Pathway-Initiated Risk Assessment of Fresh Melon (*Cucumis melo* L. subsp. *melo*) and Watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai var. *lanatus*) Fruit from Peru into the Continental United States

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Table of Contents

A. Introduction

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 fresh *Cucumis melo* L. subsp. *melo* (melon) and *Citrullus lanatus* (Thunb.) Matsum. & Nakai var. *lanatus* (watermelon) fruits from Peru into the continental United States. *Cucumis melo* subsp. *melo* as used in this document includes all varieties and groups (ARS, 2001, Zitter, *et. al.*, 1996) within the subspecies with the exception of the Chito/Dudaim group *(C. melo* var. *chito* (E. Morr.) Naud., (synonyms *C. chito* C. Morren, *C. dudaim* L., *C. melo* var. *dudaim* (L.) Naudin). Also excluded is the other subspecies, *Cucumis melo* L. subsp. *agrestis* (Naudin) Pangalo (Weirsema and León, 1999). Watermelon, *Citrullus lanatus* var. *lanatus,* as used in this document specifically excludes other subvarieties considered 'wild melon' as they include poisonous or weedy melons (Weirsema and León, 1999). This is a qualitative pest risk assessment and estimates of risk are expressed in qualitative terms such as high or low rather than in numerical terms such as probabilities or frequencies. The details of methodology and rating criteria are in the Guidelines for Pathway-Initiated Pest Risk Assessment, version 5.0 (USDA, 2000).

International plant protection organizations such as the 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 used to initiate, conduct, and report this pest risk assessment are consistent with the guidelines provided by NAPPO, IPPC and FAO. The use of biological and phytosanitary terms conforms with the NAPPO Compendium of Phytosanitary Terms (Hopper, 1996) and the Definitions and Abbreviations (Introduction Section) in International Standards for Phytosanitary Measures, Section 1—Import Regulations: Guidelines for Pest Risk Analysis (FAO, 1996).

B. Risk Assessment

1. Initiating Event: Proposed Action

This pest risk assessment is commodity-based, and therefore pathway-initiated. The assessment was initiated in response to a request for USDA authorization to allow imports of a particular commodity presenting a potential plant pest risk. In this case, the importation into the United States of fruit of melon (*Cucumis melo* subsp. *melo*) and watermelon (*Citrullus lanatus* var. *lanatus*) grown in Peru is a potential pathway for introduction of plant pests. The regulation known as Quarantine 56 (7 CFR §319.56) provides regulatory authority for the importation of fruits and vegetables from foreign sources into the United States.

Correspondence

1. January 22, 1998 letter (068-98) from Carlos Meza Segura, Director of Servicio Nacional

de Sanidad Agraria (SENASA) to Donald Wimmer, Area Director, South America Region, IS requesting to reactivate melon exportation from the Villacuri Valley, Ica State. This letter mentioned "that during the last two years of constant work, using the official MacPhail traps, there has not been a single presence of *Anastrepha grandis* within the monitored area".

2. May 6, 1998 letter (083-98) from SENASA to Donald Wimmer on a protocol for the determination of zones free of pests in Peru.
3. June 12, 1998 letter (663-98) from SENASA to Gladys Solano, APHIS including historical information on previous melon exportation to the US from 1980 to 1991. Melons (assuming *C. melo*) were coming from production areas located at the Canete Valley (Lima State), Chincha Valley (Ica State) and there was no sanitary treatment applied for melon exportation. Reasons why exports stopped: agricultural land reform.
4. June 16, 1998 memorandum from Robert Spaide, Assistant to Deputy Administrator to Gladys Solano which summarizes the history of the request and supporting documentation. It mentions that a technical report was sent to Mr. Willmer Snell, Assistant Director- Operations Staff, APHIS-IS on SENASA's Fruit Fly monitoring program for *Anastrepha grandis*. It also explains that letter No. 083 from Peru's Minister of Agriculture is "basically an additional request on establishing free disease areas for fruits, since SENASA has been monitoring with no pest detection".
5. August 5, 1998 - A memorandum requesting a PRA on melons from Peru was received from Wayne Burnett, Import Specialist, Import and Interstate Services, through Gladys Solano, Program Assistant, South America Region, International Services (IS) in Lima, on behalf of the Ministry of Agriculture of Peru.
6. May 6, 1999 - Letter from Alan S. Green, Assistant Director, Phytosanitary Issues Management, references letter dated January 29, 1999 (No. 0119) from SENASA regarding their proposed systems approach for exporting melons from Peru to the United States. It states that an absolute requirement would be a demonstrated absence or low prevalence of the pest *A. grandis*. It says APHIS will rely on Mr. Donald Wimmer's assessment of the Peruvian trapping program and his general analysis of their proposal before making any decision. It requested the following be provided:
   A. Summary of the McPhail trapping program in the export area, including traps adjacent to the melon fields and historical trapping records.
   B. Comprehensive report on the known distribution of *A. grandis* in Peru taken from survey data and scientific collections.
   C. Description of the diagnostic capability of the program entomologists, i.e., who identifies the flies in the traps and how they distinguish *A. grandis* from the other species of *Anastrepha*.
   D. Comprehensive pest list for melons in Peru.
7. May 25, 1999 - Letter to Donald Wimmer from SENASA requesting that we accept the pest free area and not do a PRA, since this will take too long. Request made that we consider their mitigation system for Villacuri, Ica area and the establishment of a work plan.
8. August 5, 1999 - Letter (2207) from SENASA to D. Wimmer, IS-APHIS (received November 2, 1999), references communications USDA March 10, 1999 and May 4,

