *Citrus* spp. from Peru. The baseline risk is assessed in the absence of specific phytosanitary risk mitigation measures, however standard industry practices (*e.g.*, packhouse culling) described in Section 1.2.3. were considered in conducting the assessment.

The proposed importation of fresh fruit of *Citrus* spp. from Peru, if approved, would be regulated by existing fruit and vegetable regulations (7 CFR § 319.56). The procedures described in 7 CFR § 319.56, are designed to ensure that fruit are imported from areas free from injurious pests or that such pests are eliminated from imported fruit, thereby effectively removing them from the pathway and precluding them from establishment in the United States. While not specifically required under 7 CFR§319.56, standard industry practices help to further ensure that the pests of concern do not follow the pathway. These include surveys (Hill, 1983; Johnston, 1983), sanitation and chemical treatments designed to reduce or eliminate pests in the field(de la Rosa Brachowicz, 2002; Timmer et al., 2000), postharvest treatments to reduce or eliminate bacteria (Brown, 1987; Stapleton, 1986) and fungi (Taverner, 2001), and quality control as well as phytosanitary inspections in Peru.

Options for specific measures may be selected from a range of pre-harvest and post-harvest measures (*e.g.*, surveys, inspections, sanitation, chemical treatments, *etc.*), and include mitigation measures to compensate for uncertainty. This section describes risk mitigation for the quarantine pests likely to follow the pathway of *Citrus* spp. from Peru: *Anastrepha fraterculus, A. obliqua, A. serpentina, Ceratitis capitata,* and *Ecdytolopha aurantiana*. The following *Citrus* commodities are proposed for import from Peru to the U.S.: Grapefruit (*C.* x *paradisi* Macfad.); Lime (*C. aurantiifolia* [Christm.] Swingle); Mandarin Orange or tangerine (*C. reticulata* Blanco); Sweet Orange (*C. sinensis* [L.] Osbeck); Tangelo (*Citrus* x *tangelo* J.W. Ingram & H.E. Moore). The preceding section, **2. Pest Risk Assessment**, determined the Pest Risk Potentials (PRPs) for *Anastrepha fraterculus, A. obliqua, A. serpentina,* and *Ceratitis capitata* as **High** and the PRP for *Ecdytolopha aurantiana* as **Medium**, in accordance with the USDA/APHIS PRA Guidelines, Version 5.02 (USDA 2000).

3.2. Proposed Risk Mitigation Measures

The proposed importation of fresh citrus fruit from Peru, if approved, will be subject to the mitigation measures outlined in 7 CFR§319.56. These measures include:

- The requirement for imported fruits to be free from soil and plant parts (*e.g.*, leaves) other than the commodity;
- That the fruit originate from pest-free areas or that injurious pests are eliminated by treatment or other procedures (*e.g.*, inspection).

Although PPQ inspectors frequently detect *Anastrepha* spp. fruit flies (approximately 6500 interceptions since 1985) (PIN309, 2003) and *Ceratitis* spp. fruit flies (approximately 200 times since 1985) (PIN309, 2003), studies have indicated that even when using fruit cutting, inspectors may only detect a fraction of the fruit fly larvae present in citrus fruit (Gould, 1995). Previous regulatory decisions for the importation of citrus fruit from countries where these pests occur have required application of an approved cold treatment to mitigate the risk of these fruit fly pests (**Appendix 2**). In light of these previous decisions on citrus imports from Peru and other countries, port of entry inspection alone is not considered sufficient to provide phytosanitary security against the fruit flies, *Anastrepha fraterculus*, *A. obliqua*, *A. serpentina* and *Ceratitis capitata*, in fresh fruit of *Citrus* spp. from Peru. The following specific mitigation measures are recommended in addition to the standard 7 CFR§319.56 measures mentioned above:

- Fruit must originate from groves registered for export with SENASA;

- In the case of commodities attacked, as Peruvian citrus fruit is, by regulated fruit flies, 7 CFR§319.56 requires a cold treatment to mitigate those fruit flies. The choice and application of the cold treatment are governed by 7 CFR§319.56-2d and the APHIS Treatment Manual (PPQ, 2003a). The current (as of 3/24/03) USDA approved cold treatment schedule (T107-a-1) for *Ceratitis capitata* and species of *Anastrepha* (other than *A. ludens*) in grapefruit, oranges, and clementines is:

T107-a-1 **Apple, Apricot, Cherry, Grape, Grapefruit, Kiwi, Nectarine, Orange, Peach, Pear, Plum, Pomegranate, Quince, Tangerine (includes Clementine)**

Pest: *Ceratitis capitata* (Mediterranean fruit fly) and species of *Anastrepha* (other than *Anastrepha ludens)*

Treatment: T107-a Cold treatment

Temperature	Exposure Period
34 °F (1.11 °C) or below	15 days
35 °F (1.67 °C) or below	17 days

- Shipments are subject to inspection of the fruit at the port of entry to ensure freedom from *Ecdytolopha aurantiana* as well as fruit flies; and,
- A phytosanitary certificate signed by SENASA with an Additional Declaration of freedom from *Ecdytolopha aurantiana* must accompany each shipment in order to provide increased phytosanitary security against this tortricid.

3.3. Historical Performance of Existing Programs

Approximately 20 million boxes of Spanish Clementines were imported into the United States during the 2002-2003 shipping season. The number of fruit per box ranges from 15 to 52. The fruit come to the United States by sea either in refrigerated containers or ship holds where Clementines receive the necessary cold treatment while in transit. All of the fruit had received the necessary cold treatment before being imported and were certified as such. A total of 70,190 clementines were selected, dissected and inspected for fruit fly (*Ceratitis capitata*) larva. No live larvae were found in any of the fruit sampled. A total of 126 dead larvae were found in 26 of the sampled fruit. The season estimate of 0.00045 fruit infested with dead larvae was calculated by weighting each sample's infestation rate by the number of fruit represented by that sample (APHIS, 2003).

3.4. Evidence for the Effective Removal of Pests of Concern from the Pathway

3.4.1. *Ecdytolopha aurantiana*

Eggs of *Ecdytolopha aurantiana* (synonym: *Gymnandrosoma aurantianum*) are deposited externally on the fruit and then the larvae, once hatched, bore into the rind of the fruit where they feed on the mesocarp (White, 1999). Some individuals then work their way to the center of the fruit and may enter the seeds (White, 1999). A few of the larvae pupate in the fruit, but the majority leave the fruit to pupate in the soil (White and Tuck, 1993). Infestation of the fruit by the first-instar larvae leads to secondary infestation by fungi, bacteria, beetles, and fruit flies (White and Tuck, 1993). Also, fruit attacked by *E. aurantiana* gradually develop a necrotic area around the entrance hole caused by the larva in the rind of the fruit, and then the fruit either drops prematurely or develops a bright orange color distinct from healthy fruit (White and Tuck, 1993).

As an internal pest, this tortricid could evade detection in fruit if the infestation is relatively recent and not very heavy. The fact that irradiation has been recently studied as a possible quarantine treatment for this pest in oranges after harvest (Faria et al., 1998) indicates that visual inspection for infested fruit is not completely adequate. However, because of secondary infestation by other pest organisms and the relatively obvious symptoms created by this tortricid, once the infestation has progressed past the early stage, fruit infested by *E. aurantiana* are probably easier to detect than fruit infested by other internal pests, such as fruit flies. Furthermore, the fact that *Ecdytolopha* sp. and *Gymnandrosoma* sp. have been intercepted a total of 393 times on fruit by PPQ at ports of entry since 1985 (**Table 18**) indicates that PPQ officers would be capable of detecting it in commercial fruit from Peru.

Table 18. Selected interceptions with fruit by PPQ since 1985[1]

Pest	w/ fruit	w/ fruit in cargo	w/ citrus fruit	w/ citrus fruit in cargo
Anastrepha sp.	55,644	726	6,358	57
Ceratitis capitata	2,338	20	190	10
Ecdytolopha sp.[1]	393	6	10	0

[1] Interceptions include both *Ecdytolopha* sp. and *Gymandrosoma* sp., as *Gymnadrosoma aurantianum* is a synonym of *Ecdytolopha aurantiana*. The interceptions for these genera were not identified to the species level.
Source: (PIN309, 2003)

The symptoms caused by infestation by *E. aurantiana* would help officers detect infested fruit at ports of entry, and probably also decrease the chance of infested fruit being selected during harvest and post-harvest processing and, in turn, the chance of this pest being in commercial citrus fruit imported into the United States from Peru. Since 1985, neither *Ecdytolopha* sp. nor *Gymnandrosoma* sp. has ever been intercepted by PPQ with citrus fruit in cargo (**Table 18**). This despite the fact that fruit are dissected for fruit fly inspections and citrus fruit is permitted importation from most of the countries within *E. aurantiana*'s distribution (*e.g.*, Costa Rica, Dominica, Trinidad, Venezuela, Belize, Dominica, Ecuador, Colombia, French Guiana, Mexico) without any special mitigation measures required against this pest (PPQ, 2003a). Also, these genera have only been intercepted 6 times in cargo fruit and 10 times in non-cargo citrus fruit (**Table 18**). In terms of interceptions from Peru, since 1985, *Ecdytolopha* sp. has only been intercepted one time (in fruit of *Phaseolus vulgaris*), which was in baggage, and *Gymnandrosoma* sp. has never been intercepted (PIN309, 2003). When *Ecdytolopha* sp. or *Gymnandrosoma* sp. have been intercepted in fruit by PPQ, only one larva (or pupa, in two cases) was detected 67.88% of the time for all hosts (**Figure 4**) and 91.67% of the time for citrus hosts (11 interceptions where one larva was found; 1 interception where two larvae were found) (PIN309, 2003). These data, plus the fact that females only deposit one egg per fruit (Garcia, 1999), as cited by (Bento et al., 2001), suggest that the infestation rate per fruit is very small. Even in the highly unlikely event *E. aurantiana*-infected fruit are able to evade the harvest and post-harvest culling processes and subsequently the port of entry inspection process, evidence suggests that the adults do not travel long distances (White, 1999), decreasing their chance of coming into contact with suitable hosts. Consequently, APHIS believes that the standard port of entry inspection to which all commodities are subjected can be expected to assure that sufficient phytosanitary security has been provided regarding this pest.

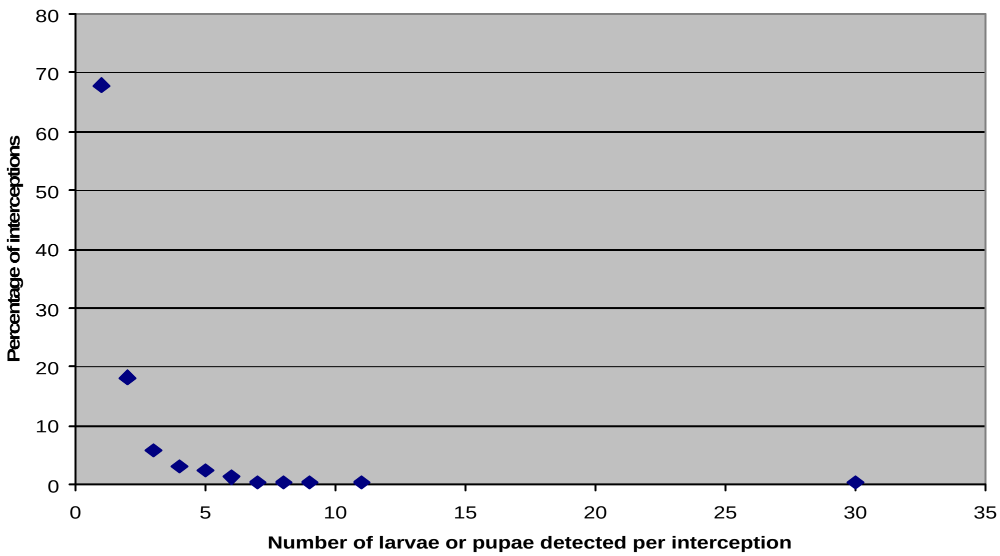


Figure 4. The percentage of interceptions of *Ecdytolopha* sp. and *Gymnandrosoma* sp. versus the number of larvae or pupae detected per interception (PIN309 query by Peter Touhey, National Identification Services (NIS), April 16, 2003).

3.4.2. Fruit Flies (*Ceratitis capitata* and *Anastrepha* spp.)

The eggs and larvae of the fruit flies (*Ceratitis capitata, Anastrepha* spp.) are borne internally and, therefore, would be difficult to detect by officers at the port of arrival, especially if infestation of the fruit was not of such great age that damage was obvious. Fruit fly-infested fruit can go unrecognized (White and Elson-Harris, 1992). The fruit can show signs of oviposition punctures; however, these are often difficult to detect in the early stages of infestation (CAB International, 2002). The fruit flies may easily go undetected even if the fruit is dissected. (Gould, 1995) examined inspectors' ability to detect *Anastrepha suspensa* infesting a variety of fruit, including grapefruit. This author found that the inspectors were not able to detect infested grapefruit in most cases.

Because *Anastrepha* spp. and *C. capitata* are more difficult to detect compared to the other quarantine pest analyzed here, *Ecdytolopha aurantiana*, USDA requires a specific cold treatment schedule prior to entry for potential citrus fruit hosts of these pests. The current (as of 3/24/03) USDA approved cold treatment schedule (PPQ, 2003a) for *Ceratitis capitata* and species of *Anastrepha* (other than *A. ludens*) in grapefruit, oranges, and clementines is:

There are no other USDA approved treatment schedules for citrus fruit that may harbor both *C. capitata* and species of *Anastrepha* other than *A. ludens*.

Sour or Key lime (*Citrus aurantiifolia*) is listed by some authors as a host for *Ceratitis capitata* (Liquido, 1991), but is considered a poor host and infestations may be restricted to decaying fruit (Henning, 1972). The *Citrus aurantiifolia* of commerce is not considered a host (Anonymous, 1966). Noorbom and Kim list *C. aurantiifolia* as a questionable host for the species of *Anastrepha* present in Peru. As a result of these and other reports in the literature, APHIS does not require mandatory cold treatment of commercial *C. aurantiifolia* fruit to mitigate for

Ceratitis capitata or *Anastrepha* spp. (PPQ, 2003b). A Mexican report (Tejada, 1980) maintained that the level of acidity in the fruit of *Citrus aurantiifolia* prevents development of *Ceratitis* and Anastrepha larvae. Additional data supporting the claim for the poor or non-host status of *C. aurantiifolia* was gathered from the National Fruit Fly Survey Program and provided by Peru (Carbonell Torres, 2003) (**Table 19**).

Table 19. Results of Key lime (*Citrus aurantifolia*) fruit sampling for fruit flies

YEAR 2002

Region	PIURA	LAMBAYEQUE	ICA	LIMA
Number of hanging fruit cut	13992	10	173	414
Number of hanging fruit found infested	0	0	0	0
Infestation rate (%)	**0.00**	**0.00**	**0.00**	**0.00**
Number of fallen fruit cut	25044	793	1774	428
Number of fallen fruit found infested	0	0	0	0
Infestation rate (%)	**0.00**	**0.00**	**0.00**	**0.00**

YEAR 2003 (UP TO THE 31 th WEEK)

Region	PIURA	LAMBAYEQUE	ICA	LIMA
Number of hanging fruit cut	8560	1525	642	0
Number of hanging fruit found infested	0	0	0	0
Infestation rate (%)	**0.00**	**0.00**	**0.00**	**0.00**
Number of fallen fruit cut	27848	5080	1842	178
Number of fallen fruit found infested	0	0	0	0
Infestation rate (%)	**0.00**	**0.00**	**0.00**	**0.00**

Source.- (Carbonell Torres, 2003)

3.5. Summary and Conclusions

The preceding section, **2. Pest Risk Assessment**, determined the following Pest Risk Potentials (PRPs) for the quarantine pests likely to follow the pathway of fresh fruit of *Citrus* spp. from Peru:

- **High** for *Anastrepha fraterculus, A. obliqua, A. serpentina*, and *Ceratitis capitata;* and

- **Medium** for *Ecdytolopha aurantiana*, in accordance with the USDA/APHIS PRA Guidelines, Version 5.02 (United States Department of Agriculture, 2000).

Considering the biology of these pests, the fact that the export citrus producers in Peru have implemented a production system of “Good Agricultural Practices” (Eurogap) according to standards required for current exports to the European Union, that Peru has a national program for fruit fly control in place, which includes trapping, sampling, and IPM activities, the following specific phytosanitary measures should effectively remove these pests from the pathway:

- Fruit must originate from groves registered for export with SENASA;
- Port of entry inspection along with a phytosanitary certificate with Additional Declaration of freedom from *Ecdytolopha aurantiana* ;
- USDA approved cold treatment schedule (T107-a-1) for *Ceratitis capitata* and species of *Anastrepha* (other than *A. ludens*) for all the *Citrus* sp. commodities proposed for import except for *C. aurantiifolia* (sour or Key lime); and,
- Shipments would be subject to inspection of the fruit at the port of entry to ensure freedom from *Ecdytolopha aurantiana* as well fruit flies.

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Appendix 1. Process for Determining Weediness Potential

Process for Determining Weediness Potential of *Citrus* spp.

Commodity: *Citrus* spp.

Phase 1: Consider whether the genus is new to or not widely prevalent in the United States (exclude plants grown under USDA permit in approved containment facilities)?

Many species of *Citrus* are cultivated in the United States.

Phase 2: Answer Yes or No to the following questions:

Is the genus listed as a weed in:

NO Geographical Atlas of World Weeds (Holm et al., 1979) or World Weeds: Natural Histories and Distribution. (Holm. et al., 1997)
NO World's Worst Weeds (Holm et al., 1977)
NO Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982)
NO Economically Important Foreign Weeds (Reed, 1977)
NO Weed Science Society of America list (WSSA , 1989)
NO Is there any literature reference indicating weediness (*e.g.*, AGRICOLA, CAB, Biological Abstracts, and AGRIS search on "species name" combined with "weed").

Phase 3: **Conclusion**

Citrus spp. are prevalent in the United States and the answer to all of the questions in Phase 2 is “no”, therefore the pest risk assessment proceeds.