1999 regarding APHIS' position to collaborate with the establishment of the watermelon trade from Villacuri, Ica to the US under a system approach. (Although it is not specifically stated, it has been assumed that Peru intends to use a systems approach for *C. melo* subsp. *melo* as well because the monitoring reports refer to the exportation zone for Cucurbitaceae.) The following information was sent as requested:

A. Summary of MacPhail trapping system from watermelon areas of exportation and other surrounding areas. (SENASA has implemented an official McPhail trapping system in Villacuri - Ica which grows citrus and olives and also this is where the cucurbits (melon and watermelon) are grown by Corporation West S.A.. To monitor for *A. grandis* in cucurbit areas, traps (1/ha) were placed in the 96-97, 97-98, and 98-99 growing seasons. There were no catches of *Anastrepha* spp.. SENASA also permanently monitors in the adjacent areas to those cultivated for the cucurbit exportation. Tables indicate there are some *Anastrepha* spp. in the adjacent areas. Because *Anastrepha* spp. is the category monitored, it is unclear if *A. grandis* was actually trapped or monitored.

B. Trapping historical data (1996-98).

C. Report of *A. grandis* distribution in Peru.

D. Description of diagnostic capacity of the entomological programs.

E. Complete list of *C. melo* subsp. *melo* pest and diseases in Peru. (The cover page is mislabeled as watermelon.).

9. December 23, 1999 - Letter (3362) from SENASA to Donald Wimmer, APHIS with information regarding melon and watermelon production location and hectares harvested in Peru in 1998.

10. January 10, 2000 - Conference call between APHIS and SENASA. According to the February 18, 2000 summary of the call, the following was discussed:

A. APHIS expressed concern about the possible presence of *A. grandis* in Peru, and for this reason APHIS required that identification to species be made, not just Anastrepha spp..

B. APHIS requires geographic distribution of the areas free of *A. grandis* (Punto).

C. APHIS requested details about detection systems, distribution of the traps, density and types of traps used, as well as reading and evaluations of the captures in the areas of production of melon and the surrounding areas.

D. APHIS underlined the importance to declare the areas free of *A. grandis* particularly if the interest of Peru is to expand the areas of export to approximately 1000 hectares.

E. APHIS requested that information would be sent for each geographical area that would be included in the work plan as long as these areas were free of this species.

F. APHIS also requested the relation of other pests that are present in the areas of production.

G. SENASA commented that they are working on declaring areas free of *A. grandis*, that natural conditions of the central-south zone of Peru are not favorable to *A. grandis*, that it has only been reported in the northern area, and that a "System's Approach" like that of Ecuador and Brazil could be used.

H. SENESA discussed the National trapping program. Traps are installed in the cucurbit production areas as well as surrounding areas and the trapping densities were given. SENASA is interested in exporting from productions areas in addition to Villicuri in Ica: i.e. valleys of the province of Lima, Arequipa, Moquegua, Tacna, and others in which it has been demonstrated the natural absence of *A. grandis*. SENASA will forward evidence that these areas are free, including trapping records, and show which flies do occur, identified to the species. APHIS stated that maps showing the areas and trap locations would be the best way to describe these additional areas from which melons could be shipped.

I. APHIS requested and SENASA agreed to send information concerning the specific areas for each valley, total areas of production of melon and watermelon, volume of exports and probable shipment dates, and internal regulations relating to this matter.

11. May 5, 2000 - Email from Darlene Orr, Trade Director, South America, Phytosanitary Trade Issues, to Donald Wimmer and Gladys Solano requesting that they obtain an official written response from Peru to the following questions for the PRA for *C. melo*.
    A. Is Peru requesting to export just to the contiguous United States?
    B. Does Peru intend to export stems, leaves or soil with the melons?
    C. Is the pest list which was included with the letter from SENASA to Donald Wimmer dated Aug. 5, 1999 for *Cucumis melo* subsp. *melo* only? Are these pests distributed in the area of production for *C. melo*? Is there a reference for the following pests listed for *C. melo* subsp. *melo* in Peru on this list, and what plant parts are they associated with (e.g., flowers, fruit, stems, roots, leaves): *Aphis fabae* (black bean aphid), *Aphis spiraecola* (green citrus aphid), *Diaphania nitidalis* (pickle worm), *Helicoverpa zea* (American cotton bollworm), *Sclerotinia sclerotiorum* (cottony soft rot), *Liriomyza trifolii* (American serpentine leafminer), tobacco ringspot virus.

12. June 2, 2000 - Letter 1287 from SENASA addressed to Donald Wimmer, APHIS. Reference telephone conversation dated Jan. 10, 2000. The following information previously requested was forwarded:
    A. Information on *A. grandis* monitoring to establish melon production free areas.
    B. Distribution and charts of species of *Anastrepha* and their hosts in Peru.
    C. Report on pests presently found in the production areas forecasted for export.
    D. Geographic information on the export production areas.
    E. Areas, production volume, export and forecasted dispatch dates.
    F. Copies of internal regulations for mobilization of vegetable plants and products within the local territory.

13. Email correspondence between Darlene Orr and Gladys Solano to clarify expected export volumes of melon and watermelon from Peru.

2. Assessment of Weediness Potential of *Cucumis melo* subsp. *melo* and *Citrullus lanatus* var. *lanatus*.

Cucumis and *Citrullus* are genera within the family Cucurbitaceae. There are about 30 species of annuals and perennials within the genus *Cucumis*, a few of which are grown for the edible fruits. Bailey (1949) defined four genera producing edible fruits which included *Cucumis melo* subsp. *melo* and five of its varieties. The results of the weediness screening for *Cucumis melo* subsp. *melo* (Table 1a) and *Citrullus lanatus* var. *lanatus* (Table 1b) did not prompt a pest-initiated risk assessment.

Table 1a: Weediness Potential of *Cucumis melo* L. subsp. *melo*.

Phase 1: *Cucumis melo* subsp. *melo* is widely cultivated in the United States. The weed, *Cucumis melo* subsp. *melo* var. *chito* (syn. *dudaim*) is reported from Arizona and California.

Phase 2: Is the species listed in:

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

Phase 3: Conclusion:

The *Geographical Atlas of World Weeds* included *Cucumis melo,* without specification of subspecies or variety, as a principal weed in Colombia and a weed of unknown importance in Ghana, West Polynesia and Sudan. *The *Weed Science Society of America* includes one variety, *C. melo* var. *dudaim* Naud. (smellmelon). The only articles in the literature with *C. melo* as a weed are ones that refer to the variety *dudaim* as a weed, e.g., in cotton. This variety is a synonym for *C. melo* var. *chito*, which is excluded for import in this assessment. *Cucumis melo* subsp. *melo* does not meet the definition of a Federal Noxious Weed because they are not "new to or not widely prevalent in the United States".

Table 1b:	Weediness Potential of *Citrullus lanatus* var. *lanatus* (Thunb.) Matsum & Nakai	
Phase 1:	*Citrullus lanatus* var. *lanatus* (watermelon) is native to tropical Africa and is widely cultivated in the United States.	
Phase 2:	Is the species listed in:	
	YES	*Geographical Atlas of World Weeds* (Holm, 1979)
	NO	*World's Worst Weeds* (Holm, 1977) or *World Weeds: Natural Histories and Distribution* (Holm *et al.*, 1997)
	NO	*Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act* (Gunn and Ritchie, 1982)
	NO	*Economically Important Foreign Weeds* (Reed, 1977)
	YES	Weed Science Society of America list (WSSA, 1989)
	YES	Is there any literature reference indicating weediness (*e.g.*, *AGRICOLA*, *CAB*, *Biological Abstracts*, *AGRIS*; search on "species name" combined with "weed").
Phase 3:	Conclusion:	
	The *Geographical Atlas of World Weeds* includes *Citrullus lanatus*, without specification to variety, as a common weed in Australia. The Weed Science Society of America includes *Citrullus lanatus*, without specification to variety, in its list of weeds of current or potential importance in the United States. The PLANTS database (USDA, 1999) reports that *Citrullus lanatus* var. *lanatus* is introduced in 32 states and is a State Noxious weed for Arizona and California. The literature search revealed two articles about *Citrullus lanatus* as a weed in Australia, and one article about 'wild watermelons' as weeds in Texas. This species does not meet the definition of a Federal Noxious Weed because it is not "new to, or not widely prevalent in the United States."	

3. Previous Risk Assessments, Current Status and Pest Interceptions

Decision History for melon *(Cucumis melo* subsp. *melo)* and watermelon *(Citrullus lanatus* var. *lanatus)* fruit : (The search was limited to the last 30 years for South America, and to the oldest risk assessment for Peru shown.)

1997 - Venezuela, Melon: Entry permitted into all ports under *Anastrepha grandis* pest free zone program.

1997 - Venezuela and Brazil, Watermelon: Entry approved into all ports from *A. grandis* free area only.

1994 - Brazil, Honeydew Melon: Entry permitted into all ports under pest free zone program, subject to conditions in 7CFR 319.25 - 2aa.
1993 - Ecuador, Watermelon: Entry approved for pre-cleared product at North Atlantic ports.
1989 - Ecuador, Melon: Entry permitted into all ports under *A. grandis* pest free zone program.
1985 - Argentina, Brazil, Colombia, Ecuador, Peru, Uruguay, Venezuela, all fresh cucurbits (except honeydew melons and certain hothouse grown seedless cucumbers): Prohibited entry into the United States due to *A. grandis*. Honeydew melons are allowed entry into North Atlantic ports with limited distribution requirements until October 31, 1986.
1981 - Venezuela, Melon: Entry denied because of fruit flies (*A. grandis*).
1974 - Venezuela, Melon: Entry permitted to North Atlantic and North Pacific ports, subject to inspection.
1971 - Brazil, Melon: Entry denied because of fruit flies (*A. grandis*) and other pests of concern.
1967 - Uruguay, Melon: Entry denied because of fruit flies (*A. grandis*) and other pests of concern.
1964 - Columbia, Cucurbits (including melon and watermelon): Entry approved through North Atlantic ports, subject to inspection. Shipments to be denied entry in case *A. grandis* larvae are encountered in them.
1962 - Ecuador, Cucurbits: Entry permitted subject to inspection at North Atlantic and South Atlantic and Gulf ports.
1960 - Brazil, Melon and Watermelon: Entry denied because of fruit flies (*A. grandis*).
1950 - Colombia, Watermelon: Entry denied because of *A. grandis* and *Ceratitis capitata*.
1949 - Uruguay, Watermelon: Approved entry at Northern ports. Recommendation was made that entry be denied at South Atlantic and Gulf ports until more information on *A. grandis* is developed.
1930 - Uruguay, Melon: Entry approved at Northern ports.
1928 - Peru, Melon: Entry approved at South Pacific ports.
1924 - Peru, Melon and Watermelon: Entry approved at Northern ports.