Appendix 2. Regulatory Decision History

Country	Date	Recommendation	Reason / Comment
***Citrus aurantifolia* (Lime)**			
Chile	1962	Disapproved	No acceptable treatment for *Brevipalpus chilensis*
Chile	1991	Approved	Subject to inspection and methyl bromide fumigation for *B. chilensis*
***Citrus* x *paradisi* (Grapefruit)**			
Brazil	1924	Denied	Denied because of the presence of several different fruit flies
Panama	1928	Denied	Denied because of the presence of several different fruit flies
Peru	**1928**	**Denied**	**Denied because of the presence of several different fruit flies especially *Anastrepha peruviana* (=*A. fraterculus*)**
Bolivia	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha fraterculus* and *Ceratitis capitata*
Venezuela	1964	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Ecuador	1970	Approved	Entry approved through North Atlantic ports subject to cold treatment
***Citrus reticulata* (Clementine, Mandarin, Tangerine, Unshu)**			
Ecuador	1970	Approved	Entry approved through North Atlantic ports subject to cold treatment
***Citrus sinensis* (Orange)**			
Brazil	1924	Denied	Denied primarily because of the presence of several different fruit flies
Ecuador	1926	Denied	Denied primarily because of the presence of several different fruit flies
Peru	**1928**	**Denied**	**Denied because of the presence of several different fruit flies especially *Anastrepha peruviana* (=*A. fraterculus*)**
Uruguay	1930	Denied	Denied primarily because of the presence of several different fruit flies
Ecuador	1935	Approved	Entry approved only at New York and Boston and only for transshipping to Europe
Chile	1962	Denied	No acceptable treatment for *Brevipalpus chilensis*

Country	Date	Recommendation	Reason / Comment
Venezuela	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Venezuela	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Bolivia	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Ecuador	1964	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Multiple *Citrus* species			
Colombia	1963	Approved	Oranges, grapefruits, tangerines approved entry through Port of New York subject to cold treatment for *Anastrepha* fruit flies.
Peru	**1969**	**Disapproved**	**No approved treatments for South American *Anastrepha* fruit flies**
Venezuela	1974	Approved	Oranges, grapefruit and tangerine approved entry into Seattle or New York subject to cold treatment for fruit flies
Peru	**1974**	**Disapproved**	***Guignardia citricarpa* (citrus black spot) reported in the literature to occur in Peru**
Chile	1979	Disapproved	No acceptable treatment available for *Brevipalpus chilensis*
Chile	1984	Disapproved	No acceptable treatment available for *Brevipalpus chilensis*
Peru	**1988**	**Disapproved**	**No acceptable treatment or inspection for *Guignardia citricarpa* (citrus black spot)**
Chile	1993	Disapproved	No acceptable treatment available for *Brevipalpus chilensis*
Argentina	1997	Disapproved	No available treatment for *Elsinoë australis*, *Guignardia citricarpa* and *Xanthomonas campestris* pv. *citri*

Appendix 3. Selected Plant Pest Interception Records

TABLE A3- 1. PESTS INTERCEPTED ON CITRUS SPP. ARRIVING FROM PERU				
HOST		PEST	WHERE	TOTAL
CITRUS	AURANTIIFOLIA	CLADOSPORIUM SP.	Baggage	1
CITRUS	AURANTIIFOLIA (FRUIT)	ANASTREPHA SP.	Stores	1
CITRUS	AURANTIIFOLIA (FRUIT)	ANASTREPHA SP.	Baggage	1
CITRUS	AURANTIIFOLIA (FRUIT)	GUIGNARDIA CITRICARPA	Baggage	1
CITRUS	AURANTIIFOLIA (FRUIT)	PARLATORIA CINEREA	Baggage	27
CITRUS	AURANTIIFOLIA (FRUIT)	PARLATORIA CINEREA	Stores	4
CITRUS	AURANTIIFOLIA (FRUIT)	PARLATORIA ZIZIPHI	Stores	1
CITRUS	AURANTIIFOLIA (FRUIT)	PARLATORIA ZIZIPHI	Baggage	6
CITRUS	AURANTIIFOLIA (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Stores	1
CITRUS	AURANTIIFOLIA (LEAF)	VINSONIA STELLIFERA	Baggage	1
CITRUS	AURANTIUM (FRUIT)	PARLATORIA CINEREA	Baggage	1
CITRUS	LIMETTA	PARLATORIA ZIZIPHI	Baggage	1
CITRUS	LIMETTIOIDES (FRUIT)	GUIGNARDIA CITRICARPA	Baggage	1
CITRUS	LIMON	PARLATORIA ZIZIPHI	Baggage	1
CITRUS	LIMON	SEPTORIA SP.	Baggage	3
CITRUS	LIMON (FRUIT)	GUIGNARDIA CITRICARPA	Baggage	1
CITRUS	LIMON (FRUIT)	PARLATORIA CINEREA	Baggage	6
CITRUS	LIMON (FRUIT)	PARLATORIA SP.	Baggage	1
CITRUS	LIMON (FRUIT)	PARLATORIA ZIZIPHI	Baggage	8
CITRUS	LIMON (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Baggage	1
CITRUS	LIMON (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Stores	1
CITRUS	LIMON (FRUIT)	SEPTORIA SP.	Baggage	1
CITRUS	LIMON (LEAF)	MARGARODIDAE, SPECIES OF	Baggage	1
CITRUS	PARADISI (FRUIT)	GUIGNARDIA CITRICARPA	Quarters	1
CITRUS	PARADISI (FRUIT)	PARLATORIA ZIZIPHI	Baggage	2
CITRUS	RETICULATA (FRUIT)	CERATITIS CAPITATA	Baggage	1
CITRUS	RETICULATA (FRUIT)	PARLATORIA ZIZIPHI	Stores	1
CITRUS	SINENSIS	AONIDIELLA SP.	Baggage	1
CITRUS	SINENSIS	CERATITIS CAPITATA	Baggage	2
CITRUS	SINENSIS	CHRYSOMPHALUS SP.	1	1
CITRUS	SINENSIS	COLLETOTRICHUM SP.	Baggage	1
CITRUS	SINENSIS	PARLATORIA ZIZIPHI	Baggage	2
CITRUS	SINENSIS	PARLATORIA ZIZIPHI	Stores	1
CITRUS	SINENSIS (FRUIT)	ANASTREPHA SP.	Baggage	1
CITRUS	SINENSIS (FRUIT)	ANASTREPHA SP.	Stores	1
CITRUS	SINENSIS (FRUIT)	CERATITIS CAPITATA	Baggage	1
CITRUS	SINENSIS (FRUIT)	CHRYSOMPHALUS PINNULIFER	Stores	1
CITRUS	SINENSIS (FRUIT)	ELSINOE AUSTRALIS	Baggage	3
CITRUS	SINENSIS (FRUIT)	ELSINOE AUSTRALIS	Stores	1
CITRUS	SINENSIS (FRUIT)	ELSINOE AUSTRALIS	Stores	8
CITRUS	SINENSIS (FRUIT)	GUIGNARDIA CITRICARPA	Stores	4
CITRUS	SINENSIS (FRUIT)	PARLATORIA CINEREA	Baggage	1
CITRUS	SINENSIS (FRUIT)	PARLATORIA CINEREA	Stores	6
CITRUS	SINENSIS (FRUIT)	PARLATORIA ZIZIPHI	Baggage	8
CITRUS	SINENSIS (FRUIT)	PARLATORIA ZIZIPHI	Stores	3
CITRUS	SINENSIS (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Baggage	1
CITRUS	SINENSIS (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Stores	1

TABLE A3- 1. PESTS INTERCEPTED ON CITRUS SPP. ARRIVING FROM PERU				
HOST		PEST	WHERE	TOTAL
CITRUS	SINENSIS (FRUIT)	PSEUDAULACASPIS SP.	Stores	1
CITRUS	SINENSIS (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	Baggage	1
CITRUS	SINENSIS (LEAF)	PARLATORIA ZIZIPHI	Baggage	2
CITRUS	SINENSIS (LEAF)	PSEUDAONIDIA TRILOBITIFORMIS	Baggage	1
CITRUS	SP.	APHIDIDAE, SPECIES OF	Baggage	1
CITRUS	SP.	DIASPIDIDAE, SPECIES OF	Baggage	1
CITRUS	SP.	ELSINOE SP.	Baggage	1
CITRUS	SP.	GUIGNARDIA CITRICARPA	Baggage	2
CITRUS	SP.	LEPTOSPHAERIA SP.	Baggage	1
CITRUS	SP.	PARLATORIA CINEREA	Baggage	1
CITRUS	SP.	PHYLLOSTICTA CITRICARPA	Baggage	1
CITRUS	SP.	PSEUDOCOCCIDAE, SPECIES OF	Baggage	1
CITRUS	SP.	PSYLLIDAE, SPECIES OF	Baggage	1
CITRUS	SP.	SEPTORIA SP.	Baggage	1
CITRUS	SP. (DRIED FRUIT)	GUIGNARDIA CITRICARPA	Baggage	1
CITRUS	SP. (FRUIT)	ANASTREPHA SP.	Baggage	1
CITRUS	SP. (FRUIT)	CERATITIS CAPITATA	Baggage	2
CITRUS	SP. (FRUIT)	CLADOSPORIUM SP.	Baggage	1
CITRUS	SP. (FRUIT)	DIASPIDIDAE, SPECIES OF	Baggage	1
CITRUS	SP. (FRUIT)	ELSINOE AUSTRALIS	Baggage	3
CITRUS	SP. (FRUIT)	ELSINOE AUSTRALIS	Stores	4
CITRUS	SP. (FRUIT)	ELSINOE SP.	Baggage	2
CITRUS	SP. (FRUIT)	GUIGNARDIA CITRICARPA	Baggage	5
CITRUS	SP. (FRUIT)	LONCHAEIDAE, SPECIES OF	Baggage	1
CITRUS	SP. (FRUIT)	PARAGRYLLUS TEMULENTUS	Baggage	1
CITRUS	SP. (FRUIT)	PARLATORIA CINEREA	Baggage	19
CITRUS	SP. (FRUIT)	PARLATORIA CINEREA	Stores	4
CITRUS	SP. (FRUIT)	PARLATORIA ZIZIPHI	Baggage	37
CITRUS	SP. (FRUIT)	PARLATORIA ZIZIPHI	Stores	12
CITRUS	SP. (FRUIT)	PARLATORIA ZIZIPHI	Quarters	2
CITRUS	SP. (FRUIT)	PHYLLOSTICTA CITRICARPA	Baggage	2
CITRUS	SP. (FRUIT)	PLANOCOCCUS SP.	Baggage	2
CITRUS	SP. (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Baggage	13
CITRUS	SP. (FRUIT)	PSEUDAONIDIA TRILOBITIFORMIS	Stores	1
CITRUS	SP. (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	Baggage	1
CITRUS	SP. (FRUIT)	PYRALINAE, SPECIES OF	Baggage	1
CITRUS	SP. (FRUIT)	SEPTORIA SP.	Baggage	1
CITRUS	SP. (FRUIT)	XANTHOMONAS AXONOPODIS PV. CITRI	Baggage	2
CITRUS	SP. (LEAF)	AGROMYZIDAE, SPECIES OF	Baggage	1
CITRUS	SP. (LEAF)	GUIGNARDIA CITRICARPA	Baggage	1
CITRUS	SP. (LEAF)	PARLATORIA ZIZIPHI	Baggage	5
CITRUS	SP. (LEAF)	PSEUDAONIDIA TRILOBITIFORMIS	Baggage	3
CITRUS	SP. (LEAF)	PSEUDAONIDIA TRILOBITIFORMIS	Baggage	3
CITRUS	SP. (LEAF)	VINSONIA STELLIFERA	Baggage	1

	Total			272

Appendix 4. Pests Associated with *Citrus* spp. and Reported in Peru

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru

Pest Name (Order: Family)	Distribution	Plant Part Affected	Quarantine Pest	Pest Likely to Follow Pathway	Reference(s)
Arthropods					
Acromyrex hispidus Santschi (Hymenoptera: Formicidae)	PE	Whole plant, leaves	Yes	No	(Alata Condor, 1973)
Agrotis ipsilon Hufnagel (Lepidoptera: Noctuidae)	PE US	Whole plant, leaves, stems, fruits	No	No	(CAB International, 2001; Carbonell Torres, 1999)
Aleurodicus dispersus Russell (Homoptera: Aleyrodidae)	PE US (FL, HI)	Leaves	Yes[1]	No	(CAB International, 2000; Mound, 1978)
Aleurothrixus floccosus (Maskell) (Homoptera: Aleyrodidae)	PE US (FL, CA, HI, TX)	Leaves (fruit, stems and flowers may be indirectly affected by honeydew and subsequent sooty mold	No[2]	No	(Alata Condor, 1973; CAB International, 2000; Miklasiewicz, 1990)
Anastrepha distincta Greene (Diptera: Tephritidae)	PE	Fruit	Yes[1]	No[20]	(CAB International, 2002; Norrbom and Kim, 1988; Miller, 2003a)
Anastrepha fraterculus (Wiedemann) (Diptera: Tephritidae)	PE	Fruit	Yes[1, 16]	Yes	(Alata Condor, 1973; CAB International, 2001)
Anastrepha grandis Macquart (Diptera: Tephritidae)	PE	Fruit	Yes[3]	No[8]	(CAB International, 2002; Korytkowski and Ojeda D., 1968; Norrbom and Kim, 1988; Stone, 1942)
Anastrepha minensis Lima Syn.: *Anastrepha extensa* Stone (Diptera: Tephritidae)	PE	Fruit	Yes[3]	No[8]	(Korytkowski and Ojeda D., 1968; Norrbom and Kim, 1988; Stone, 1942)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Anastrepha obliqua Macquart (Diptera: Tephritidae)	PE	Fruit	Yes[1]	Yes	(CAB International, 2001) (C.I.E., 1988; Korytkowski and Ojeda D., 1968)
Anastrepha serpentina (Wiedemann) (Diptera: Tephritidae)	PE	Fruit	Yes[1, 17]	Yes	(Alata Condor, 1973; CAB International, 2001; Foote et al., 1993; Weems, 1969; CAB International, 2001)
Anastrepha striata Schin. Diptera: Tephritidae	PE	Fruit	Yes[1, 18]	No[23]	(Alata Condor, 1973; CAB International, 2000; Hennessey, 2003; Norrbom, 2003; CAB International, 2000)
Ancistrosoma klugi Curtis (Coleoptera: Scarabaeidae)	PE	Roots, leaves, flowers	Yes	No	(Alata Condor, 1973; Blackwelder, 1956; Dourojeanni, 1992; Peña and Bennett, 1995)
Aonidia spp. (Homoptera: Diaspididae)	PE		Yes[3, 4]	Yes	(Alata Condor, 1973)
Aonidiella aurantii (Maskell) (Homoptera: Diaspididae)	PE, US (AZ, CA, FL, TX)	Leaves, stems, fruits	No[2, 4]	Yes	(CAB International, 2000)
Aphis gossypii Glover (Homoptera: Aphididae)	PE, US	Leaves, stems, flowers	No	No	(Alata Condor, 1973; Blackman, 2000; CAB International, 2000)
Aphis spiraecola Patch (Homoptera: Aphididae)	PE, US	Leaves, stems, flowers, fruit	No	No	(Alata Condor, 1973; Blackman, 2000; CAB International, 2000)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru

Pest Name (Order: Family)	Distribution	Plant Part Affected	Quarantine Pest	Pest Likely to Follow Pathway	Reference(s)
Argyrotaenia sphaleropa Meyrick (Lepidoptera: Tortricidae)	PE	Leaves flowers, fruit	Yes	No[22]	((Alata Condor, 1973); (Ebeling, 1959; Salazar Torres, 1999; Carbonell Torres, 2003); (Aguilar F., 1980); **Appendix 5)**(Manfredi-Coimbra et al., 2001; Bentancourt and Scatoni, 1986; Bentancourt and Scatoni, 1989; Aguilar, 1982; Van Der Geest and Evenhuis, 1991; Beingolea et al., 1969)
Arvelius acutispinus Breddin (Hemiptera: Pentatomidae)	PE	Leaves, stems, flowers, fruit	Yes[3]	No[5]	(Alata Condor, 1973; Henry and Froeschner, 1988; McPherson and McPherson, 2000)
Aspidiotus destructor Signoret, 1869 (Homoptera: Diaspididae)	PE, US (CA, FL, HI)	Leaves, stems, fruit	No[2, 4]	Yes	(CAB International, 2000)
Aspidiotus nerii Bouché (Homoptera: Diaspididae)	PE, US (CA, HI)	Leaves, stems, fruit	No[2, 4]	Yes	(CAB International, 2000)
Asterolecanium sp. (Homoptera: Asterolecaniidae)	PE	Leaves, stems, fruit	Yes[3]	Yes[9]	(Alata Condor, 1973; Hill, 1983; Hamon, 1977)
Atherigona orientalis Schiner (Diptera: Muscidae)	PE, US (CA, FL, GA, HI, TX)	Leaves, stems, roots, fruit	No[2]	Yes	(CAB International, 2000)
Atta cephalotes L. (Hymenoptera: Formicidae)	PE	Leaves	Yes[1]	No	(Alata Condor, 1973; Kliejunas et al., 2001)
Atta sexdens L. (Hymenoptera: Formicidae)	PE	Leaves	Yes[1]	No	(Alata Condor, 1973; Escalante et al., 1981; Kliejunas et al., 2001)
Aulacaspis tubercularis Newstead (Homoptera: Diaspidae)	PE[10]	Leaves, stems, fruit	Yes[1, 4]	Yes	(CAB International, 2002; PIN309, 2003; Miller, 1985)
Carales astur (Cramer) (Lepidoptera: Arctiidae)	PE	Leaves	Yes	No	(Jacobson, 2003; Zhang, 1994; Anonymous, 2003; Jacobson, 1991; Zhang, 1994; Anonymous, 2003)
Ceratitis capitata (Wiedemann) (Diptera: Tephritidae)	PE, US (HI)	Fruit	Yes[1]	Yes	(Alata Condor, 1973; CAB International, 2000; Aguilar, 1982)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Ceroplastes sp. (Homoptera: Coccidae)	PE	Leaves, stems	Yes[3]	No	(Alata Condor, 1973; CAB International, 2000)
Ceroplastes cirripediformis (Comstock) (Homoptera: Coccidae)	PE, US (TX)	Leaves, stems	No[2]	No	(CAB International, 2000; Marin, 1995)
Ceroplastes floridensis (Comstock) (Homoptera: Coccidae)	PE, US	Leaves, stems	No	No	(CAB International, 2000; Marin, 1995)
Chrysomphalus aonidum (L.) (Homoptera: Diaspididae)	PE, US	Leaves, stems, fruits	No[4]	Yes	(Alata Condor, 1973; CAB International, 2001; Nakahara, 1982)
Chrysomphalus dictyospermi (Morgan) (Homoptera: Diaspididae)	PE, US	Leaves, stems, fruits	No[4]	Yes	(Alata Condor, 1973; CAB International, 2001; Nakahara, 1982)
Coccus hesperidum L. (Homoptera: Coccidae)	PE, US	Leaves, stems	No	No	(Alata Condor, 1973; CAB International, 2000; Hamon, 1984)
Coccus viridis (Green) (Homoptera: Coccidae)	PE, US (FL, HI)	Leaves, stems, fruit	Yes[1]	No[21]	(Alata Condor, 1973) (Dekle, 1976; Miller, 2003b); (CAB International, 2002); **Appendix 5**(Escalante et al., 1981; Hamon, 1984; PIN309, 2003; CAB International, 2002; Escalante et al., 1981; Hamon, 1984)
Compsus sp. (Coleoptera: Curculonidae)	PE	Leaves, roots, fruit	Yes[3]	Yes[11]	(Alata Condor, 1973; Borrer et al., 1989; Arnett et al., 2002)
Diabrotica speciosa (Germar) Coleoptera: Chrysomelidae	PE	Leaves, roots, fruits	Yes[1]	No[5]	(CAB International, 2002)
Dialeurodes citri (Ashmead, 1885) Homoptera: Aleyrodidae	PE, US	Leaves	No	No	(CAB International, 2000)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Diaspidiotus perniciosus (Comstock) (Homoptera: Diaspididae)	PE, US	Stems, leaves, fruits	No[4]	Yes	(CAB International, 2000)
Dysmicoccus brevipes (Cockerell) Homoptera: Pseudococcidae	PE, US (CA, FL, HI, LA)	Stems, leaves, fruit	No[2]	Yes	(CAB International, 2000)
Ecdytolopha aurantiana (Lima) (Syn.: *Gymnandrosoma aurantianum. Ecdytolopha torticornis*) (Lepidoptera: Tortricidae)	PE, PR	Fruit	Yes[3]	Yes	(CAB International, 2000; Escalante et al., 1981; Bento et al., 2001; Adamski and Brown, 2001; Escalante et al., 1981; Bento et al., 2001)
Euryophthalmus balteatus (Stal) (Hemiptera: Pyrrhocoridae)	PE	Fruit	Yes	No[5]	(Alata Condor, 1973; University of California Statewide Integrated Pest Management Program, 2000)
Ferrisia virgata Cock (Homoptera: Pseudococcidae)	PE, US	Leaves, stems, fruit	No	Yes	(CAB International, 2002)
Frankliniella occidentalis (Pergande) Thysanoptera: Thripidae	PE, US	Leaves, flowers	No	No	(CAB International, 2002)
Gymnetosoma mathani (Pauill) (Coleoptera: Scarabaeidae)	PE	Leaves, fruit, flowers[12]	Yes	No[5]	(Alata Condor, 1973; Borrer et al., 1989; White, 1983)
Helicoverpa zea (Boddie) Lepidoptera: Noctuidae	PE, US	Leaves, flowers, fruits, seeds	No	Yes	(CAB International, 2002)
Heliothrips haemorrhoidalis Bouché Thysanoptera: Thripidae	PE, US	Leaves, fruits	No	Yes	(CAB International, 2002)
Hemiberlesia lataniae (Signoret) (Homoptera: Diaspidae)	PE, US	Leaves, stems, fruit	No[4]	Yes	(Alata Condor, 1973; CAB International, 2000; Nakahara, 1982)
Icerya purchasi Maskell (Homoptera: Margarodidae)	PE, US	Leaves, stems	No	No	(Alata Condor, 1973; CAB International, 2000)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru

Pest Name (Order: Family)	Distribution	Plant Part Affected	Quarantine Pest	Pest Likely to Follow Pathway	Reference(s)
Inga iacunata (Meyr.) (Lepidoptera: Oecophoridae)	PE	Leaves, flowers, stems	Yes	No	(Alata Condor, 1973; Borrer and White, 1970; Borrer et al., 1989; Becker, 2003; Borrer and White, 1970; Borrer et al., 1989)
Lecanium corni Bouché (Hemoptera: Coccidae)	PE, US	Leaves, stems	No[2]	No	(Alata Condor, 1973; CAB International, 2000)
Lecanodiaspis sp. (Homoptera: Asterolecaniidae)	PE	?	Yes[3]	Yes[6]	(Alata Condor, 1973)
Lepidosaphes beckii (Newman) (Homoptera: Diaspididae)	PE, US	Leaves, stems, fruit	No[4]	Yes	(Alata Condor, 1973; CAB International, 2000; Nakahara, 1982)
Lepidosaphes gloverii (Packard) (Homoptera: Diaspididae)	PE, US	Leaves, stems, fruit	No[4]	Yes	(Alata Condor, 1973; CAB International, 2000; C.I.E., 1962a; Nakahara, 1982)
Macropophora acentifer (Oliver) (Coleoptera: Cerambycidae)	PE	Stems	Yes[1]	No	(Escalante et al., 1981)
Macrosiphum euphorbiae (Thomas) Homoptera: Aphididae	PE, US	Leaves, flowers	No	No	(CAB International, 2002; INRA, 1998)
Macrostylus puberulus Boheman Syn.: *Amphideritus puberulus* (Coleoptera: Curculionidae)	PE	Stem	Yes	No	(Alata Condor, 1973; Wibmer and O'Brien, 1986; Garces, 1988)
Melipona sp. (Hymenoptera: Meliponidae)	PE	Fruit	Yes	No[5]	(Escalante, 1974)
Microcentrum laurifolium L. (Orthoptera: Acrididae)	PE, US	Leaves, flowers	Yes[3]	No	(Alata Condor, 1973; Krauth, 2003)
Microcephalothrips abdominalis (D.L. Crawford) Thysanoptera: Thripidae	PE, US	Flowers, seeds	No	No	(CAB International, 2002; NCSU (North Carolina State University), 2003)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Myzus persicae Sulzer Homoptera: Aphididae	PE, US	Leaves, stems, flowers	No	No	(CAB International, 2002)
Nipaecoccus nipae (Maskell) Homoptera: Pseudococcidae	PE, US (CA, FL, LA, HI)	Leaves, stems, fruit	No[2]	Yes	(CAB International, 2002)
Nyctobates gigas L. (Coleoptera: Tenebrionidae)	PE	?	Yes	No[5]	(Alata Condor, 1973; White, 1983; Hill, 1983)
Oiketicus kirbyi Guilding (Lepidoptera: Psychidae)	PE	Leaves	Yes[1]	No	(Alata Condor, 1973; Zhang, 1994; Ponce et al., 1979; Gravena and Almeida, 1982; Gordh and Headrick, 2001; Zhang, 1994; Ponce et al., 1979)
Orthezia citricola Beingolea (Homoptera: Ortheziidae)	PE	Leaves, stems	Yes[3]	No	(Beingolea, 1971b; CAB International, 2001; ScaleNet, 2002)
Orthezia olivicola Beingolea (Homoptera: Ortheziidae)	PE	Leaves, stems	Yes[3]	No	(Alata Condor, 1973; CAB International, 2001; Peña and Bennett, 1995; ScaleNet, 2002)
Orthezia praelonga Douglas (Homoptera: Ortheziidae)	PE, US (VI, PR)	Leaves, stems	Yes[1]	No	(Alata Condor, 1973)(CAB International, 2001; ScaleNet, 2002; PIN309, 2003)
Panonychus citri (McGregor) (Acari: Tetranychidae)	PE, US	Leaves, stems, fruits	No	Yes	(Alata Condor, 1973; CAB International, 2000)
Pantomorus cervinus (Boheman) [Syn.: *Pantomorus godmani* (Crotch)] (Coleoptera: Curculonidae)	PE, US	Leaves, roots, may lay eggs on fruit	No	Yes	(Alata Condor, 1973; CAB International, 2000)
Papilio anchisiades Esper (Syn.: *Papilio idaeus* Fabricius) (Lepidoptera: Papilionidae)	PE, US (TX)	Leaves	No	No	(CAB International, 2000; Lamas, 1975; Zhang, 1994)
Papilio isidorus isidorus Doubleday (Lepidoptera: Papilionidae)	PE	Leaves	Yes[3]	No	(Alata Condor, 1973; Savela, 2000)
Papilio paeon paeon (Boisduval) (Lepidoptera: Papilionidae)	PE	Leaves	Yes[3]	No	(Alata Condor, 1973; Savela, 2000)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru

Pest Name (Order: Family)	Distribution	Plant Part Affected	Quarantine Pest	Pest Likely to Follow Pathway	Reference(s)
Parlatoria cinerea Hadden in Doane & Hadden (Homoptera: Diaspididae)	PE[13], US (MD, DC)	Leaves, stems, fruit	Yes[1,4]	Yes	(ScaleNet, 2002; Kosztarab, 1996; Ooi et al., 2002; Miller, 1985)
Parlatoria pergandii Comstock (Homoptera: Diaspididae)	PE, US	Leaves, stems, fruits	No[4]	Yes	(Alata Condor, 1973; CAB International, 2001; Kosztarab, 1996)
Parlatoria ziziphi (Lucas) (Homoptera: Diaspididae)	PE, US (FL, HI)	Leaves, stems fruits	Yes[4]	Yes	(ScaleNet, 2002; PIN309, 2003; Courneya, 2003a; CAB International, 2002)
Parthenolecanium corni (Bouché) Homoptera: Coccidae	PE, US	Leaves, stems	No	No	(CAB International, 2002)
Peridroma saucia (Hübner) Lepidoptera: Noctuidae	PE, US	Leaves, stems, flowers, fruits, seeds	No	Yes	(CAB International, 2002)
Phenacoccus madeirensis Green Homoptera: Pseudococcidae	PE, US	Leaves, stems	No	No	(CAB International, 2002)
Phyllocnistis citrella Stainton (Lepidoptera:Gracillariidae)	PE, US (AL, FL, LA, TX)	Leaves	Yes[1]	No	(CAB International, 2001; Cruz and Dale, 1999; Heppner and Dixon, 1995; Cavey, 2002)
Phyllocoptruta oleivora (Ashmead) (Acari: Eriophyidae)	PE, US	Leaves, stems, fruits	No	Yes	(Alata Condor, 1973; CAB International, 2001)
Pinnaspis aspidistrae (Signoret) (Homoptera: Diaspidae)	PE, US	Leaves, stems, fruits	No[4]	Yes	(Aguilar F., 1980; Beingolea, 1973; CAB International, 2001; Aguilar, 1982; Hill, 1983; Dekle, 1965; Kosztarab, 1996; C.I.E., 1977; ScaleNet, 2002)
Pinnaspis strachani Cooley (Homoptera: Diaspidae)	PE, US	Leaves, stems, fruits	No[4]	Yes	(Alata Condor, 1973; CAB International, 2002; ScaleNet, 2002)
Polyphagotarsonemus latus Banks (Acari: Tarsonemidae)	PE, US	Leaves, stems, flowers, fruits	No	Yes	(CAB International, 2001; C.I.E., 1986; Marin, 1985)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Protopulvinaria pyriformis (Ckll.) (Homoptera: Coccidae)	PE, US	Leaves, stems, fruits	No	Yes	(Alata Condor, 1973; CAB International, 2001; ScaleNet, 2002)
Planococcus citri (Risso) (Homoptera: Pseudococcidae)	PE, US	Leaves, stems, roots, flowers and fruits	No	Yes	(Alata Condor, 1973; Beingolea, 1971a; CAB International, 2000)
Planococcus minor (Maskell) (Homoptera: Pseudococcidae)	PE	Stems, flowers, fruit	Yes[1]	No[14]	(CAB International, 2002); (ScaleNet, 2002); (PIN309, 2003); (Ben-Dov, 1994); (Ooi et al., 2002)
Pseudaonidia trilobitiformis (Green) (Homoptera: Diaspidae)	PE[15]	Stem, bark, leaves, fruit	Yes[1, 4]	Yes	(Kosztarab, 1996; PIN309, 2003)
Pseudococcus jackbeardsleyi Gimpel and Miller, 1996 (Homoptera: Pseudococcidae)	PE, US (FL, TX, HI, VI)	Leaves, stems, fruit	No[2]	Yes	(Williams and Watson, 1988; Ooi et al., 2002)
Pseudococcus longispinus Targioni Tozzetti (Homoptera: Pseudococcidae)	PE, US	Leaves, stems, flowers, fruits	No	Yes	(CAB International, 2002)
Pulvinaria sp. (Tao, Wong & Chang) (Homoptera: Coccidae)	PE	Leaves, stems, fruit	Yes[3]	Yes	(Alata Condor, 1973; Hill, 1983; ScaleNet, 2002; CAB International, 2002)
Rhopalosiphum maidis (Fitch) (Homoptera: Aphididae)	PE, US	Leaves, stems	No	No	(CAB International, 2002)
Rhynchophorus palmarum (Linnaeus) (Coleoptera: Curculionidae)	PE	Leaves, stems, flowers, fruits	Yes[1]	No[5]	(CAB International, 2002; Thomas, 2002; PIN309, 2003)
Saissetia coffeae (Walker) (Homoptera: Coccidae)	PE, US	Leaves, stems	No	No	(Alata Condor, 1973; CAB International, 2001; Hamon, 1984)
Saissetia oleae (Olivier) (Homoptera: Coccidae)	PE, US	Leaves, stems	No	No	(Alata Condor, 1973; CAB International, 2001; C.I.E., 1973; Hamon, 1984)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Schistocerca cancellata Serv. (Orthoptera: Acrididae)	PE	Leaves	Yes[3]	No	(Alata Condor, 1973; CAB International, 2000)
Selenaspidus articulatus (Morgan) (Homoptera: Diaspidae)	PE, US (FL)	Leaves, stems, fruits	No[2, 4]	Yes	(Alata Condor, 1973; CAB International, 2000; Ebeling, 1959)
Sibine sp. (Lepidoptera: Limacodidae)	PE	Leaves?	Yes[3]	Yes[6]	(Alata Condor, 1973)
Spodoptera eridania Stoll (Lepidoptera: Noctuidae)	PE, US	Leaves, fruit	No	Yes	(CAB International, 2002)
Spodoptera frugiperda J.E. Smith (Lepidoptera: Noctuidae)	PE, US	Leaves, stems, flowers, fruits	No	Yes	(CAB International, 2002)
Tetreuaresta punctipennata Hering (Diptera: Tephritidae)	PE	Flowers	Yes	No	(Alata Condor, 1973); (Borge and Basedow, 1997; Gordh and Headrick, 2001)
Tetranychus cinnabarinus (Boisduval) (Acari: Tetranychidae)	PE, US (CA, HI, TX)	Leaves	No[2]	No	(CAB International, 2001; Ehler, 1974; Johnson et al., 1989; Mollet, 1984)
Toxoptera aurantii (Boyer de Fonscolombe) (Homoptera: Aphididae)	PE, US	Leaves, stems, flowers	No	No	(Alata Condor, 1973; CAB International, 2001; C.I.E., 1961)
Toxoptera citricidus (Kirkaldy) (Homoptera: Aphididae)	PE, US (FL)	Leaves	Yes[1]	No	(Alata Condor, 1973; CAB International, 2001; C.I.E., 1961; Halbert, 1995)
Trigona hyalinata amazonensis Du. (Hymenoptera: Apidae)	PE	Leaves, flowers, fruit	Yes[3]	No[5]	(Alata Condor, 1973; Hill, 1983; Myazaki et al., 1984; Myazaki et al., 1984; Hill, 1983)
Trigona testacea cupira Smith (Hymenoptera: Apidae)	PE	Leaves, flowers, fruit	Yes[3]	No[5]	(Alata Condor, 1973; Freire and Gara, 1970; Hill, 1983; Escalante, 1974)

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Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Trigona trinidadensis (Provancher) (Hymenoptera: Apidae) [Synonym: *Melipona trinidadensis*]	PE	Leaves, flowers, fruit	Yes[3]	No[5]	(Alata Condor, 1973; CAB International, 2001; Hill, 1983)
Unaspis citri (Comstock) (Homoptera : Diaspididae)	PE, US (CA, FL, GA, LA)	Leaves, stems, fruits	No[2, 4]	Yes	(Alata Condor, 1973; CAB International, 2000; C.I.E., 1962b)
Fungi					
Alternaria brassicae (Berk.) Sacc. (Deutermycotina: Hyphomycetes)	PE, US	Flowers, leaves, seeds, fruits	No	Yes	(CAB International, 2001; Farr et al., 1989)
Alternaria sp. (Deutermycotina: Hyphomycetes)	PE	Flowers, leaves, fruits	Yes[3]	Yes	(Dongo, 1972)
Botryodiplodia theobromae Pat. (Deuteromycotina: Coelomycetes) Syn.: *Diplodia natalensis* Pole Evans Teleomorph: *Physalospora rhodina* Berk. & M.A. Curtis	PE, US	Flowers, leaves, stems, roots, fruits, seeds	No	Yes	(Abbot, 1931; CAB International, 2000; C.M.I., 1985)
Botryotinia fuckeliana (de Bary) Whetzel (Ascomycetes: Sclerotiniaceae) Anamorph: *Botrytis cinerea*	PE, US	Flowers, leaves, fruits, stems	No	Yes	(Dongo, 1972)
Ceratocystis fimbriata Ellis & Halst. (Microascales: Ceratocystaceae)	PE, US	Roots, stem, leaves, fruits	No	Yes	(CAB International, 2001; Farr et al., 1989)
Cercospora sp. (Deutermycotina: Hyphomycetes)	PE	Leaves, fruit	Yes[3]	Yes	(Abbot, 1931; Farr et al., 1989)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru

Pest Name (Order: Family)	Distribution	Plant Part Affected	Quarantine Pest	Pest Likely to Follow Pathway	Reference(s)
Cochliobolus lunatus R.R. Nelson & Haasis [teleomorph] (head mould of grasses, rice and sorghum) (Dothideales:Pleosporaceae)	PE, US	leaves, seeds, flowers	No	No	(CAB International, 2001; Farr et al., 1989)
Colletotrichum musae (Berk. & M.A.Curtis) Arx (Deuteromycotina: Coelomycetes) Syn.: *Gloeosporium musarum*	PE, US (FL, HI, TX)	Fruit	No[2]	Yes	(Abbot, 1931; Farr et al., 1989)
Corticium koleroga (Cooke) Höhnel Syn.: *Pellicularia koleroga* Cooke (Basidiomycetes: Corticiaceae)	PE, US	Leaves, stems, fruit	No	Yes	(CAB International, 2000; Timmer et al., 2000; Farr et al., 2003)
Corticium rolfsii Curzi (Basidiomycetes: Corticiaceae)	PE, US	Leaves, stems, roots, flowers, fruit	No	Yes	(CAB International, 2000)
Corticium salmonicolor Berk. & Broome Syn.: *Erythricium salmonicolor* Berk. & Broome) Burds. (Basidiomycetes: Corticiaceae)	PE, US (FL, LA, MS)	Leaves, stems	No	No	(CAB International, 2000; Timmer et al., 2000)
Elsinoë fawcettii Bitanc. & Jenkins (Ascomycetes: Elsinoaceae)	PE, US	Leaves, fruit	No	Yes	(CAB International, 2000; Sivanesan and Critchett, 1974)
Fusarium sp. (Deutermycotina: Hyphomycetes)	PE	Root	Yes[1]	No	(Abbot, 1931)
Glomerella cingulata (Stonem.) Spauld. & Schrenk [teleomorph] (Phyllachorales: Phyllachoraceae)	PE, US	Leaves, stems, fruit, flowers	No	Yes	(CAB International, 2001; Farr et al., 1989)