Pest Interception Data for Curcurbitaceae from South America, 1985-Present

No pest interceptions were identified for Peru, French Guiana, Bolivia, or Paraguay. A list of pest interceptions for the other countries is found in Appendix 1.

4. Pest List: Pests Associated with *C. melo* subsp. *melo* and *C. lanatus* var. *lanatus* in Peru

Table 2 shows the pest list for *Cucumis melo* subsp. *melo* and *Citrullus lanatus* for both Peru. The table was compiled from scientific and regulatory reports, including pest lists provided by officials of Peru. Information sources consulted included bliographic databases such as AGRICOLA and CAB Abstracts; CAB International Crop Pest Compendium (CPC, 1999); previous risk assessments relevant to the proposed commodity; PPQ's Catalog of Intercepted Pests and interception records (USDA Port Information Network PIN 309 Database); CIE and

CMI Distribution Maps and/or Descriptions of plant pests; PPQ data sheets on Pests Not Known to Occur in the United States (PNKTO) and Insects Not Known to Occur in the United States (INKTO); standard texts; and published and unpublished scientific and regulatory reports. For each pest, Table 2 summarizes information on the distribution in the exporting countries and the United States, commodity association, quarantine status in the United States, and likelihood that it could move with the commodity (i.e. follow the pathway). Pests for which cucurbits or Cucurbitaceae were listed as hosts were included in the list since it is reasonable to assume then that *C. melo* subsp. *melo* and *C. lanatus* var. *lanatus* could be hosts.

Table 2: Pest List - Pests attacking *Cucumis melo* subsp. *melo* and *Citrullus lanatus* var. *lanatus* in Peru and present on any host within the United States.

Legend

Distribution: Peru (PE) and the United States (US) are listed when they are specifically listed in the references. South America (SA) is listed when the pest is known to occur in countries near Peru, but either Peru is not specifically listed. When a pest is of quarantine significance to the US, its distribution within the US (if any) is listed. AZ (Arizona), CA (California), FL (Florida), HI (Hawaii), LA (Louisiana), MA (Massachussetts), MD (Maryland), NJ (New Jersey), PR (Puerto Rico), TX (Texas), USVI (US Virgin Islands). Cosmopolitan means having worldwide distribution.

Host: Every attempt was made to identify hosts to the species level.
M = Melon, *Cucumis melo*; or *Cucumis* spp. as noted by # in the reference column.
W = Watermelon, *Citrullus lanatus* var. *lanatus*.
B = Both *Citrullus lanatus* var. *lanatus* and *Cucumis melo* subsp. *melo* (or *Cucumis*).
C = Cucurbits listed as hosts.

Plant Parts: F = fruit, Flw. = flower, L = leaves, S = stem, R = roots

Quarantine Pest and Follow Pathway: Y = yes; N = no

Scientific Name, Classification	**Distribution**	**Host**	**Plant Part Affected**	**Quar-antine Pest**	**Follow Path-way**	**References (# indicates *Cucumis* is listed as a host, but the species is not listed.)**
Pathogens **Fungi**						
Alternaria cucumerina (Ellis & Everh.) Elliot [=*Macrosporium cucumerinum* Ellis & Everh.] (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	B	L, F, Seeds	N	Y	Bazán de Segura, 1959; Farr *et al.*, 1989; Holliday, 1980; SENASA, 2000
Aspergillus fumigatus Fresen. (Fungi Imperfecti: Hyphomycetes)	SA, US	M	R, S, L, F	N	Y	CPC, 1999; Farr *et al.*, 1989#
Aspergillus niger Tiegh. (Fungi Imperfecti: Hyphomycetes)	Cosmopolitan, SA, US	M	R, S, L, F	N	Y	CPC, 1999; Farr *et al.*, 1989# ; Onions, 1996
Aspergillus versicolor (Vuill.) Tiraboschi (Fungi Imperfecti: Hyphomycetes)	Cosmopolitan, US	M	F	N	Y	Farr *et al.*, 1989#; Kozakiewicz, 1990
Botryosphaeria quercuum (Schwein.) Sacc. [=*Botryosphaeria obtusa* (Schwein.) Shoem.] (Loculoascomycetes: Dothideales)	Cosmopolitan, US	W	S	N	N	CPC, 1999; Farr *et al.*, 1989