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Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Lasiodiplodia theobromae (Pat.) Griffiths & Maubl. [anamorph] (Xylariales: Hyponectriaceae)	PE, US	Leaves, stems, roots, flowers, fruits, seeds	No[2]	Yes	(CAB International, 2002)
Macrophomina phaseolina (Tassi) Goid (Deuteromycotina: Coelomycetes)	PE, US	leaves, stems, roots, and seeds	No	No	(CAB International, 2001; Farr et al., 1989)
Mycena citricolor (Berk. & Curtis) Sacc. (Agaricales: Tricholomataceae)	PE, US (PR, VI)	Leaves, stems, fruits	Yes[1]	No[19]	(CAB International, 2002; Mariau, 2001; Schubert, 2002; Thurston, 1989; Farr et al., 2003)
Penicillium digitatum (Pers.: Fr.) Sacc. (Deutermycotina: Hyphomycetes)	PE, US	Fruit	No	Yes	(Abbot, 1931; CAB International, 2000)
Penicillium italicum Wehmer (Deutermycotina: Hyphomycetes)	PE, US	Fruit	No	Yes	(Abbot, 1931; CAB International, 2000)
Penicillium sp. (Deutermycotina: Hyphomycetes)	PE	Flowers, fruits	No	Yes	(Dongo, 1972)
Phytophthora cactorum (Lebert & Cohn) Schröter (Pythiales: Pythiaceae)	PE, US	Leaves, stems, roots, fruit	No	Yes	(CAB International, 2001; Farr et al., 1989)
Phytophthora capsici Leonian (Pythiales: Pythiaceae)	PE, US	Leaves, stems, fruit	No	Yes	(CAB International, 2001; Farr et al., 1989; Horst, 2001)
Phytophthora citrophthora (R.H. Sm. & E. Sm.) Leonian (Pythiales: Pythiaceae)	PE, US	Leaves, stems, roots, fruit	No	Yes	(CAB International, 2001; Farr et al., 1989)
Phytophthora nicotianae Breda de Haan (Pythiales: Pythiaceae)	PE, US	Leaves, stems, roots, fruit	No	Yes	(CAB International, 2001; Farr et al., 1989)
Phytophthora palmivora (E. J. Butler) E. J. Butler (Pythiales: Pythiaceae)	PE, US	Leaves, stems, roots, flowers, fruit	No	Yes	(CAB International, 2001; Farr et al., 1989; Timmer et al., 2000)

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Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Rhizopus stolonifer (Ehrenb.) Lind (Zygomycetes: Mucoraceae) Syn.: *Rhizopus nigricans* Ehrenb.	PE, US	Fruit	No	Yes	(Abbot, 1931; CAB International, 2000; Farr et al., 1989)
Rosellinia bunodes (Berk. & Broome) Sacc. (Xylariales: Xylariaceae)	PE, US (PR, VI)	Roots	Yes	No	(CAB International, 2002; Timmer et al., 2000; Farr et al., 2003)
Sclerotinia sclerotiorum (Lib.) de Bary (Leotiales: Sclerotiniaceae)	PE, US	Leaves, stems, roots, fruit, seeds, flowers	No	Yes	(CAB International, 2001; Farr et al., 1989; Timmer et al., 2000)
Sphaeropsis tumefaciens Hedges (Deuteromycotina: Coelomycetes)	PE, US (FL, HI)	Stems	No[2]	No	(Abbot, 1931; Farr et al., 1989; Timmer et al., 2000; CAB International, 2002; Farr et al., 2003)
Thanatephorus cucumeris (Frank) Donk [teleomorph] (Ceratobasidiales: Ceratobasidiaceae)	PE, US	Leaves, stems, roots, flowers, fruit, seeds	No	Yes	(CAB International, 2001; Farr et al., 1989; Timmer et al., 2000)
Thielaviopsis basicola (Berk. & Broome) (synanamorph: *Chalara elegans*) (Deuteromycotina: Hyphomycetes)	PE, US	Roots	No	No	(CAB International, 2001; Farr et al., 1989; Timmer et al., 2000)
Bacteria					
Rhizobium radiobacter (Beij. & v. Deld.) Pribram 1933 (Rhizobiales: Rhizobiaceae)	PE, US	Roots, stems, seedlings	No	No	(Bradbury, 1986; CAB International, 2001)
Phytoplasmas and Spiroplasmas					
Spiroplasma citri Saglio, et al. 1973 (Mycoplasmatales: Mycoplasmataceae)	PE, US	Leaves, stems, fruits, seeds	No	No	(Bazan de Segura, 1972; Timmer et al., 2000)
Viruses, Viroids and Virus-like Agents					

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Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Citrus psorosis virus (Ophiovirus)	PE, US	Leaves, stems	No	No	(Bazan de Segura, 1972; Timmer et al., 2000)
Citrus tristeza virus (Closteroviridae: Closterovirus)	PE, US	Leaves, stems	No	No	(Bar-Joseph and Lee, 1989; CAB International, 2000; Roistacher, 1988)
Citrus vein enation virus (Unclassified)	PE, US	Stems	No	No	(Bazan de Segura, 1972; Timmer et al., 2000)
Nematodes					
Criconemella spp. De Grisse & Loof, 1965 (Tylenchida: Criconematidae)	PE	Roots	Yes[3]	No	(SON (Society of Nematologists), 1984; CAB International, 2000)
Ditylenchus destructor Thorne, 1945 (Tylenchida: Anguinidae)	PE, US	roots, stems, leaves	No	No	(CAB International, 2001; SON (Society of Nematologists), 1984)
Helicotylenchus dihystera (Cobb, 1893) Sher, 1961 (Tylenchida: Hoplolaimidae)	PE, US	Roots	No	No	(CAB International, 2001; SON (Society of Nematologists), 1984; O'Brannon and Inserra, 1989)
Helicotylenchus multicinctus (Cobb, 1893) Golden, 1956 (Tylenchida: Hoplolaimidae)	PE, US	Roots	No	No	(CAB International, 2001; SON (Society of Nematologists), 1984; O'Brannon and Inserra, 1989)
Hemicriconemoides mangiferae Siddiqi, 1961 (Tylenchida: Criconematidae)	PE	Roots	Yes[1]	No	(SON (Society of Nematologists), 1984; CAB International, 2001; MacGowan, 1984)
Meloidogyne exigua Goeldi, 1892 (Tylenchida: Meloidogynidae)	PE	Roots	Yes[3]	No	(CAB International, 2001)
Pratylenchus brachyurus (Godfrey, 1929) Filipjev & Schuurmans Stekhoven, 1941 (Tylenchida: Pratylenchidae)	PE, US	Roots	No	No	(CAB International, 2001; SON (Society of Nematologists), 1984)
Radopholus similis (Cobb, 1893) Thorne, 1949 (Tylenchida: Pratylenchidae)	PE, US (FL, HI, PR)	Roots	Yes[1]	No	(CAB International, 2001; Timmer et al., 2000)

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Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Rotylenchulus reniformis Linford & Oliveira, 1940 (Tylenchida: Rotylenchulidae)	PE, US	Roots	No	No	(CAB International, 2001; SON (Society of Nematologists), 1984)
Scutellonema brachyurus Steiner (1938) Andrássy, 1958 (Tylenchida: Hoplolaimidae)	PE, US (CA, FL, NC, SC)	Roots	No[2]	No	(CAB International, 2001; O'Brannon and Duncan, 1990)
Trichodorus spp. (Triplonchida: Trichodoridae)	PE	Roots	Yes	No	(CAB International, 2001; SON (Society of Nematologists), 1984)
Tylenchulus semipenetrans Cobb (Tylenchida: Tylenchulidae)	PE, US	Roots	No	No	(CAB International, 2001; Herrera et al., 1980)
Xiphinema brasiliense (Dorylaimida: Longidoridae)	PE, US (FL)	Roots	Yes[1]	No	(Alkemade and Loof, 1990; SON (Society of Nematologists), 1984; Lamberti et al., 1987)
Xiphinema brevicolle (Dorylaimida: Longidoridae)	PE, US (CA)	Roots	Yes[1]	No	(Alkemade and Loof, 1990; SON (Society of Nematologists), 1984)
Xiphinema californicum Lamberti and Bleve-Zacheo, 1979 (Dorylaimida: Longidoridae)	PE, US (CA)	Roots	No	No	(Alkemade and Loof, 1990; SON (Society of Nematologists), 1984)
Xiphinema floridae Lamberti and Bleve-Zacheo, 1979 (Dorylaimida: Longidoridae)	PE, US (FL)	Roots	No	No	(Lamberti et al., 1987; SON (Society of Nematologists), 1984)
Xiphinema index Thorne & Allen, 1950 (Dorylaimida: Longidoridae)	PE, US	Roots	No	No	(CAB International, 2001; SON (Society of Nematologists), 1984; Lehman, 1981)
Xiphinema paritaliae (Dorylaimida: Longidoridae)	PE	Roots	Yes[3]	No	(Lamberti et al., 1987)
Xiphinema peruvianum n.sp. (*Xiphinema americanum* Cobb sensu lato) (Dorylaimida: Longidoridae)	PE	Roots	Yes[3]	No	(Lamberti and Bleve-Zacheo, 1979; Lamberti et al., 1987)

Table A4-1. Pests Associated with *Citrus* spp. and Reported in Peru					
Pest Name (Order: Family)	**Distribution**	**Plant Part Affected**	**Quarantine Pest**	**Pest Likely to Follow Pathway**	**Reference(s)**
Xiphinema setariae Luc, 1958 (Dorylaimida: Longidoridae)	PE, US (FL)	Roots	No	No	(Alkemade and Loof, 1990; SON (Society of Nematologists), 1984)
Xiphinema vulgare (Dorylaimida: Longidoridae)	PE, US (FL)	Roots	No	No	(Lamberti et al., 1987; Tarjan, 1964)
Mollusks					
Helix aspersa Muller (Mollusca: Helicidae)	PE, US	Bark, wood, roots, fruit, leaves, stems, seeds, flowers	Yes[7]	No[5]	(CAB International, 2001; Dekle, 1969; Dekle and Fasulo, 2002)

Footnotes

[1] Listed as **actionable** pest in the USDA Catalog of Intercepted Pests.

[2] Listed as **non-actionable** pest in the USDA Catalog of Intercepted Pests.

[3] Genus listed as an **actionable** pest in the USDA Catalog of Intercepted Pests.

[4] This is an armored scale and USDA does not take action on armored scales when intercepted on commercial citrus fruit for consumption.

[5] Because of its size, biology and/or mobility, this pest is not expected to stay on the commodity through harvest and standard handling and processing.

[6] Because of a lack of information, it is assumed that this genus can follow the pathway.

[7] Listed as **actionable** pest in the USDA Catalog of Intercepted Pests for Alabama and Florida only.

[8] Not likely to follow the pathway, because *Citrus* is considered to be a doubtful host (Norrbom and Kim, 1988; Ooi et al., 2002) or is not included in their reported host ranges (White and Elson-Harris, 1992; Weems, 1990).

[9] Based on the fact that there are species in this genus that can attack fruit (Hill, 1983; Hamon, 1977), it is assumed that the species in Peru may follow the pathway.

[10] This scale species is reported in Brazil and Colombia but not in Peru (CAB International, 2002; Miller, 1985). However, it was intercepted on non-citrus hosts from Peru 7 times since 1985 (PIN309, 2003).

[11] In general, curculionids may attack every part of a plant, from the roots upward, the larvae feeding inside the tissues of the plant, and the adults drilling holes in fruits, nuts, and other plant parts (Borrer et al., 1989); therefore, it is assumed that *Compsus* sp. in Peru could possibly follow the pathway.

[12] Many scarabs feed on plant materials such as grasses, foliage, fruits, and floweres, and some are serious pests of various agricultural crops (Borrer et al., 1989). It is assumed that only the adults attack the fruit, as the literature does not mention scarab larvae feeding on fruit (White, 1983).

[13] (Miller, 1985) does not include Peru in its distribution but does report slides from Peru in the ARS collection. Also, this scale was intercepted on citrus fruit from Peru 10 times since 1985 (PIN309, 2003).

[14] The only evidence of this scale species possibly being in Peru are baggage interceptions (PIN309, 2003); therefore, it is assumed that it will not follow the pathway.

[15]This scale species is not listed as present in Peru in (CAB International, 2002); however, since 1985 there were 9 interceptions on citrus from Peru, 7 of which were on fruit, and there were 12 interceptions from Peru on non-citrus hosts, one of which was in permit cargo (PIN309, 2003).

[16](Foote et al., 1993) and (White and Elson-Harris, 1992) include south Texas, USA in the distribution of *A. fraterculus*. However, the flies trapped occasionally in south Texas and identified as *A. fraterculus* are considered to be distinct from the *A. fraterculus* (South American fruit fly) found in Argentina and other South American countries (personal communication A. Norrbohm, R. L. Mangan). The fruit flies identified as *A. fraterculus* in South American do not occur in the United States. (Alata Condor, 1973; CAB International, 2002; Foote et al., 1993; White and Elson-Harris, 1992)

[17] At least two sources (Foote et al., 1993; White and Elson-Harris, 1992) include south Texas, USA in the distribution of *A. serpentina*. However, only adults of *A. serpentina* have been trapped in south Texas, and only as rare detections. (Foote et al., 1993) describe the situation as "*A. serpentina* seldom has been found in Texas since 1959". *A. serpentina* is known to be established in Mexico and recent (since 1959) rare detections of adult *A. serpentina* in south Texas are considered to have resulted from stray flying adults, not from established populations (personal communication A. Norrbohm, R. L. Mangan).

[18](Foote et al., 1993) included *A. striata* in their U.S. distribution "...by virtue of one U.S. collection in...Texas (it has not been seen there since 1959), one collection in... California, in 1963 and one in Los Angeles in 1989. These occurrences probably originated by infested fruit having been brought into the United States."

[19] See discussion in **Section 2.7 Quarantine Pests Selected for Further Analysis**

[20] (Norrbom and Kim, 1988) list only lab and questionable reports of *A. distincta* on citrus. Based on this evidence, it is estimated that this fruit fly species is not likely to be associated with commercial citrus for export (Miller, 2003a).

[21]Although *Coccus viridis* is reported to attack fruit (CAB International, 2002), it mainly attacks the leaves of its hosts (Dekle, 1976; Miller, 2003b)(**Appendix 5**). Since 1985, *C. viridis* has been intercepted a total of 10,252 times, of which only 170 of those interceptions were on fruit; and it has been intercepted 1,249 times on citrus, of which only 55 of those interceptions were on fruit and only 6 on fruit in cargo (PIN309, 2003). Based on this evidence, it is estimated that the commercial processing and culling of the citrus fruit should eliminate this pest from the pathway (Miller, 2003b).

[22]Although *Argyrotaenia sphaleropa* is reported to attack fruit (Manfredi-Coimbra et al., 2001; Bentancourt, 1988), it only attacks citrus during fruit set, causing premature fruit drop (Salazar Torres, 1999; Carbonell Torres, 2003) (**Appendix 5**). It is, therefore, not a problem on fruit at harvest.

[23]The primary records of *Anastrepha striata* on citrus are questionable, and, therefore, this fruit fly probably does not attack citrus (Norrbom, 2003). Based on this evidence, it is estimated that this fruit fly species is not likely to be associated with commercial citrus for export (Hennessey, 2003).

Appendix 5. Site Visit Report

APHIS Site Visit of Citrus Growing Areas Proposed for Citrus Exports from Peru, June 9-13, 2003
Notes by L. Millar for Trip Report

Contents

APHIS Technical Team

Dr. Edward Podleckis, APHIS-PPQ Policy, Planning and Critical Issues
Ms. Leah Millar, APHIS-PPQ Center for Plant Health Science and Technology
Mr. Lou Vanechanos, APHIS International Services
Ms. Annabella Reszczynski, APHIS International Services

Objectives of the site visit

1. Review production groves representing the different export regions of Peru with respect to climate/topography, agricultural practices, and size.

2. Review packing houses that illustrate the typical methods used in the different proposed export regions.

3. Visit SENASA facilities where the technical team can meet with officials responsible for conducting the citrus disease and fruit fly surveys.

Site Visit Itinerary

Monday, June 9 (5:30am-9pm)

- Flight from Lima to Chiclayo, Department of Lambayeque
- Cultural excursion: brief visit of Museo de Sitio Túcume, Dirección Departmental de Cultura, Lambayeque
- Visit citrus orchards in the Department of Lambayeque (citrus production Zone II), in Northwestern Peru:
    1. La Vina orchard (owner Roberto Puga Castro)
       Zone: La Vina-Jayanca; citrus crops: key limes (5 years old); other crops: mango; not exporting now, but want to export key lime.
    2. Iturregui orchard (owner Julio Sabala)
       Zone: Anchovira-Motupe; citrus crops: Washington navel orange; other crops: mango
    3. Palo Blanco orchard (owner Jaime Berrios)

Zone: Palo Blanco-Motupe; citrus crops: key lime, Minneola tangelo, mandarin (Dancy), sweet lima; other crops: mango

- Visit of SENASA area office in Motupe, Department of Lambayeque. The three primary activities of this office are: 1) Fruit fly detection, 2) Integrated Pest Management, and 3) Training of farmers.
- Travel to hotel in Piura

Tuesday, June 10 (7:30am-10pm)

- Visit citrus orchards in the Department of Piura (citrus production Zone I) in Northwestern Peru:
  1. Agrocurumuy orchard (owner Explotacion Agricola Curumuy)
     Zone: Curumuy-Piura; citrus crops: key lime, Tahitian lime; other crops: avocado
  2. Tungasuca orchard (owner Emilio Hilbck)
     Zone: Curumuy-Piura; citrus crop: key lime; other crops: mango, papaya.
  3. El Refugio orchard (owner Limago)
     Zone: Chalacala Alta-Sullana; citrus crop: key lime; other crops: mango
- Visit citrus packing houses in Sullana, Department of Piura:
  1. Frutopia
  2. Incochira
- Flight from Piura back to Lima

Wednesday, June 11 (7am-7pm)

- Visit citrus orchards in the Department of Lima (citrus production Zone III), north of Lima:
  1. Agricola Ganadero El Chico orchard (owner Rafael Bellido)
     Zone: Santa Rosa-Huaura; citrus crop: Washington navel orange; other crop: avocado
  2. Duna Corp orchard (owner Bruno Carlini)
     Zone: Santa Rosa-Huaura; citrus crops: tangelo, Satsuma mandarin; other crop: avocado
  3. El Paraiso orchard (owner: Miguel León Inurritegui)
     Zone: Santa Rosa-Huaura; citrus crops: Satsuma mandarin, Minneola tangelo, malvasio mandarin, Washington navel orange; non citrus crop: avocado
- Visit one packing house, Agrihusa, in Huaral, Department of Lima

Thursday, June 12 (8am-6pm)

- Visit one packing house and two orchards in the Department of Lima (citrus production Zone III), south of Lima:
  1. EMAPAC packing house, Zone: Canete
  2. Don Alfonso orchard (owner Alfonso Pescheira)
     Zone: San Luis-Canete; citrus orchards: mandarins (Satsuma, Kara, Murcott, Malvasio); other crop: avocado
  3. Ramos orchard (owner Raúl Ramos)
     Zone: Hualcara-Canete; citrus crops: mandarins (Satsuma, Kara, Murcott)

Friday, June 13 (9am-7pm)

- Presentations given by SENASA personnel at the SENASA central office in La Molina, Lima.

1. National fruit fly program (by Rafael Guillen Encinas, Director, Programa Nacional de Mosca de la Fruta)
2. Citrus disease survey (by Cecilia Lévano Stella, for Ricardo Mont)

- Question/Answer session with SENASA personnel
- Visit of the SENASA facilities in La Molina, Lima
- Closing meeting

People present at all or part of the orchard and packing house visits included:

- Ing. Alicia de la Rosa Brachowicz, Directora General de Sanidad Vegetal
- Ing. Cecilia Lévano Stella, Especialista en Sanidad Vegetal, Dirección de Vigilencia Fitosanitaria, SENASA
- Ing. Vilma Gutarra Garcia, Especialista, Dirección de Defensa Fitosanitaria, SENASA
- Rafael Guillen Encinas, Director del Programa Nacional de Mosca de la Fruta, SENASA
- Blgo. Francisco Luis Palomino Palomino, Especialista, Dirección de Defensa Fitosantaria
- SENASA personnel from Lambayeque, Piura, and Lima area offices as well as other SENASA personnel from the SENASA central office
- Miguel León Inurritegui, Presidente, ProCitrus (Asociación de Productores de Citricos del Perú)
- Renzo Carlini Chiappe, Director, ProCitrus (Asociación de Productores de Citricos del Perú)

People present at the meetings and visit of SENASA facilities on Friday, June 13 included:

- Ing. Alicia de la Rosa Brachowicz, Directora General de Sanidad Vegetal
- Ing. Cecilia Lévano Stella, Especialista en Sanidad Vegetal, Dirección de Vigilencia Fitosanitaria, SENASA
- Ing. Vilma Gutarra Garcia, Especialista, Dirección de Defensa Fitosanitaria, SENASA
- Rafael Guillen Encinas, Director del Programa Nacional de Mosca de la Fruta, SENASA
- Blgo. Francisco Luis Palomino Palomino, Especialista, Dirección de Defensa Fitosantaria
- Ing. Johny Naccha Oyola, Director de Vigilancia Fitosanitaria
- Jorge Barrenechea Cabrera, Director de Defensa Fitosanitaria
- Miguel León Inurritegui, Presidente, ProCitrus (Asociación de Productores de Citricos del Perú)

Site Visit Findings

Orchards:

- Department of Lambayeque:
    - La Vina was very clean with little weeds. This orchard does not export currently but wants to export key limes.
    - Iturregui was an older orchard and not as well kept (lot of weeds, old fruit on ground, more fruit damage, etc.) as La Vina. This orchard is trying to encourage the conservation of natural and released natural enemies. It does not export at this time.
    - Palo Blanco is a 34 year old orchard. Parts of the orchard were very weedy. Citrus tristeza virus was observed. This orchard is not exporting and is not interested in exporting.
- Department of Piura:
    - Agrocurumuy is in the process of getting certified by SENASA as an organic farm (only biocontrol used against crop pests). The orchard was very clean. They do not export currently but will

possibly export next year. Currently there are 19 hectares of key lime, 1 hectare of Tahitian lime. They project to plant 50 hectares of key lime in 2004-2005.
    - Tungasuca orchard has been exporting mango (with hot water treatment) to the US since 1991. The other crops (key lime, papaya) are only for local markets. Currently there are 60 hectares of mango, 20 hectares of avocado, 25 hectares of key lime, and 6 hectares of papaya.
    - El Refugio orchard is an old farm with 100 hectares of key lime and 35 hectares of mango. Orchard was very clean. It is currently exporting mango and key lime. Some wind and mite damage on fruit noted. We observed an open air packing house for fruit going to local markets.
- Department of Lima:
    - The citrus growing valleys along the coast in the Department of Lima are surrounded by barren, desert hills, which act as natural barriers to fruit flies.
    - Agricola Ganadero El Chico orchard has 19 hectares of 6-8 year old Washington navel orange trees. This farm does not currently export, but will try to export next year. Better pest control will be implemented in order to meet quality requirements for export.
    - Duna Corp orchard is an 8 year old farm with 100 hectares of citrus. This farm currently exports to Europe, Canada, and some South American countries (e.g., Venezuela, Colombia). Water for irrigation is brought via canal from a river 30 km away. The orchard was very clean and the phytosanitary condition of the fruit appeared better than that of the Agricola Ganadero El Chico orchard.
    - El Paraiso orchard exports tangelos and Satsuma mandarin. We visited one of the Washington navel orange groves, which are currently only for local markets. The ground was relatively clean of fallen fruit and weeds, but there were some problems with whiteflies and sooty mold.
    - Don Alfonso orchard exports citrus to other South American countries. The age of the trees range from 1 to 16 years. It has a total of 52-53 hectares of citrus and 37 hectares of asparagus. The orchard was very clean.
    - Ramos orchard exports mandarins to Canada and Europe. The age of the trees range from 5 to 15 years old. Orchard was very clean, and foliage and fruit did not have much obvious damage.

Arthropod pests:

- The following arthropods were reported as pests of citrus (key lime and oranges) in the Department of Lambayeque: *Anastrepha* spp., *Ceratitis capitata*, *Phyllocnistis citrella* (citrus leaf miner), *Phyllocoptruta oleivora* (rust mite), *Pinnaspis strachani*, *Lepidosaphes beckii*, *Argyrotaenia sphaleropa*, whiteflies, mealybugs, and aphids. *Lepidosaphes beckii* is reported to be a problem only in oranges. *A. sphaleropa* is reported to be more of a problem in key limes, being only an occasional problem in oranges, and it tends to be more of a problem when there is high humidity.
- The following arthropods were reported as pests of citrus in the Department of Piura: *Anastrepha* spp., *Ceratitis capitata*, *Phyllocnistis citrella*, *Panonychus citri* (red mite), *Coccus viridis*, *Phyllocoptruta oleivora* (rust mite), *Pinnaspis strachani*, *Argyrotaenia sphaleropa*, whiteflies. *C. viridis* is only a minor problem, occurring mainly in July and August when the temperatures are cooler and attacking only the leaves and not the fruit or stems. *C. viridis* can cause sooty mold to develop. *A. sphaleropa* is not much of a problem in Piura, occurring only occasionally. Also, this tortricid is reported to not attack mature fruit, attacking the peduncle of only very young fruit, which causes the fruit to drop prematurally.
- The following arthropods were reported as pests of citrus in the Department of Lima: *Anastrepha* spp., *Ceratitis capitata*, *Aleurothrixus floccosus*, *Argyrotaenia sphaleropa*, *Chrysomphalus* sp., *Ceroplastes floridensis*, *Coccus hesperidium*, *Dialeurodes citri*, *Lepidosaphes beckii*, *Panonychus citri*, *Phyllocnistis citrella*, *Phyllocoptruta oleivora*, *Pinnaspis*, *Planococcus citri*, *Saissetia* sp., *Selenaspidus articulatus*,

aphids, mealybugs, thrips, whiteflies (*Aleurothrixus floccosus, Dialeurodes citri, Parabemisia myricae, Aleurodicus cocoas, Paraleyrodes sp.*), sooty mold (because of whiteflies). In the Santa Rosa Valley, *A. sphaleropa* is an occasional problem from fruit set (November) to January when the fruit is small and green. However, Miguel Leon (El Paraiso orchard) reported it to be a problem in one of his younger citrus groves, because this grove receives a lot of wind and, therefore, it is harder for the released *Trichogramma* parasitoids to be effective as biocontrol agents. In the Canete valley, *A. sphaleropa* is reported to be a big problem certain years, especially in oranges, up until the fruit start to change color, and it is reported to be difficult to control. This tortricid is an external feeder that attacks the peduncle and the very top of the fruit, causing the fruit to drop prematurely. In the Santa Rosa valley as well as the Canete valley, *Coccus viridis* is not reported as a problem, and *Pinnaspis* is reported as only a minor problem.

- Pests observed in orchards – aphids on leaves, mite damage on fruit, mealybugs on fruit, citrus leaf miner damage, whiteflies with associated sooty mold on leaves, *Pinnaspis* on fruit (mandarin) and leaves, *Lepidosaphes* on fruit, *Ceroplastes floridensis* on leaf.
- None of the citrus growers nor SENASA personnel have heard of *Ecdytolopha* sp. (or *Gymnandrosoma* sp.). In other words, this tortricid has not been reported on citrus in Peru. Vilma Gutarra Garcia, SENASA engineer, stated that the one report in the literature of *Ecdytolopha aurantiana* Peru (Escalente et al, 1981) was an error.

Mitigation measures against arthropod pests:

- Mitigation measures used against pests in the Department of Lambayeque include: sulfur for rust mites; light traps, release of parasitoids, and *Bacillus thuringiensis* bioinsecticide (when populations are high) for *A. sphaleropa*; pesticides used against scales and aphids; water and soap against whiteflies; release of *Ageniaspis* parasitoid against the citrus leaf miner.
- Mitigation measures used against pests in the Department of Piura include: wash with water and release of *Metaphycus* parasitoid against *Coccus viridis*; sulfur for red mite and citrus rust mite; wash and brush plus conservation of natural enemies (e.g., green lace wings, predatory beetles) (by not using insecticides) for *Pinnaspis strachani* and whiteflies; release of *Ageniaspis* parasitoid against the citrus leaf miner; release of *Trichogramma* parasitoids for *Argyrotaenia sphaleropa*.
- Mitigation measures used against pests in the Department of Lima include: release of *Ageniaspis* parasitoid against the citrus leaf miner; use of *Bacillus thuringiensis* and metomil insecticide and release of *Trichogramma* parasitoids against *Argyrotaenia sphaleropa*; natural control for aphids, whiteflies, and *Lepidosaphes* (e.g., *Cales noacki* parasitoid for whiteflies); chemical pesticides and liquid soap for mites. The Duna Corp orchard reported that they release *Trichogramma* for the control of *A. sphaleropa* 3 times during the year. In rare instances when the *Trichogramma* are released too late or in inadequate quantities, *Bacillus thuringiensis* bioinsecticide is also used to control this tortricid. The Don Alfonso orchard reported that *A. sphaleropa* is difficult to control. *Trichogramma* are released as soon as this pest appears, and, in extreme cases, night applications of metomil are made. Light traps and *Bacillus thuringiensis* applications have been tried in the past against this pest by this orchard but are no longer used.
- Fruit fly control:
  - Pilot Fruit Fly Free Areas include: Santa Rosa (Department of Lima), Olmos (Department of Lambayaque), Lanchas (Department of Ica), San Lorenzo (Department of Piura). We visited the Santa Rosa area, which includes 7,800 hectares of citrus and non-citrus hosts (including mango, *Inga*, guava). An Integrated Pest Management plan is being used for fruit fly eradication in these areas, with a focus on: chemical control with toxic baits applied to the foliage, mass trapping by use of homemade bottle traps hung in trees, and clean agricultural practices (e.g., picking up fruit on the ground). The bottle traps, which are constructed and put in place by the growers, consist of plastic bottles (e.g., Coke bottles) with holes on the sides and food attractant (water with ammonium

phosphate) in the bottom. These traps are left for 15 days at a time. The toxic bait insecticide is applied by SENASA personnel. Releases of sterile medflies have been made in some areas and are made when the mean number of fruit flies trapped per trap per day is at or below 0.005. Regulatory controls are also in place by SENASA to keep potentially infested host material from entering the pilot areas.

  - In areas where there is no official eradication program, there is no chemical control on a large scale by SENASA but only localized controls by the growers. In the Canete valley (Department of Lima), for example, the growers use the above mentioned homemade bottle traps and also large sticky traps with the hormone attractant Trimedlure for fruit fly control. The sticky traps can last 1-2 months in the field. The number of traps placed in the orchard is determined by each farmer. In one orchard visited, Don Alfonso, these traps are applied at a density of 300 sticky traps and 1000 bottle traps for 50 hectares. Toxic bait insecticide is also applied to trees susceptible to attack when there are increased fruit fly problems, mostly in the summer and early fall.

Fruit Fly Survey:

- Details of the national fruit fly survey program for *Ceratitis capitata* and *Anastrepha* spp. can be found (in English and in Spanish) in SENASA's online Manual of National System of Fruit Flies Detection (http://www.senasa.gob.pe/Moscas/manual%20deteccion%20ingles.pdf). This manual has very detailed descriptions with color diagrams of how the program is run, including information on: the biology of the fruit flies, determination of trap location, preparation of the traps, trap servicing, trap coding, processing fruit samples, etc. Information provided during the site visit included the following:
  - The density for each type of trap (Jackson and McPhail) is 1 trap per 20 hectares in host areas and 1 trap per 180 hectares in nonhost areas. A McPhail trap is placed in the center of each quadrant and a Jackson trap is placed on each corner of each quadrant. Placed in this fashion, the distance between two traps of the same type is 447 meters, and the distance between two different types of trap is 315m. In the Santa Rosa Valley (Department of Lima), for example, there are a total of 408 traps (200 McPhail and 208 Jackson). Traps are placed in host and non-host commercial orchards as well as small gardens located beside orchards, but they are not placed in urban areas. All the traps are geographically referenced using GPS.
  - Both types of trap (Jackson and McPhail) are serviced every 7 days. In the Canete valley, for example, there are 5 inspectors that cover 24,000 hectares with 667 total traps (367 Jackson, 300 McPhail). An inspector will service around 30 traps per day. SENASA inspectors demonstrated and explained the procedure they use for servicing both types of traps. For McPhail: The lid is taken off the trap and the water+bait solution poured through a funnel. All the insect specimens are caught on a screen and then transferred with forceps into a bottle with 70% alcohol. The sediments in the bottom of the trap are rinsed out, and the trap is refilled with 250cc of fresh bait solution. The used bait solution is taken back to the lab to be discarded. For Jackson: The sticky trap is taken out of the trap, folded, and signed with the date. The cardboard triangle is cleaned with a dry cloth and is signed by the inspector with his name and the date serviced. A new sticky trap, on which the trap code and date are written, is signed and placed into the triangle. The traps (both types) are not relocated to a new tree after each inspection but instead stay in the exact same georeferenced location. The SENASA inspector records information for each trap serviced in a chart (e.g., fruit flies detected in trap, presence of fruit on trees, condition of orchard, hosts present, # days since trap last serviced, etc.). Insect specimens are taken to the area SENASA office for identification. If identification cannot be made by the area office, the specimens are then sent to the national fruit fly taxonomy lab in Lima. The information collected from the trap survey is entered into a database and submitted to the SENASA headquarters in Lima.

- Samples of fruit are collected as well for the detection of fruit flies. Fruit samples are taken at the same time as when traps are inspected. The number of fruit collected per trap varies and depends on the host (i.e., the risk of the host), the fruit phenology, the number of fruit flies being trapped, and the number of trees present. Usually each fruit sample represents approximately 1-2 kg. Using each trap as a reference, the most damaged fruit are collected from both trees and off the ground at approximately 40-60 meters from the McPhail traps and 100-120 meters from the Jackson traps. The fruit in one sample can come from different hosts. The same code used for the trap is used to identify each fruit sample collected. The SENASA inspector records information for each fruit sample collected in a chart (e.g., presence of fruit on trees, condition of orchard, hosts present, # days since trap last serviced, etc.). The fruit are then taken back to the area SENASA office for dissection, and any fruit fly larvae collected from the fruit are reared to the adult stage for identification. According to information presented by Rafael Guillen Encinas (Director del Programa Nacional de Mosca de la Fruta, SENASA), the fruit fly % infestation of citrus fruit depends on the host and the geographical area. The ranges of % infestation rates for 2002 were the following in the Pilot Fruit Fly Free Areas: 0.01% in Chira to 0.56% in Canete for Naranja orange (*Citrus sinensis*), 0.04% in San Lorenzo and Motupe to 0.42% in Chancay-Huaral for mandarins, and 0.012% in Chira to 0.16% Chicha for tangelo. These infestation rates are for damaged fruit only.
- A "visit sheet" is provided by SENASA to the farmer with the total number and identification of the fruit flies trapped/detected along with recommendations as to what type and amount of mitigation measures are needed.
- For each survey area, color coded maps are produced each week showing the number of *Ceratitis capitata* and *Anastrepha* sp. fruit flies trapped in each trap. SENASA personnel showed us the most up-to-date version of these maps for the different areas during the orchard visits.
- Other information collected during orchard visits:
    - Department of Lambayeque: The weekly mean number of captures per trap per day (MTD) was reported to be 0.054 for *C. capitata* and 0.4 for *Anastrepha* sp. for the Motupe Valley. Fruit flies have not been trapped in key lime orchards. Grapefruit is the only citrus fruit in which fruit flies (*Anastrepha* sp. only) have been recovered. Fruit flies have been recovered from other fruit, however (e.g., *Anastrepha* sp. in mango). We looked at one McPhail trap in a key lime tree at the La Vina orchard, in which 2 tephritid flies were identified by the SENASA personnel. The tree was flagged with a large yellow label (with the trap code written upon it) in order to facilitate the location of the trap. We looked at one McPhail trap in navel orange in the Iturregui orchard. One medfly was identified by SENASA personnel.
    - Department of Piura: Fruit flies have never been found in fruit samples in 10 years of sampling, and they have never been found in traps located in key lime orchards. We looked at one Jackson trap and one McPhail trap in the Agrocurumuy orchard (Piura), both of which were empty.
    - Department of Lima: In the Canete valley, the weekly MTD was reported to be 0.8 for McPhail traps (0.3 for *Anastrepha*, 0.5 for *Ceratitis capitata*) and 0.6 for Jackson traps. In this valley, medflies have been detected in both type of traps in citrus and in citrus fruit, and *Anastrepha* (*A. fraterculus* and *A. distincta*) have been found in mango and loquat but not citrus (including traps and fruit samples). Detections in this valley have been more numerous in small gardens/fields compared to commercial orchards (for both traps and fruit samples). In the Santa Rosa Valley (Department of Lima), the MTD is 0.04 for *Ceratitis capitata* and 0.001 for *Anastrepha* (*A. frateruculus* and *A. distincta*). We looked at one McPhail trap and one Jackson trap in a Washington navel orange grove in the Agricola

Ganadero El Chico orchard, one McPhail in the El Paraiso orchard, and one Jackson on the Ramos orchard. No fruit flies were present in these traps.