Scientific Name, Classification	Distribution	Host	Plant Part Affected	Quar-antine Pest	Follow Path-way	References (# indicates *Cucumis* is listed as a host, but the species is not listed.)
Cercospora citrullina Cooke (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	B	L	N	N	Bazán de Segura, 1959; Chupp, 1953; Farr *et al.*, 1989; Zitter *et al.*, 1996
Choanephora cucurbitarum (Berk. & Ravenel) Thaxt. (Zygomycetes: Mucorales)	SA, US	B	L, S, F, Flw.	N	Y	Farr *et al.*, 1989; Galli *et al.*, 1968
Cladosporium cucumerinum Ellis & Arth. (Fungi Imperfecti: Hyphomycetes)	SA, US	B	L, S, F	N	Y	CPC, 1999; Farr *et al.*, 1989
Colletotrichum gloeosporioides (Penz) (Penz & Sacc.) (Fungi Imperfecti: Coelomycetes)	PE, US	B	L, S, F	N	Y	CPC, 1999
Colletotrichum orbiculare (Berk. & Mont.) Arx [=*Colletotrichum lagenarium* (Passerini) Ellis et Halsted] (Fungi Imperfecti: Coelomycetes)	SA, US	B	F, L	N	Y	CMI, 1986a; Farr *et al.*, 1989; Zitter *et al.*, 1996
Corynespora cassiicola (Berk. M.A. Curtis) C. T. Wei (Fungi Imperfecti: Hyphomycetes)	Cosmopolitan - tropical & subtropical, SA, US	B	F, L, S, R, Flw.	N	Y	Ellis and Holliday, 1971; Farr *et al.*, 1989; Zitter *et al.*, 1996
Cylindrocladium scoparium Morgan (Fungi Imperfecti: Hyphomycetes)	SA, US	W	F	N	Y	CPC, 1999; Farr *et al.*, 1989
Didymella bryoniae (Auersw.) Rehm [= *Mycosphaerella citrullina* (C.O.Sm.) Gross., Anamorph, *Phoma cucurbitacearum* (Fr. ex Fr.) Sacc.] (Loculoascomycetes: Dothideales)	Cosmopolitan SA, US	B	F, L, S	N	Y	CMI, 1984a; CPC, 1999; Holliday, 1980; Farr *et al.*, 1989
Erysiphe cichoracearum DC. (Pyrenomycetes: Erysiphales)	PE, US Cosmopolitan	B	L, S, F - water-melon occasion ally	N	Y	Bazán de Segura, 1959; Kapoor, 1967a; Zitter *et al.*, 1996

Scientific Name, Classification	Distribution	Host	Plant Part Affected	Quar-antine Pest	Follow Path-way	References (# indicates *Cucumis* is listed as a host, but the species is not listed.)
Fusarium acuminatum Ellis & Everh. [= *Fusarium scirpi* Lambotte & Fautrey var. *acuminatum* (Ellis & Everh)] Wollenweb. (Fungi Imperfecti: Hyphomycetes)	Cosmopolitan US	M	R	N	N	Farr *et al.*, 1989#
Fusarium culmorum (W. G. Smith) Sacc. (Fungi Imperfecti: Hyphomycetes)	PE, US	M	R, F, S	N	Y	Booth & Waterston, 1964a; CMI, 1984b; Farr *et al.*, 1989#
Fusarium javanicum Koord. [=*Fusarium solani* (Mart.) Sacc. f. sp. *radicicola* (Wollenweb.) W.C. Snyder & H.N. Hanns] (Fungi Imperfecti: Hyphomycetes)	Widespread, US	M	R	N	N	Farr *et al.*, 1989#
Fusarium moniliforme Sheldon [Teleomorph: *Gibberella fujikuroi* (Sawada) S. Ito] (Fungi Imperfecti: Hyphomycetes)	PE, US	M	R, S, F	N	Y	Booth & Waterston, 1964b; CMI, 1990a; Farr *et al.*, 1989#
Fusarium oxysporum Schlechtend: FR. f.sp. *melonis* (Leach & Currence) Snyder & Hansen (Fungi Imperfecti: Hyphomycetes)	PE, US	M	L, S, R, Seeds	N	N	Cheng, 1990; CPC, 1999; Farr *et al.*, 1989
Fusarium oxysporum Schlechtend: FR. f.sp. *niveum* (E.F. Sm.) Snyder & Hansen (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	W	L, S, R, Seeds	N	N	Cheng, 1990; CPC, 1999; Farr *et al.*, 1989
Fusarium roseum Link:Fr. (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	B	F	N	Y	Farr *et al.*,1989; Wellman, 1977
Fusarium solani (Mart.) Sacc. (Fungi Imperfecti: Hyphomycetes)	SA, US	B	F, S, Seeds	N	Y	Farr *et al.*, 1989; Holliday, 1980; Wellman, 1977

Scientific Name, Classification	Distribution	Host	Plant Part Affected	Quar-antine Pest	Follow Path-way	References (# indicates *Cucumis* is listed as a host, but the species is not listed.)
Fusarium subglutinans (Wollenweb. & Reinking) Nelson, Toussoun & Marasas [=*Fusarium moniliforme* Sheld. var. *subglutinans* Wollenweb. & Reinking, Teleomorph *Gibberella fujikuroi* var. *subglutinans* Edwards] (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	M	R, S, F	N	Y	Booth & Waterston, 1964c; Farr *et al.*, 1989#
Lasiodiplodia theobromae (Pat.) Griffon & Maubl., [=*Botryodiplodia theobromae* Pat.] (Fungi Imperfecti: Coelomycetes)	PE, US	M	F, S	N	Y	CMI, 1985a; CPC, 1999; Farr *et al.*, 1989; Holliday, 1980; Wellman, 1977
Leandria momordicae Rangel [=*Stemphyllium cucurbitacearum* G. A. Osner] (Fungi Imperfecti: Hyphomycetes)	SA, US	M	L	N	N	Farr *et al.*, 1989; Wellman, 1977
Macrophomina phaseolina (Tassi) Goidanich (Fungi Imperfecti: Coelomycetes)	PE, US	B	F, S, R, Seeds	N	Y	CMI, 1985b; CPC, 1999; Farr et al., 1989; Zitter *et al.*, 1996
Myrothecium roridum Tode:Fr. (Fungi Imperfecti: Hyphomycetes)	SA, US	M	F, L, S	N	Y	CMI, 1969; Farr *et al.*, 1989# ; Fitton & Holliday, 1970
Phaeoramularia cucurbiticola (Henn.) Deighton in M.B. Ellis [=*Cercospora cucurbiticola* Henn.] (Fungi Imperfecti: Hyphomycetes)	SA, US (FL)	C	L	Y	N	Chupp, 1953; Farr *et al.*, 1989
Phoma eupyrena Sacc. (Fungi Imperfecti: Coelomycetes)	SA, US	M	R, S, F, L	N	Y	Albornett *et.al.*, 1994; Farr *et al.*, 1989; Morgan-Jones & Burch, 1988; Sutton, 1980
Phoma exigua var. *exigua* Desmaz. (Fungi Imperfecti: Coelomycetes)	Cosmopolitan	B	L, S, R, soil	N	N	Farr *et al.*, 1989

Scientific Name, Classification	Distribution	Host	Plant Part Affected	Quar-antine Pest	Follow Path-way	References (# indicates *Cucumis* is listed as a host, but the species is not listed.)
Phoma terrestris E. M. Hans. (Fungi Imperfecti: Coelomycetes)	Worldwide, tropical and subtropical	B	R	N	N	Farr *et al.*, 1989; Zitter *et al.*, 1996
Phytophthora cactorum (Lebert & Cohn) J. Schröt. (Oomycetes: Peronosporales)	PE, UY, US	B	F, S, R	N	Y	CMI, 1984c; CPC, 1999; Waterhouse & Waterston, 1996; Zitter *et al.*, 1996
Phytophthora capsici Leonian (Oomycetes: Peronosporales)	SA, PE, US	B	F, L, S	N	Y	CPC, 1999; CMI, 1990b; Holliday, 1980; Zitter *et al.*, 1996
Phytophthora citrophthora (R.H. Sm. & E. Sm.) Leonian (Oomycetes: Peronosporales)	PE, US	B	F, L, S, R	N	Y	CPC, 1999; Farr *et al.*, 1989
Phytophthora drechsleri Tucker (Oomycetes: Peronosporales)	SA, US	B	R, F	N	Y	CMI, 1979; CPC, 1999; Farr *et al.*, 1989
Phytophthora nicotianae Breda de Haan var. *parasitica* (Dastur) G.M. Waterhouse (Oomycetes: Peronosporales)	PE, US	W	F, L, S, R	N	Y	CPC, 1999; Farr *et al.*, 1989
Pseudoperonospora cubensis Berk. & M.A. Curtis) Rostovzev (Oomycetes: Peronosporales)	PE, US	B	L	N	N	CMI, 1981; Holliday, 1980
Pythium acanthicum Dreschler (Oomycetes: Peronosporales)	Cosmopolitan, SA, US	W	R, S, F	N	Y	Farr *et al.*, 1989; Valdebonito Sanhueza *et al.*, 1984a, b
Pythium anandrum Dreschler (Oomycetes: Peronosporales)	Cosmopolitan	M	R, F	N	Y	Farr *et al.*, 1989
Pythium aphanidermatum (Edson) Fitzp. (Oomycetes: Peronosporales)	SA, PE, US	B	F, R	N	Y	CMI, 1978; Waterhouse & Waterston, 1964; Zitter *et al.*, 1996
Pythium debaryanum Hesse (Oomycetes: Peronosporales)	Widespread SA, US	B	L, S, R	N	N	CMI, 1984d; Farr *et al.*, 1989
Pythium hydnosporum (Mont.) J. Schrot. (Oomycetes: Peronosporales)	Cosmopolitan	W	R	N	N	Farr *et al.*, 1989