- Based on a presentation given by Rafael Guillen Encinas (Director del Programa Nacional de Mosca de la Fruta, SENASA), the highest monthly mean number of captures per trap per day (MTD) in 2003 (through May) for the pilot Fruit Fly Free Areas are the following:
  - *Anastrepha* spp: ~0.06% in Santa Rosa, ~0.085% in Olmos, 0% in Lanchas, ~0.325% in San Lorenzo.
  - *Ceratitis capitata*: ~0.1% in Santa Rosa, ~0.03% in Olmos, ~0.14% in Lanchas, and ~0.325% in San Lorenzo.
- The selection of the SENASA survey inspectors is based on a certain amount of agricultural and technical knowledge. Their training consists of learning theory and getting practical field experience with more experienced inspectors. It takes about 1-2 months for an inspector to become fully trained and ready to conduct inspections on their own. All inspectors then receive training on a continual basis after the initial training.
- Fruit fly identifications are carried out using morphology. SENASA has a very rigorous training and certification program for the fruit fly identifiers. Training is provided for each fruit fly species, and the identifiers receive a certificate giving them authorization to identify only those fruit flies for which they have received training and have successfully passed an examination. The certificates are only valid for one year, after which the identifiers have to receive additional training and examination.

Packing Houses

- **General:**
  - In order to export, both packing houses and orchards have to be certified for export by SENASA. Specific requirements (e.g., double-door entrance at the packing house, % infestation by specific pests of post-harvest fruit) are determined by an agreement with the importing country.
  - There are two types of criteria that can cause the rejection of a lot of fruit during the packing process: 1) the packing house's criteria, and 2) SENASA's criteria, which are determined by agreements with the importing countries.
  - A SENASA inspector conducts a quality control on 1-2% of the boxes for each grower at the end of the packing process. The fruit is rejected if pest infestation levels go above a certain predetermined amount. The inspector is also present throughout the entire packing process, during which he/she looks for all kinds of pests and pest damage. They will dissect fruit that looks suspicious of fruit fly infestation. Fruit that has been rejected during the culling process are not inspected, however. The SENASA inspector will stay at the packing house up until 6pm each day. If fruit is still being packed after 6pm, the inspector will finish the inspections the following day.
- **Frutopia** (Sullana, Piura department)**:** This packing house exports key limes to Chile and mangoes to Europe. It was not in function at the time we visited, but the manager gave us a detailed description of the packing process: Trucks with boxes/bags of fruit enter into a screened area. The fruit go through an initial manual inspection for skin damage (e.g., mite damage, bruising, yellowing, streaks, punctures from thorns). Damaged fruit are culled. Fruit are then passed through a high volume wash with fungicide and water, brushed, dried, and waxed. Fruit are then selected for size using a semi-automatic system, followed by two more manual inspections for damage. The fruit are packed in 10kg boxes. A SENASA inspector then conducts a quality control on 1-2% of the boxes before they are loaded onto the trucks. The boxes of fruit are loaded into a truck in a screened area.
- **Incochira** (Sullana, Piura Department): This packing house exports key lime mainly to Chile and a very small amount to Europe. Again, the packing house was not in function, but the manager gave a description

of the packing process: Trucks with fruit from the field enter into an open air area (is not screened). The fruit enter into the packing house through a small door with a plastic flap door. Personnel enter through a double door entrance. The fruit go through an initial manual inspection and culling on a moving ramp. The fruit are then passed through a high volume wash with water and chloride, brushed, dried, waxed, and then dried at 45 degrees C. The fruit are then placed in plastic crates and kept in cold storage, after which they are placed in shipping boxes. When the boxes of fruit are loaded into a truck, the back of the truck is enclosed inside the building. This packing house was very small, and its fruit inspection process (for pests, plus pest and other damage) did not appear to be as thorough as that at the other packing houses visited.

- **Agrihusa** (Huaral, Department of Lima): This packing house is certified for export by SENASA and currently exports mandarins, tangelos, and avocado to Canada and Europe. This packing house was larger and more modern than the ones visited the day before. Again, the packing house was not in function, but the manager gave a description of the packing process: Trucks with fruit from the field enter into an open air area (is not screened). The fruit first pass through a chlorine (100ppm) and 2,4-D (to preserve the calyx) rinse. The fruit are then held in cold storage (19-21 degrees C; 91-95% humidity) for degreening. The fruit then go through a first inspection for damage and size followed by a high volume fungicide wash. The fruit are then brushed, dried, waxed, dried again at 45 degrees C, and then inspected a second time for damage and quality. The fruit are then selected for size using a semi-automatic system and then packed in 15kg boxes. A SENASA inspector then conducts a quality control on 1-2% of the boxes for each grower. One of the main things the SENASA inspector looks for is thrips damage. The trips damage is probably caused by *Heliothrips haemorrhoidalis*.
- **EMAPAC** (Canete, Department of Lima): This packing house receives fruit from growers in the provinces of Chincha (Dept. of Ica), Ica (Dept. of Ica), Canete (Dept. of Lima), and Huaral (Dept. of Lima), and it exports to Canada and Europe. It processes mandarins, oranges, and Hass avocado. It has only been working for 6 months and is about the same size and quality as the Agrihusa packing house. Mandarins were being processed during our visit. All workers were wearing lab coats and hair nets. Fruit from the field arrive by truck to an open air area with no screen. An initial quality control of a certain number of fruit is performed and a form is filled out indicating any problems with the fruit (e.g., color), how fruit were transported (e.g., cleanliness), etc. This form is then given to the farmer and is used in order to push the farmers to produce better fruit. The fruit are then washed one pallet at a time in a large drencher with a solution of water and Cercobin fungicide. Up to 18 pallets are washed with 1000 liters of solution and then the solution is changed. The fruit is then passed through a degreening chamber for a certain number of days depending on the fruit, after which the fruit is held for approximately 12 hours at ambient temperature and under fans for drying. The fruit are subsequently passed through a water and chlorine (200ppm) bath, passed through a high volume wash with OPP fungicide and water (200cc OPP: 45 liters water), brushed, rinsed, dried, waxed (1.0-1.2 liters/ton of fruit; using CITROSOL UE wax for export fruit), dried (50 or 55 degrees C depending on air temperature). The OPP fungicide is changed after every 18 tons of fruit, which equals approximately every 2.3 hours. The wax contains a fungicide as well. The fruit then go through a manual inspection and culling on a moving ramp, size selection using a semi-automatic system, and packaging into plastic crates (which are cleaned after each use and are reused only in the packing house). The plastic crates are labeled with the following information: grower, size of fruit, if came directly from the field, date, variety, etc. The crates are taken into an enclosed building where the fruit are inspected and culled followed by packing into 10 or 15 kg cardboard boxes. Fruit are culled out based on criteria provided by the importing country [e.g., diseases, color defects, pest and other damage (e.g., thrips damage, pitting)]. The main pests and pest damage found during the final SENASA quality control at this packing house were reported to be: thrips damage, scale damage, and the scales *Lepidosaphes beckii* and *Selenaspidus articulatus*. No hitchhikers have been found. The inspector at this packing house stated that no more than 1-2 fruit per box are found to be infested with one or more scales. The packing house had

several posters up on bulletin boards of pictures of damage and pests for which the cullers and SENASA inspectors should be inspecting.

SENASA Facilities in La Molina, Lima

These facilities are very new (opened November 2002) and modern. We visited the entomology, weed, nematology, phytopathology, bacteriology, and virology labs of the phytosantary diagnostics center (Centro de Diagnotico de Sanidad Vegetal). The entomology lab contains a quarantine facility, which is still in the implementation stage and, therefore, not yet in use. We also visited the greenhouses (not yet in use), the rearing facility for *Anastrepha fraterculus*, the fruit fly taxonomy lab, and the sterile fruit fly production center (Centro de Producción de Moscas de la Fruta Estériles). The sterile fruit fly production center is used to produce sterile *Ceratitis capitata* adult males. It uses the TSL (Thermal Sensitive Lethal) genetic sexing strain Vienna-8. In the mass production process, the eggs are heat treated at 34 degrees C for one day, which kills all the female eggs. Therefore, only males are mass produced. The center can produce 160 million fruit flies per week. The pupae are painted with florescent paint (in order to identify the sterile fruit flies in the field) and placed into tubular 2.5 liter plastic bags. The pupae are then sterilized with gamma rays. 40 million sterile fruit flies can be produced per hour.

Conclusions:

- The site visit confirmed first hand the observations and assumptions made in the risk analysis. No new diseases or arthropod pests were discovered.
- Although there is some variability between the orchards visited, in general they are well managed. Also, in general, the packing houses have good systems in place that decrease substantially the risk of pests being in the pathway, including: high volume washes with fungicides, brushing, multiple inspections by the packing house cullers as well as SENASA personnel, and protection of fruit from hitchhikers at the end of the process.
- SENASA's fruit fly survey, disease surveys, and system of certification and inspection of orchards and packing houses for export are very thorough and very well implemented.
- SENASA was asked to review the draft pest risk analysis as soon as possible. In particular, they were asked to review the figures for predicted export volumes presented in the document.
- The following additions/changes should be made to the pest risk analysis:
    - If the absence of *Ecdytolopha aurantiana* in Peru is confirmed, this pest will be taken out of the assessment.
    - The following information on the biology of *Argyrotaenia sphaleropa* should be added to the analysis: this tortricid attacks only young citrus fruit, and it is an external feeder attacking the peduncle and the very top of fruit and causing the fruit to drop prematurely. It is, therefore, not a problem on fruit at harvest. This information is additional evidence for the low likelihood of this pest being in the pathway.
- The following recommendations will be added to the risk mitigation section of the pest risk analysis and/or the operational workplan, if the importation is approved:
    - Attention should be focused on assuring the absence of mealybug infested fruit, as presence of immature mealybugs that cannot be identified to species can result in the fruit requiring treatment at U.S. ports of entry.
    - Fruit should be required to originate from groves registered for export with SENASA.
    - Key limes should not require cold treatment, as key lime is not considered a fruit fly host.
- The expected timeline is the following:
    1. Internal review of the pest risk analysis completed by the end of June.
    2. Comments from the internal review plus those from SENASA incorporated.

3. The final draft will then undergo an external review. This entails publishing the draft on the internet and allowing a 60-day comment period.
4. Final risk analysis completed.
5. Proposed rule published probably in the 15th periodic amendment, the submissions for which close the end of December.
6. Once the final rule is made, the permit becomes effective 30 days after publishing

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References

Escalante G J, Del Castillo A M and Ochoa O 1981 Catalogo preliminar de las plagas insectiles de papas, maiz y frutales en el departamento del Cusco, Peru. *Revista peruana Entomologia* 24: 87-90.

5. Literature Cited

1UpInfo. 1992. Country Study Guide- Peru [Web Page]. *Last accessed 2003 Apr 22*. Available at: http://www.1upinfo.com/country-guide-study/peru/.

Abbot, E. V. 1931. Enfermedades de las plantas en el Peru. Boletin De La Direccion De Agricultura y Ganaderia. 1(1):54-58.

Adamski, D. and Brown, J. W. 2001. Systematic revision of the Ecdytolopha group of genera (Lepidoptera: Tortricidae: Grapholitini) in the New World. Entomologica Scandinavica/Insect Systematics and Evolution. Supplement No. 58:1-86.

Aguilar F., P. G. 1980. Apuntes sobre el control biologico y el control integrado de las plagas agricolas en el Peru. Revista Peruana De Entomologia. 23(1):83-110.

Aguilar, F. P. G. 1982. El control biologico y el control integrado de las plagas agricolas en el Peru. Zoologia Neotropical. Actas Del VIII Congreso Latinoamericano De Zoologia. 1982:293-296.

Alata Condor, J. 1973. Lista de insectos y otros animales daninos a la agricultura en el Peru. Manual No. 38.La Molina, Peru: Ministerio de Agricultura, Direccion General de Investigacion Agraria

Alfieri, S. A.; Langdon, K. R.; Kimbrough, J. W.; El-Gholl, N. E., and Wehlburg, C. 1993. Diseases and disorders of Plants in Florida. Gainesville, Florida: Florida Department of Agriculture and Consumer Services, Division of Plant Industry; Bulletin No. 14. x + 1114.

Alkemade, J. R. M. and Loof, P. A. A. 1990. The genus *Xiphinema* Cobb, 1913 (Nematodo: Longidoridae) in Peru. Revue Nematol. 13(3):339-348.

Aluja, M. 1994. Bionomics and management of Anastrepha. Annual Review of Entomology. 39:155-178.

Anonymous. 1966. La Mosca del Mediterraneo en Chile. Boletin Tecnico No. 20. Santiago, Chile: Ministerio de Agricultura.

---. 2000. Tecnologia contra o bicho-furao. Rev. Fundecitrus. 96(8-10).

---. 2002. 2002 Insect Pest Management Guide.Baton Rouge, LA: Cooperative Extension Service, LSU Agricultural Center

Anonymous. 2003. Family: Arctiidae (Tiger Moths): http://140.247.119.145/EB/Field%20guides/FieldGuidesDone/Lepidoptera/pdfs/Arctiidae.pdf [Web Page]. *Last accessed 2003 Feb 24*.

APHIS. 2003. Spanish Clementine Data Report and Analysis, 2002-2003 Season [Web Page]. *Last accessed 2003 Jun 1*. Available at: http://www.aphis.usda.gov/lpa/issues/clementine/clementine_data.pdf.

Arnett, R. H. Jr.; Thomas, M. C.; Skelley, P. E., and Frank, J. H. 2002. American Beetles Volume 2 Polyphaga: Scarabaeoidea through Curculionionoidea: CRC Press. xiv + 861 pp.

BackyardGardner.com. Map of South America, Central America, and the Caribbean with USDA plant hardiness zones indicated (http://www.backyardgardener.com/zone/sazone.html) (last accessed: March 7, 2003). 2003.

Baker, A. C.; Stone, W. E., and Plummer, C. C. 1944. A review of studies on the Mexican fruitfly and related Mexican species. United States Department of Agriculture Miscellaneous Publication. 531:1-155.

Baker, E. W. 1945. Studies on the Mexican fruit fly known as *Anastrepha fraterculus*. Journal of Economic Entomology. 38(1):95-100.

Baker, G. S. 1962. The cytotaxonomy of the larvae of some Mexican fruit flies in the genus Anastrepha (Tephritidae, Diptera). Psyche. 69:87-101.

Bar-Joseph, M. and Lee, R. F. 1989. Citrus tristeza virus. AAB Descriptions of Plant Viruses, No. 353.Wellesbourne, Warwick, UK: : Association of Applied Biologists

Bazan de Segura, C. 1972. Los citricos y sus principales problemas fitopatologicos en el Peru. Proceedings of the Tropical Region, American Society for Horticultural Science. 16:77-92.

Becker, V. 2003. Letter To: Email (March 27, 2003 from Dr. Vitor Becker Entomologist Brazil to Leah Millar Entomologist USDA-APHIS-PPQ that all *Inga* species he has studied or received are leaf feeders leaf tiers or leaf rollers.

Beingolea, G. 1971a. Contribucion al conocimiento de los ortezidos del Peru- - II. Biologia: desarrollo y reproduccion. Revista Peruana De Entomologia. 14:33-40.

---. 1971b. Contribucion al conocimiento de los ortezidos del Peru - IV. Control fisico, quimico, cultural e integrado. Revista Peruana De Entomologia. 14:52-55.

---. 1973. Current estimation of the losses caused by pests to agriculture in Peru. Boletin Sociedad Entomologica Del Peru. 7(1):3-11.

Beingolea, O.; Salazar, J., and Murat, I. 1969. The Rehabilitation of a Citrus-D Orchard as an Example of the Feasibility of the Application of an Integrated Control System for Citrus-D Pests in Peru. Revista Peruana De Entomologia Agricola. 12(1):3-45.

Ben-Dov, Y. 1994. [A Systematic Catalogue of the Soft Scale Insects of the World (Homoptera: Coccoidea: Coccidae) With Data on Geographical Distribution, Host Plants, Biology and Economic Importance]. Gainesville, FL: Sandhill Crane Press, Inc.

Bentancourt, C. M. 1988. Observations on the biology of Argyrotaenia sphaleropa (Meyrick 1909) (Lepidoptera, Tortricidae) in the southern region of Uruguay. Boletin De Investigacion (Universidad De La Republica (Uruguay). Facultad De Agronomia. No. 13:12 p.

Bentancourt, C. M. and Scatoni, I. B. 1986. Biology of *Argirotaenia sphaleropa* Meyrick (1909) (Lep., Tortricidae) under laboratory conditions. Revista Brasileira De Biologia. 46(1):209-216.

---. 1989. Lepidoptera of economic importance in Uruguay (identification and biology of agricultural and forest pests and the damage caused by them). Part I - Tortricidae. Notas Tecnicas Facultad De Agronomia, Universidad De La Republica, Montevideo. No. 7:57 pp.

Bento, J. M. S.; Parra, J. R. P.; Vilela, E. F.; Walder, J. M., and Leal, W. S. 2001. Sexual behavior and diel activity of citrus fruit borer Ecdytolopha aurantiana. Journal of Chemical Ecology. 27(10):2053-2065.

Blackman, R. L. and Eastop V. F. 2000. Aphids on the World's Crops: An Identification and Information Guide.Second ed. West Sussex, U.K.: John Wiley and Sons. p. 466 pp.

Blackwelder, R. E. 1956. Checklist of the coleopterous insects of Mexico, Central America, The West Indes, and South America; Bulletin No. 185, Parts 1-6. Smithsonian Institution:1492 pp.

Blanco, H.; Watt, A., and Cosens, D. 1993. Life cycle and oviposition behaviour of the macadamia nut borer Ecdytolopha torticornis (Lepidoptera: Tortricidae). Manejo Integrado De Plagas(29):36-36.

Borge, M. N. R. and Basedow, T. 1997. A survey on the occurrence and flight periods of fruit fly species (Diptera: Tephritidae) in a fruit growing area in southwest Nicaragua, 1994/95. Bulletin of Entomological Research. 87(4):405-412.

Borrer, D. J.; Triplehorn, C. A., and Johnson, N. F. 1989. [An Introduction to the Study of Insects 6th Edition].: Harcourt Brace College Publishers. xiv + 875 pp.

Borrer, D. J. and White, R. E. 1970. [A field guide to insects: America north of Mexico]. New York: Houghton Mifflin Company(Company, Houghton Mifflin.

Bradbury, J. F. 1986. [Guide to plant pathogenic bacteria].: Farnham Royal, Slough : CAB International. xviii, 332 p.

Brown, G. E. and Schubert T. S. 1987. Use of *Xanthomonas campestris* pv. *vesicatoria* to evaluate surface disinfectants for canker quarantine treatment of citrus fruit. Plant Disease. 71:319-323.