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Pythium irregulare Buisman (Oomycetes: Peronosporales)	Cosmopolitan SA, US	W	R	N	N	CMI, 1986b; Farr *et al.*, 1989
Pythium myriotylum Drechsler (Oomycetes: Peronosporales)	Worldwide in warm regions SA, US	B	F, R	N	Y	CPC, 1999; Farr *et al.*, 1989
Pythium oligandrum Drechsler (Oomycetes: Peronosporales)	Cosmopolitan SA, US	B	S, F, R	N	Y	Waterhouse and Waterson, 1966
Pythium periplocum Drechsler (Oomycetes: Peronosporales)	Cosmopolitan SA, US	B	R, F	N	Y	Farr *et al.*, 1989; Valdebenito Sanhueza *et al.*, 1984a, b
Pythium ultimum Trow (Oomycetes: Peronosporales)	PE, US	B	R, F	N	Y	CPC, 1999; Farr *et al.*, 1989
Rhizoctonia solani Kuehn [=Teleomorph *Thanatephorus cucmeris* (Frank) Donk] (Fungi Imperfecti: Agonomycetes)	PE, US	B	F, R	N	Y	Bazán de Segura, 1959; Farr *et al.*, 1989; Mordue, 1974; Wellman, 1977; Zitter *et al.*, 1996
Sclerotium rolfsii Sacc. (Fungi Imperfecti: Agonomycetes)	PE, US	B	F, S, soil	N	Y	CMI, 1992; Zitter *et al.*, 1996
Sclerotium sclerotiorum (Lib.) de Bary. (Fungi Imperfecti: Agonomycetes)	PE, US	B	F, S, soil	N	Y	CPC, 1999; Wellman, 1977; Zitter *et al.*, 1996
Sphaerotheca fuliginea (Schlecht. ex Fr.) Pollacci (Pyrenomycetes: Erysiphales)	Cosmoplitan SA, PE, US	B	L, S	N	N	Cheng, 1990; Farr *et al.*, 1989; Holliday, 1980; Kapoor, 1967b; Zitter *et al.*, 1996
Thielaviopsis basicola (Berk. & Broome) Ferraris (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	B	R, soil	N	N	CPC, 1999; Farr *et al.*, 1989; Subramanian, 1968
Trichothecium roseum Link (Fungi Imperfecti: Hyphomycetes)	Cosmopolitan US	M	Sapro-phyte	N	Y	CPC, 1999
Verticillium albo-atrum Reinke & Berthold (Fungi Imperfecti: Hyphomycetes)	PE, US	B	L, S	N	N	CPC, 1999; Farr *et al.*, 1989
Verticillium dahliae Kleb. (Fungi Imperfecti: Hyphomycetes)	SA, PE, US	B	L, S	N	N	CPC, 1999; Farr *et al.*, 1989

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Bacteria						
Agrobacterium tumefaciens (Smith & Townsend) Conn (Rhizobiales)	PE, US	B	R, S	N	N	Bradbury, 1986; CMI, 1980; CPC, 1999
Erwinia carotovora subsp. *carotovora* (Jones) Bergey *et. al.* [=*Bacillus melonis* Giddings, 1910] (Euterobacteriales)	PE, US	B	R, S, L, F	N	Y	Bradbury, 1986; CPC, 1999; Yi and Kim, 1996
Pseudomonas cichorii (Swingle) Stapp (Pseudomonadales)	SA, US	B	L, S	N	N	Bradbury, 1986; CPC, 1999
Pseudomonas solanacearum (Smith) (Pseudomonadales)	PE, US	W	systemic	N	Y	Bradbury, 1986
Pseudomonas syringae pv. *lachrymans* (Smith & Bryan) Young, Dye and Wilkie (Pseudomonadales)	SA, US	B	L, S, F, Seeds	N	Y	Bradbury, 1986; CMI, 1987; Wellman, 1977
Xanthomonas cucurbitae (Bryan) Vauterin *et al.* [*Xanthomonas campestris* pv. *cucurbitae*] (Bryan) Dye (Zymobacteria: Xanthomonadales)	SA, US	B	L, S, F, Seeds	N	Y	Bradbury, 1986; CPC, 1999
Viruses						
Cucumber mosaic virus (Bromoviridae: Cucumovirus)	PE, US	B	F, L, S	N	Y	Cheng, 1990; Wellman, 1977; Zitter *et al.*, 1996
Beet curly top virus (Geminiviridae: Curtovirus)	SA (western arid and semi-arid regions), US	W	F, L, S	N	Y	Brunt *et al.*, 1996; Zitter *et al.*, 1996
Beet western yellows virus (Luteoviridae: Polerovirus)	worldwide, US	W	F, L, S	N	Y	Brunt *et al.*, 1996