Browning, H. W.; Childers, C. C.; Stansly, P. A., and Peña, J. 2002. 2003 Florida Citrus Pest Management Guide: Soft-bodied Insects Attacking Foliage and Fruit.Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences

Browning, H. W.; Stansly, P. A., and Peña, J. 2001. 2002 Florida Citrus Pest Management Guide: Citrus Leafminer.Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences

C.I.E. 1958. Distribution Maps of Insect Pests, Series A, Map No. 88. *Anastrepha fraterculus*.London: Commonwealth Institute of Entomology. p. 2 pp.

---. 1961. Distribution Maps of Plant Pests, Map No. 131. *Toxoptera aurantii*.London: CAB International Institute of Entomology. p. 2 pp.

---. 1962a. Distribution Maps of Plant Pests, Map No. 146. *Lepidosaphes gloverii*.Wallingford, UK: CAB International

---. 1962b. Distribution Maps of Plant Pests, Map No. 149. *Unaspis citri*.London: CAB International Institute of Entomology

---. 1973. Distribution Maps of Plant Pests, Map No. 24. *Saissetia oleae*.Wallingford, UK: CAB International Institute of Entomology. p. 2 pp.

---. 1977. Distribution Maps of Plant Pests, Map No. 369. *Pinnaspis aspidistrae* (Sign.) (Homoptera: Diaspidae).Wallingford, UK: CAB International

---. 1986. Distribution Maps of Plant Pests, Map No. 191. *Polyphagotarsonemus latus*.Wallingford, UK: CAB International

---. 1988. Distribution Maps of Plant Pests, Map No. 90. *Anastrepha obliqua*.London: CAB International Institute of Entomology. p. 2 pp.

C.M.I. 1985. [Distribution Maps of Plant Diseases, Map No. 561, *Botryodiplodia theobromae* Pat.]. Wallingford, UK: CAB International. 3 pp.

CAB International. 2000. Crop Protection Compendium.Second Edition ed. Wallingford, UK: CAB International

---. 2001. Crop Protection Compendium. Wallingford, Oxon, UK: CAB International.

---. 2002. Crop Protection Compendium. Wallingford, Oxon, UK: CAB International.

Carbonell Torres, E. 1999. (Ministerio de Agricultura, Servicio Nacional de Sanidad Agraria, Peru). Letter To: Don Wimmer, Area Director USDA APHIS IS Lima Peru. Letter dated October 12, 1999, Carta No. 2904-99-AG-SENASA, Pests of citrus in Peru. Reprint: In File

---. 2002. (Head, Servicio Nacional de Sanidad Agrario, Peru). Letter To: Lou Vanechanos, Area Director APHIS IS Santiago Chile. Lima, Peru; Letter No. 0382-2002-AG-SENASA, February 12, 2002, Additional informationfor pest risk assessment for exportation of Peruvian fresh citrus fruit to the U.S.A.

---. 2003. (Ministerio de Agricultura, Servicio Nacional de Sanidad Agraria, Peru). Letter To: Cathleen Enright, Acting Assistant Deputy Administrator PIM-PPQ. Letter dated July 24, 2003, SENASA's comments on the draft PRA: Importation of fresh citrus fruits from Peru into the United States (June-2003).
Reprint: In file

Cargo Systems. 2001. Container Brokers-Sales & Leasing [Web Page]. *Last accessed 2002 Aug 5*. Available at: www.cargosystems.net/equipment/sales_leasing.html.

Cavey, J. 2002. Letter To: Leah Millar. Email (May 20, 2002) from Joe Cavey, Entomologist, USDA-APHIS-PPQ to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming that *Phyllocnistis citrella* is an actionable pest in USDA Catalog of Intercepted Pests.

Childers, C.; Kitajima, E.; Welbourn, W.; Rivera, C., and Ochoa, R. 2001. Brevipalpus mites on citrus and their status as vectors of citrus leprosis. Manejo Integrado De Plagas (Costa Rica). 60:66-70.

---. *Brevipalpus* mites on citrus and their status as vectors of Citrus Leprosis, http://www.nps.ars.usda.gov/publications/publications.htm?SEQ_NO_115=128944. USDA Agricultural Research Service; 2003.

Childers, C. C.; McCoy, C. W.; Nigg, H. N., and Stansly, P. A. 2002. 2003 Florida Citrus Pest Management Guide: Rust Mites, Spider Mites and Other Phytophagous Mites.Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences

Courneya, P. 2003a. Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ. Email (Feb. 21, 2003) from Paul Courneya, USDA-APHIS-PPQ National Identification Services to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming that, except for *Unaspis yanonenis* and *Parlatoria ziziphi*, PPQ does not take action on armored scales (Diaspidae) found on certain fruit (including *Citrus*) for consumption.

---. 2003b. Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ. Email (Feb. 6, 2003) from Paul Courneya, USDA-APHIS-PPQ National Identification Services to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming that *Parlatoria ziziphi* is an actionable pest in USDA Catalog of Intercepted Pests.

Couturier, G.; Tanchiva, E.; Gonzales, J.; Cardenas, R., and Inga, H. 1996. Preliminary observations on the insect pests of araza (Eugenia stipitata Mc Vaugh, Myrtaceae), a new fruit crop in Amazonia. Fruits Paris. 51(4):229-239.

Cruz, R. and Dale, W. E. 1999. Bekampfung des Zitrus-Blattminierers mit Imidacloprid im "Drench" - Verfahren in Wustenboden Perus. Pflanzenschutz-Nachrichten Bayer. 52(3):310-319.

de la Rosa Brachowicz, A. 2002. (Servicio Nacional Sanidad Agraria, Peru). Letter To: Lou Vanechanos, Area Director USDA APHIS IS Santiago Chile. Lima, Peru; Letter No. 3296/2002-AG-SENASA-DGSV, December 20, 2002, Peruvian Citrus Questionnaire. Reprint: In File

Dekle, G. W. 1965. Snow scales on Florida citrus (Homoptera: Coccidae). Florida Department of Agriculture and Consumer Services - Division of Plant Industry Entomology Circular. No. 39.

---. 1969. The brown garden snail (*Helix aspersa* Muller) (Pulmonata - Helicidae). Florida Department of Agriculture, Division of Plant Industry, Entomology Circular. No. 83.

---. 1976. Green scale, Coccus viridis (Green) (Homoptera: Coccidae). Florida Deparment of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular. 165.

Dekle, G. W. and Fasulo, T. R. 2002. University of Florida and Florida Department of Agriculture and Consumer Services Featured Creatures: Common name: brown garden snail; scientific name: Helix aspersa Müller (Gastropoda: Pulmonata: Helicidae) [Web Page]. *Last accessed 2003 Apr 22*. Available at: http://creatures.ifas.ufl.edu/misc/gastro/brown_garden_snail.htm.

Dongo D., S. L. 1972. Control quimico de la podredumbre de las flores en citricos. Fitopatologia. 7 (1/2):20-22. ISSN: 0430-6155.

Dourojeanni, M. 1992. Environmental impact of coca cultivation and cocaine production in the amazon region of Peru. Bulletin on Narcotics. 2(005).

Ebeling, W. 1959. Subtropical Fruit Pests.Los Angeles: University of California. p. 436 pp.

Ehler, L. E. 1974. A review of the spider-mite problem on grain sorghum and corn in West Texas. Bulletin B-1149.: Texas Agricultural Experiment Station. p. 15 pp.

EPPO. 1998. *Guignardia citricarpa* is not present in Peru. EPPO Reporting Service. (98/124).

Escalante, G. J.; Del Castillo A. M. , and Ochoa O. 1981. Catalogo preliminar de las plagas insectiles de papas, maiz y frutales en el departamento del Cusco, Peru. Revista Peruana Entomologia. 24(1):87-90.

Escalante, G. J. A. 1974. Insectos de importancia economica en Quillabamba, Cusco. Revista Peruana De Entomologia. 17(1):51-53.

EXTONET. 1993a. Extension Toxicology Network, Pesticide Information Profile- Dimethoate [Web Page]. *Last accessed 2003 Apr 3*. Available at: http://pmep.cce.cornell.edu/profiles/extoxnet/dienochlor-glyphosate/dimethoate-ext.html.

EXTONET. 1993b. Extension Toxicology Network, Pesticide Information Profile - Trichlorfon [Web Page]. *Last accessed 2003 Apr 3*. Available at: http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/trichlorfon-ext.html.

FAO. 1996. [International Standards for Phytosanitary Measures, Publication No. 2. Guidelines for Pest Risk Analysis.]. Rome, Italy: Food and Agriculture Organization of the United Nations.

--. 2001a. [International Standards for Phytosanitary Measures, Publication No. 5. Glossary of Phytosanitary Terms.]. Rome, Italy: Food and Agriculture Organization of the United Nations.

--. 2001b. [International Standards for Phytosanitary Measures, Publication No. 11: Guidelines for Pest Risk Analysis for Quarantine Pests]. Rome, Italy: Food and Agriculture Organization of the United Nations.

Faria, J. T.; Arthur, V.; Wiendl, T. A., and Wiendl, F. M. 1998. Gamma radiation effects on immature stages of the orange fruit borer, Ecdytolopha aurantiana (Lima). Journal of Nuclear Agriculture and Biology. 27(1):52-56.

Farr, D. F.; Bills, G. F.; Chamuris, G. P., and Rossman , A. Y. 1989. Fungi on Plants and Plant Products in the United States.St. Paul, MN: APS Press, American Phytopathological Society. p. 1252 pp.

Farr, D. F.; Rossman, A. Y.; Palm, M. E., and McCray, E. B. 2003. Fungal Databases, Systematic Botany & Mycology Laboratory, ARS, USDA [Web Page]. Available at: http://nt.ars-grin.gov/fungaldatabases/.

Federal Register. 2001. Procedures and Standards Governing the Consideration of Import Requests. Federal Register . 66:32923-32928.

Fletcher, B. S. 1989. Movements of Tephritid fruit flies.Robinson, A. S. and Hooper, G.Amsterdam; Netherlands: Elsevier Science Publishers B.V. pp. 209-219

Foote, R. H.; Blanc, F. L., and Norrbom, A. L. 1993. [Handbook of the Fruit Flies (Diptera: Tephritidae) of America North of Mexico]. Ithaca, NY: Comstock Publishing Associates. 571 pp.

Freire, J. A. H. and Gara, R. I. 1970. Some Observations on the Behavior of Some Species of the Genus Trigona Apidae Meliponini. Turrialba. 20(3):351-356.

Garces, C. J. E. 1988. Brief notes on *Macrostylus* sp., an insect pest of *Pinus patula* and *Cupressus* sp. Informa Servicio Nacional De Proteccion Forestal. 2(1):45-48.

Garcia, M. S. 1999. Bioecologia e potencial de controle biologico de Ecdytolopha aurantiana (Lima, 1927) (Lepidoptera: Tortricidae), o bicho-furao-dos-citros, atraves de Trichogramma pretiosum Riley, 1879. Piracicaba, 1998. PhD thesis. Universidade de Sao Paulo: Universidade de Sao Paulo.

Garcia, M. S.; Postali-Parra, J. R.; Iarossi, A. R., and Junior, P. K. 1998. Bioecology of the citrus fruit borer, and control perspectives. Laranja. 19(2):249-260.

Gonzalez, H. O.; Carballo, M., and Blanco, H. 1996. Effect of strains of Beauveria bassiana (Bals.) Vuill on the mortality of Ecdytolopha torticornis (Meyrick) on macadamia. Manejo Integrado De Plagas(40):17-23.

Gordh, G. and Headrick, D. H. 2001. [A dictionary of entomology]. New York, NY: CABI Publishing. ix + 1032.

Gould, W. P. 1995. Probability of detecting Caribbean fruit fly (Diptera: Tephritidae) infestations by fruit dissection. Florida Entomologist. 78(3):502-507.

Gravena, S. and Almeida, J. C. V. de. 1982. Natural enemies of *Oiketicus kirbyi* Lands Guilding, 1827 E *Oiketicus geyeri* Berg, 1877 in the citrus ecosystem. Cientifica. 10:99-104.

Gunn, C. R. and Ritchie, C. 1982. [Report of the Technical Committee to Evaluate Noxious Weeds: Exotic Weeds For Federal Noxious Weed Act].

Halbert, S. E. 1995. Entomology Section: Citrus. Tri-Ology. 34(5).

Hamon, A. B. 1977. Oleander Pit Scale, Asterolecanium pustulans (Cockerell) (Homoptera: Coccoidea: Asterolecaniidae). Florida Department of Agriculture and Consumer Services - Division of Plant Industry Entomology Circular. No. 184.

Hamon, A. B. and Williams M. L. 1984. The Soft Scale Insects of Florida (Homoptera: Coccoidea: Coccidae).Gainesville: Florida Department of Agriculture and Consumer Services. p. 194 pp.

Hassan, E. 1977. Major Insect and Mite Pest [sic] of Australian Crops: Gatton, Qld.: Ento Press.

Hennessey, M. 2003. [*Citrus* spp. fruit from Mexico: Draft PRA pathway status of fruit flies (September 22, 2003) (on file with USDA-APHIS-PPQ, Raleigh, NC)]. Raleigh, NC: PPQ-CPHST-PERAL.

Henning, R. G. Shaw J. G. Kirkpatrick J. D. Parsons P. S. and Rhodes R. H. (USDA, ARS). 1972. An economic survey of the Mediterranean fruit fly in Central America. Field Report 21. Washington, DC: U.S. Dept. Agriculture, Economic Research Service.

Henry, T. J. and Froeschner, R. C. 1988. [Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States]. Henry, T. J. and Froeschner, R. C.: St. Lucie Press. xix + 958 pp.

Heppner, J. B. and Dixon, W. N. 1995. Potential spread of Phyllocnistis citrella (Lepidoptera: Gracillariidae: Phyllocnistinae) in the United States. American Entomologist. 41(2):2, 110-113.

Herrera, E.; Kiman, J., and Garcia, P. 1980. Distribution of Tylenchus semipenetrans in lemon tree (Citrus limon) of high Piura, Chulucanas (Peru) (Distribucion de Tylenchus semipenetrans en limonero [Citrus limon] del alto Piura, Chulucanas [Peru]); Huacho, Peru. Sociedad Entomologica del Peru, Lima: p. 23.

Hill, D. S. 1983. [Agricultural insect pests of the tropics and their control]. Second ed. New York, NY: Cambridge University Press. xii+ 746.

Holm., L. G.; Doll, J.; Holm, E.; Pancho, J. V., and Herberg. 1997. [World Weeds: Natural Histories and Distribution]. New York , NY: J.Wiley and Sons.

Holm, L. G.; Pancho, J. V.; Herberger, J. P., and Plucknett, D. L. 1979. [A Geographical Atlas of World Weeds]. New York, NY: Wiley and Sons.

Holm, L. G.; Plucknett., D. L.; Pancho., J. V., and Herberger, J. P. 1977. [The Worlds Worst Weeds]. Honolulu, HI: University Press of Hawaii.

Hopper, B. E. 1996. [Compendium of Phytosanitary Terms]. Nepean, Ontario, Canada.: North American Plant Protection Organization.

Horst, R. K. 2001. [Westcott's Plant Disease Handbook 6th Edition]. Norwell, Massachusetts: Kluwer Academic Publishers.

INRA. 1998. *Macrosiphum euphorbiae* (Thomas): [Web Page]. *Last accessed 2003 Feb 11*. Available at: http://www.inra.fr/Internet/Produits/HYPPZ/RAVAGEUR/6maceup.htm.

Jacobson, N. 2003. Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ. Email (March 16, 2003) from Dr. Nancy Jacobson, Entomologist, Cornell University to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming that the *Carales astur* (Cramer) (Arctiidae: Arctiinae: Phaegopterini) larva reported in Jacobson (1991) was found feeding on the leaves (externally) of *Citrus* sp. in Peru; that this species would probably only attack leaves of citrus; and that most Arctiidae larvae are external leaf feeders. .

Jacobson, N. L. 1991. Parasitoid and larval food plant records for three Peruvian moths. Journal of the Lepidopterists' Society. 45(2):173-174.

Jiron, L. F. and Hedstrom, I. 1988. Occurrence of fruit flies of the genera Anastrepha and Ceratitis (Diptera: Tephritidae), and their host plant availability in Costa Rica. Florida Entomologist. 71(1):62-73.

Johnson, M. W.; Mau R. F. L. ; Martinez A. P. , and Fukuda S. 1989. Foliar pests of watermelon in Hawaii. Tropical Pest Management. 35(1):90-96.

Johnston, A. and Booth C. 1983. [Plant Pathologist's Pocketbook, Second Edition]. United Kingdom: CAB International.

Kliejunas, J. T.; Burdsall , H. H. Jr.; DeNitto, G. A.; Eglitis, A.; Haugen, D. A.; Tkacz B. M., and Wallner W. E. 2001. Pest Risk Assessment of the Importation of Unprocessed Eucalyptus Logs and Chips from South America into the United States.Madison, WI: USDA, Forest Sevice, Forest Products Laboratory. p. 250 pp.

Korytkowski, C. and Ojeda D. 1968. Especies del genero Anastrepha Schiner 1888 en el Nor-oeste peruano. Revista Peruana Entomologia. 11(1):32-70.

Kosztarab, M. 1996. Scale insects of northeastern North America : identification, biology, and distribution. Martinsville: Virginia Museum of Natural History, 1996. x, 650 p. : ill. (some col.)(Special publication (Virginia Museum of Natural History) ; no. 3.

Krauth, S. 2003. Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ. Email (Feb. 24, 2003) from Steven Krauth, Entomologist, University of Wisconsin-Madison Entomology Department Insect Research Collection, to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming *Microcentrum laurifolium* (Orthoptera: Tettigoniidae) was detected in the US in 1928 and that this genus feeds on leaves and flowers.

Lamas, G. 1975. Mariposas diurnas (Lepidoptera, Rhopalocera) que stacan plantas de interes agricola en el Peru. Revista Peruana Entomologia. 18(1):1-5.

Lamberti, F. and Bleve-Zacheo, T. 1979. Studies on Xiphinema americanum sensu lato with descriptions of fifteen. Nematologia Mediterranea. 7(1):51-106.

Lamberti, F.; Jatala, P., and Agostinelli, A. 1987. A report of some Xiphinema species occurring in Peru (Nematoda, Dorylaimida). Nematologia Mediterranea. 15(1):103-109.

Leal, W. S.; Bento, J. M. S.; Murata, Y.; Ono, M.; Parra, J. R. P., and Vilela, E. F. 2001. Identification, synthesis, and field evaluation of the sex pheromone of the citrus fruit borer Ecdytolopha aurantiana. Journal of Chemical Ecology. 27(10):2041-2051.

Lehman, P. S. 1981. Three species of dagger nematodes pathogenic to citrus. Florida Department of Agriculture and Consumer Services - Division of Plant Industry Nematology Circular. No. 81.

Levy, J. Baggage interceptions on Peruvian Citrus. E-mail to: Edward Podleckis. 2003. Reprint: In File (April 11, 2003)

Liedo, P. and J. R. Carey. 1996. Demography of fruit flies and implications to action programs, pp. 299-308.McPheron, B. A. and Steck, G. J.Delray Beach, FL: St. Lucie Press

Liquido, N. J. Shinoda L. A. and Cunningham R. T. 1991. MEDHOST: Host Plants of the Mediterranean Fruit Fly (Diptera:

Tephritidae)- An Annotated World Review. Entomological Society of America Misc. Pub. No. 77. Hilo, Hawaii: Entomological Society of America.

Lovisolo, O. 2001. Citrus leprosis virus: properties, diagnosis, agro-ecology and phytosanitary importance. Bulletin OEPP. 31(1):79-89.

MacGowan, J. B. 1984. *Hemicriconemoides mangiferae* Siddiqi 1961. Florida Department of Agriculture and Consumer Services - Division of Plant Industry Nematology Circular. No. 110.

Manfredi-Coimbra, Silvana; Garcia, Mauro S., and Botton, Marcos. 2001 Dec. Exigencias termicas e estimativa do numero de geracoes de Argyrotaenia sphaleropa (Meyrick) (Lepidoptera: Tortricidae). Neotropical Entomology. 30(4):553-557.

Mariau, D. 2001. [Diseases of Tropical Tree Crops]. Enfield, NH, USA: Science Publishers, Inc. and CIRAD, France. xi + 237 + illustrations.

Marin, R. 1985. Biologia y comportamiento del acaro blanco Polyphagotarsonemus latus en la costa central del Peru. Revista Peruana Entomologia. 28:71-77.

Marin, R. and Cisneros F. 1995. El genero Ceroplastes grupo (Homoptera: Coccidae) en el Peru: Estudio taxonomico. Revista Peruana Entomologia. 37:41-54.

Masis, C. E. and Soto Manitiu, J. 1992. Insects associated with Macadamia integrifolia in Costa Rica. Agronomia Costarricense. 16(1):137-138.

McPherson, J. E. and McPherson, R. M. 2000. [Stink Bugs of Economic Importance in America North of Mexico].: CRC Press. 253 pp.

Miklasiewicz, T. J. and Walker G. P. 1990. Population dynamics and biological control of the wooly whitefly (Homoptera: Aleyrodidae) on citrus. Environmental Entomology. 19(5):1485-1490.

Miller, C. E. 2003a. (USDA-APHIS-PPD). Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ Raleigh NC. Fax (June 30, 2003) from Ed Miller, Senior Entomologist, USDA-APHIS-PPD stating that although *A. obliqua* and *A. distincta* have been reported to attack citrus spp. rarely, they are not likely to be associated with commercial export citrus.

---. 2003b. (USDA-APHIS-PPD). Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ Raleigh NC. Fax (June 30, 2003) from Ed Miller, Senior Entomologist, stating that although *Coccus viridis* can be associated with fruit, it mainly attacks the leaves of its hosts, and the commercial processing and culling should eliminate this pest from the pathway.

Miller, D. R. 1985. [Pest Risk Assessment of Armored Scales on Certain Fruit (USDA-ARS Report submitted to USDA-APHIS-PPQ)]. Beltsville, MD: USDA Agricultural Service.

Mollet, J. A. and Sevacherian V. 1984. Pesticide and seasonal effects on within-plant distribution of Tetranychus cinnabarinus (Boisduval) (Acarina: Tetranychidae) in cotton. Journal of Economic Entomology. 77(4):925-928.

Montoya, P.; Liedo, P.; Benrey, B.; Cancino, J.; Barrera, J. F.; Sivinski, J., and Aluja, M. 2000. Biological control of Anastrepha spp. (Diptera: Tephritidae) in mango orchards through augmentative releases of Diachasmimorpha longicaudata (Ashmead) (Hymenoptera: Braconidae). Biological Control. 18(3):216-224.

Mound, L. A. and Halsey S. H. 1978. White Fly of the World. Chichester, UK: John Wiley and Sons. p. 340 pp.

Myazaki, I.; Suplicy-Filho, N., and Sampaio, A. S. 1984. Yellow winged stingless bee - Trigona hyalinata hyalinata Lepeletier 1836 (Hymenoptera, Apidae, Meliponini) - predator of the macadamia nut tree. Biologico. 50:271-272.

Nakahara, S. 1982. Checklist of the Armored Scales (Homoptera: Diaspididae) of the Conterminous United States.Beltsville, MD: United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. p. 110 pp.

NCSU (North Carolina State University). 2003. Insect and Related Pests of Flowers and Foliage Plants: some important, common, and potential pests in the southeastern United States [Web Page]. *Last accessed 2003 Feb 11*. Available at: http://ipmwww.ncsu.edu/INSECT_ID/AG136/thrips2.html.

Norrbom, A. L. 2003. (USDA-ARS-Systematic Entomology Laboratory). Letter To: Mike Hennessey, USDA-APHIS-PPQ Center for Plant Health Science and Technology Raleigh NC on file with USDA-APHIS-PPQ Raleigh NC. Personal communication 09/24/03 from A.L. Norrbom, Entomologist, USDA-ARS-Systematic Entomology Laboratory, Beltsville, MD.

Norrbom, A. L. and Kim, K. C. 1988. A list of the reported host plants of the species of *Anastrepha* (Diptera: Tephritidae). APHIS 81-52:114 pp.

O'Brannon, J. H. and Duncan, L. W. 1990. *Scutellonema* species as crop damaging parasitic nematodes. Florida Department of Agriculture and Consumer Services - Division of Plant Industry Nematology Circular. No. 179.

O'Brannon, J. H. and Inserra, R. N. 1989. *Helicotylenchus* species as crop damaging parasitic nematodes. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Nematology Circular. No. 165.

Ochoa, R. 2003. Letter To: Ed Podleckis, Plant Pathologist USDA-APHIS. Personal communication from Ron Ochoa, acaralogist and leprosis expert, USDA Agricultural Research Service, to Ed Podleckis, Plant Pathologist, USDA-APHIS, confirming that citrus leprosis virus is not present in Peru and that the Lovisolo (2001) report was based on an earlier report from the 40's that was in turn based on symptoms similar to leprosis.

Ohashi, O. S.; Dohara, R.; Zucchi, R. A., and Canal, D. Na. 1997. Occurrence of Anastrepha obliqua (Macquart) (Diptera: Tephritidae) on Malpighia punicifolia L. in Para state. Anais Da Sociedade Entomologica Do Brasil. 26(2):389-390.

Ooi, P. A. C.; A. Winotai, and Peña, J. E. 2002. Pests of minor tropical fruits .Wallingford, U.K.: CAB International

Peña, J. E. and Bennett, F. D. 1995. Arthropods associated with *Annona* spp. in the Neotropics. Florida Entomologist. 78(2):329-349. ISSN: ISSN: 0015-4040.

PIN309. 2003. [Port Information Network- USDA Pest Interception Database].

Podleckis, E. V. (USDA, APHIS, PPQ, PHP). 2002. [Trip Report for Site Visit to La Calera Citrus Grove and Packhouse, Chinch Alta, Peru. December 17, 2002.]. Riverdale, MD: USDA, APHIS, PPQ.
Reprint: In File

Ponce, O. T.; Pelaez, H. I., and Cruz de la, L. J. 1979. Biological study of the bagworm Oiketicus kirbyi Lands Guilding (Lepidoptera: Psychidae) on banana and a survey of its principal parasites. Acta Agronomica. Vol. 29:1-4, 41-46.

PPQ. 2003a. .Plant Protection and Quarantine Treatment Manual, Revision 10/2002-04, updated March 24, 2003: http://www.aphis.usda.gov/ppq/manuals/pdf_files/TM.pdf. USDA-APHIS Plant Protection and Quarantine

PPQ. 2003b. Regulating the Importation of Fresh Fruits and Vegetables, updated February 03, 2003 [Web Page]. Available at: http://www.aphis.usda.gov/ppq/manuals/pdf_files/FV_Chapters.htm.

Prates, H. S. and Pinto, W. B. S. 1988. Ocorrencia da mariposa das laranjas (Gymnandrosoma aurantiarum Lima, 1927) na citricultura paulista. Laranja. 9:117-124.

---. 1991. Bicho-furao, um grave problema para a citricultura paulista. Laranja. 12:425-434.

Reed, C. F. 1977. [Economically Important Foreign Weeds. Agriculture Handbook N498]. Washington, DC: United States Department of Agriculture, Agricultural Research Service, Animal Plant Health Inspection Service.

Rizvi, A. 1994. (USDA, APHIS, PPQ). Letter To: Nick Gutierrez, Area Director USDA APHIS IS Caracas Venezuela. Baltimore, MD; Memo from Anwar Rizvi, USDA, APHIS, PPQ, Plant Pathologist to Nick Gutierrez, Area Director, USDA, APHIS, IS, Caracas, Venezuela (March 23, 1994) regarding Peruvian Citrus Disease(s) Survey Report.

Rodrigues, J. C. 2003. Letter To: Mark Hilf, Research Plant Pathologist. Personal communication (Feb. 19, 2003) from Dr. Jose Carlos Rodrigues, a leprosis researcher from Brazil, to , USDA Agricultural Research Service, stating that there are no confirmed reports of citrus leprosis virus in Peru.

Roistacher, C. N. 1988. Observations on the decline of sweet orange trees in coastal Peru caused by stem-pitting tristeza. Plant Protection Bulletin (Faridabad). 36(1):19-26.

Salazar, J. 1972. Contibucion al conocimiento de los Pseudococcidae del Peru. Revista Peruana De Entomologia. 15277-303.

Salazar Torres, J. 1999. Control de las plagas de los citricos. Jesus Maria, Peru: Servicio Nacional de Sanidad Agraria. 101 pp.

Savela, M. 2000. Lepidoptera and some other life forms [Web Page]. *Last accessed 2003 Apr 22*. Available at: http://www.nic.funet.fi/pub/sci/bio/life/intro.html.

ScaleNet. 2002. ScaleNet: A Database of Scale Insects of the World [Web Page]. Available at: http://www.sel.barc.usda.gov/scalenet/scalenet.htm.

Scarpellini, J. R.; Santos, J. C. C. dos, and dos Santos, J. C. C. 1997. Chemical control of Ecdytolopha aurantiana Lima, 1927 (Lepidoptera - Olethreutidae) in a citrus orchard. Ecossistema. 22:27-28.

Schubert, T. S. 2002. Letter To: Leah Millar, Entomologist USDA-APHIS-PPQ. Email (June 25, 2002) from Timothy Schubert, Mycologist, Florida Division of Plant Industry to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming the status of Mycena citricolor in Florida.

Sequeira, R. A.; Millar, L. M., and Bartels, D. 2001. [Identification of susceptible areas for the establishment of Anastrepha spp. fruit flies in the United States and analysis of selected pathways]. Raleigh, NC: USDA-APHIS-PPQ Center for Plant Health Science and Technology.

Sharp, J. L. and Picho Martinez, H. 1989. Hot-water quarantine treatment to control fruit flies in mangoes imported into the United States from Peru. Journal of Economic Entomology. 83(5):1940-1943.

Silvana Tours. 2001. Peru- General Overview [Web Page]. *Last accessed 2003 Apr 22*. Available at: http://www.silvanatours.com.pe/.

Sivanesan, A. and Critchett, C. 1974. Elsinoe fawcettii. CMI Descriptions of Pathogenic Fungi and Bacteria. No. 438.

Solano, G. South America to United States flights connecting through Lima, Peru. E-mail to: (Edward Podleckis). 2003. Reprint: In File (April 8, 2003)

SON (Society of Nematologists). 1984. [Distribution of Plant-Parasitic Nematode Species in North America].: Society of Nematologists p. 205 pp.

Stapleton, J. J. 1986. Effects of postharvest chlorine and wax treatments on surface microflora of lime fruit in relation to citrus bacteriosis disease. Plant Disease. 70:1046-1048.

--. 1998. [Importation of Fresh Citrus Fruit from Peru Into the Continental United States, Plant Pest Risk Assessment- Qualitative Portion (Draft)]. Riverdale, MD: USDA, APHIS, PPQ.

Stone, A. 1942. [The Fruit Flies of the Genus Anastrepha. Miscellaneous Publication No. 439]. Washington, DC: United States Department of Agriculture.

Sugayama, R. L.; Malavasi, A.; Nora, I., and Branco, E. S. 1996. Ovipositional responses to apple in a caged tree by Anastrepha fraterculus in southern Brazil, pp. 67-69.McPheron, B. A. and Steck, G. J.

Tarjan, A. C. 1964. Two new American dagger nematodes (Xiphinema: Dorylaimidae) associated with citrus, with comments on the variability of X. bakeri Williams, 1961. Proc. Helminthol. Soc. Wash. 3165-76.

Taverner, P. 2001. CITRUS PACKER NEWSLETTER Volume 64: Fungicide use in South Africa, Spain and Florida (USA) [Web Page]. *Last accessed 2003 Jun 1*. Available at: http://www.sardi.sa.gov.au/pages/horticulture/citruspacker/pack64.htm:sectID=155&tempID=87.

Tejada, L. O. 1980. Estudio sobre las hospederos potenciales de la mosca del Mediterraneo con énfasis en los en los presentes en el área de Soconusco, Chiapas, México. Mexico City: Direccion General de Sanidad Vegetal. 95 pp.

Thomas, M. C. 2002. Letter To: Paul Lehman, Nematologist FL DPI. Email (Feb. 14, 2002) from Mike Thomas, Entomologist, Florida Division of Plant Industry (FL DPI) to Paul Lehman, Nematologist, FL DPI, confirming that Rhynchophorus palmarum is not present in the California or Texas.

Thurston, H. D. 1989. [Tropical Plant Diseases 2nd Edition]. St. Paul, MN: The American Phytophathological Society. vii + 200p.

Timmer, L. W. 2003. 2003 Florida Citrus Pest Management Guide: Pesticides Registered for Use on Florida Citrus.Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences

Timmer, L. W.; Garnsey S. M., and Graham J. H. 2000. [Compendium of Citrus Diseases, Second Edition]. St. Paul, MN: APS Press, American Phytopathological Society p. 92 pp.

Toledo, A. J. and Lara, J. R. V. 1996. Comparison of the biology of Anastrepha obliqua reared in mango (Mangifera indica L.) and in mombin (Spondias mombin) infested under field conditions, pp. 359-362.McPheron, B. A. and Steck, G. J.Delray Beach, FL: St. Lucie Press

U.S. Census. 2000. United States Census 2000 [Web Page]. *Last accessed 2002 Aug 5*. Available at: : www.census.gov/main/www/cen2000.html .

United States Department of Agriculture. 1982. [Pests not known to occur in the United States or of limited distribution, no. 18: South American fruit fly]. Hyattsville, MD: USDA APHIS PPQ.

--. 1990. [USDA plant hardiness zone map]. Wasington, D.C.: USDA Agricultural Service (ARS).

--. 2000. [Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02. USDA, APHIS, PPQ; http://www.aphis.usda.gov/ppq/pra/commodity/cpraguide.pdf.].

University of California Statewide Integrated Pest Management Program. 2000. UC Management Guidelines: Pear stink bugs and other plant bugs http://www.ipm.ucdavis.edu/PMG/r603301611.html [Web Page].

USDA-NASS. 1997. 1997 Census of Agriculture CD-Rom. Washington, DC: USDA National Agricultural Statistics Service).

USDA-NRCS. 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Van Der Geest, L. P. S. and Evenhuis, H. H. 1991. Tortricid pests : their biology, natural enemies, and control. Amsterdam; New York: Elsevier. xviii, 808 p. : ill., maps ; 31 cm.(World crop pests ; 5.

Van Dersal, J. 2003. Letter To: Personal communication by phone (April 4, 2002 from Jeanne Van Dersal PIM Import and Interstate Services USDA-APHIS-PPQ to Leah Millar Entomologist USDA-APHIS-PPQ confirming that the standard method of shipping citrus internationally is under refrigeration with the temperature varying between 35 and 37 degrees F and shipment from Peru to the United States will probably take somewhere between two and four weeks.

Vasquez Villanueva, A. 1991. (Vice Minister of Agriculture, Peru). Letter To: James Glosser, APHIS Administrator. Lima, Peru; Letter dated September 19, 1991, Phytosanitary recognition of citrus plantations in Peru.

Weems, H. V. 1980. Anastrepha fraterculus (Wiedemann) (Diptera: Tephritidae). Florida Department of Agriculture and Consumer Services, Division of Plant Industry Entomology Circular. 217.

Weems, H. V. Jr. 1969. Anastrepha serpentina (Wiedemann) (Diptera: Tephritidae). Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular. 91.

---. 1981. Mediterranean fruit fly, Ceratitis capitata (Wiedemann) (Diptera: Tephritidae). Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular. No. 230:12 pp.

---. 1990. Anastrepha grandis (Macquart) (Diptera: Tephritidae). Florida Deparment of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular. 334.

Wellman, F. L. 1972. [Tropical American Plant Disease (Neotropical Phytopathology Problems]. Metuchen, NJ: Scarecrow Press. 989 pp.

White, G. L. 1999. Sapindus saponaria L. (Sapindaceae), a new host of Ecdytolopha aurantianum (Lima) (Lepidoptera: Tortricidae: Olethreutinae). International Journal of Pest Management. 45(4):287-291.

White, G. L. and Tuck, K. 1993. Outbreak of Ecdytolopha aurantianum (Lima) on citrus in Trinidad. FAO Plant Protection Bulletin. 41(2):130-132.

White, I. and Elson-Harris, M. M. 1992. [Fruit Flies of Economic Significance: Their Identification and Bionomics]. Melksham, U.K.: CAB International, Redwood Press, Ltd. 601 pp.

White, R. E. 1983. [A field guide to the beetles of North America]. New York: Houghton Mifflin Company.

Wibmer, Guillermo J. and O'Brien, Charles William. 1986. Annotated checklist of the weevils (Curculionidae sensu lato) of South America (Coleoptera, Curculionoidea). Gainesville, Fla: The American Entomological Institute. xvi, 563 p(Memoirs of the American Entomological Institute.

Williams, D. J. and Watson, G. W. 1988. The Scale Insects of the Tropical South Pacific Region: Part 2 The Mealybugs (Pseudococcidae): C.A.B. International Institute of Entomology. 260 pp.

World Resources Institute. 2002. Sustainable Development Information Service, Guide to Environmental Statistics, Agriculture Production Statistics [Web Page]. *Last accessed 2002 May 21* . Available at: http://www.wri.org/wri/statistics/fao-prd.html.

WSSA . 1989. Composite list of weeds [Web Page]. *Last accessed 2002 Aug 5*. Available at: www.wssa.net.

Zhang, B.-C. 1994. Index of Economically Important Lepidoptera.Wallingford, U.K.: CAB International. 599pp.