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Papaya ringspot potyvirus [=*Watermelon mosaic virus 1*] (Potyviridae: Potyvirus)	SA, US	B	F, L, S	N	Y	CPC, 1999; Zitter *et al.*, 1996
Squash mosaic comovirus (Comoviridae: Comovirus)	SA, US	B	F, L, S, Seeds	N	Y	Brunt *et al.*, 1996, Zitter *et al.*, 1996
Tobacco ringspot virus (Comoviridae: Nepovirus)	PE, US	B	F, L, Seeds	N	Y	Brunt *et al.*, 1996; CPC, 1999; Zitter *et al.*, 1996
Watermelon mosaic virus [=*Watermelon mosaic virus 2]* (Potyviridae: Potyvirus)	PE, US	B	F, L	N	Y	Cheng, 1990; CPC, 1999
Zucchini yellow mosaic virus (Potyviridae: Potyvirus)	SA, US	B	F, L	N	Y	CPC, 1999; Hernandez *et al.*, 1989; Provvidenti *et al.* 1984
Arthropods						
Acalymma bivittula (Kirsch) (Coleoptera: Chrysomelidae)	PE	C	R, S, L	Y	N	Alata Condor, 1973; Arnett, 1973; Blackwelder, 1946; EIS, 1996; Oakley & Dohanian, 1954
Acalymma demissa (Erichson) (Coleoptera: Chrysomelidae)	PE	W	R, Flw., L	Y	N	Alata Condor, 1973; EIS, 1996
Acalymma pallipes (Olivier) (Coleoptera: Chrysomelidae)	SA	C	R, Flw., L	Y	N	CPC, 1999; EIS, 1996; Oakley & Dohanian, 1954
Acalymma venalis (Erichson) (Coleoptera: Chrysomelidae)	PE	C	R, S, L, Flw	Y	N	Alata Condor 1973; Arnett, 1973; EIS, 1996; Oakley & Dohanian, 1954
Agrotis experta (Walker) (Lepidoptera: Noctuidae)	PE	W	L, S, R	Y	N	SENASA, 2000 (June 2); Wille, 1952; Zhang, 1994
Agrotis ipsilon (Hufnagel) (Lepidoptera: Noctuidae)	PE, US	B	L, S	N	N	Cheng, 1999; CPC, 1999

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Agrotis malefida (Guenée) (Lepidoptera: Noctuidae)	PE, US	C	L, S	N	N	Alata Condor, 1973; CPC, 1999; Zhang, 1994
Anasa tristis De Geer (Hemiptera: Coreidae)	PE, US	B	L, S	N	N	Alata Condor, 1973; CPC, 1999
Anastrepha grandis (Macquart) (Diptera: Tephritidae)	PE	B	F	Y[1]	Y	CPC, 2001; CPC, 1999; Malavasi & Zucchi, 2000; Norrbom, 1991; Norrbom, & Kim, 1988; Silva & Malavasi, 1993a, b; Whittle & Norrbom, 1987
Anastrepha shannoni (Stone) (Diptera: Tephritidae)	PE	M[2]	F	Y	N[2]	Alata Condor, 1973; Norrbom, 1991
Aphis fabae Scopoli (Homoptera: Aphididae)	PE, US	M	L, S, Flw.	N	N	CPC, 1999
Aphis gossypii (Glover) (Homoptera: Aphididae)	PE, US	B	L, S, Flw.	N	N	Arcila *et al.*, 1991; Blackman & Eastop, 1984; CPC, 1999
Aphis spiraecola Patch (Homoptera: Aphididae)	PE, US	C	L, S, Flw	N	N	CPC, 1999; SENASA, 1999

[1]Norrbom & Kim (1988) state watermelons and melons are hosts.

[2]Norrbom, personal communication says that the reference cited by Alata Condor (1973) with regard to *Cucumis melo* being a host (ie., RPE V. 11, p. 38) is doubtful. No current references list a host for this species; therefore, we do not expect it to follow the pathway.

Scientific Name, Classification	Distribution	Host	Plant Part Affected	Quar-antine Pest	Follow Path-way	References (# indicates *Cucumis* is listed as a host, but the species is not listed.)
[3] *Asphondylia* sp. (Loew) (Diptera: Cecidomyiidae)	SA, PE, US	B	Flw	Y[3]	N	Alata Condor, 1973; Gagné, 1989; Korytkowski & Llontop, 1967
Atherigona orientalis (Schiner) (Diptera: Muscidae)	PE, US	B	F, L, S	N	Y	CPC, 1999
Atta sexdens (Linnaeus) (Hymenoptera: Formicidae)	PE	C	L	Y	N	Alata Condor, 1973; CPC, 1999
[4] *Camptoneuromyia* sp. (Felt) (Diptera: Cecidomyiidae)	PE, US	B	Flw.	Y[7]	N	Alata Condor, 1973; Gagné, 1989; Korytkowski & Llontop, 1967; USDA, 1965
Ceratitis capitata Wiedemann (Diptera: Tephritidae)	PE, US (HI only)	B	F	Y	N[5]	Miller, 1991

[3]Alata Condor (1973) lists *Asphondylia* sp. as pests of melon and watermelon in Peru, but does not list particular species. Korytkowski and Llontop (1967) describes 2 species of Cecidomyiid flies, assigned to the genera *Asphondylia* and *Camptoneuromyia*, which cause heavy damage in watermelon and melon flowers in Tucume, Peru. The *Asphondylia* species is described as more common and abundant. He describes the species as probably new to the world entomofauna. Gagné (1989) pg. 50, notes there are 247 described species, 60 of which are from N. America. The genus occurs on all continents and includes many agricultural pests. Their larvae are responsible for bud, flower, and fruit galls which are always accompanied by a fungal symbiont upon which the larvae feed. On pg. 180 it indicates that *Asphondylia* sp. cause swollen flowers or buds in Cucurbitaceae and that a series of an *Asphondylia* is labeled as reared from melon, but the damage was unspecified. If intercepted *Asphondylia* specimens can not be identified to the species, they will be treated as quarantine pests.

[4]Alata Condor (1973) lists *Camptoneuromyia* sp. as pests of melon and watermelon in Peru, but does not list any particular species. Korytkowski and Llontop (1967) describe two species of cecidomyiid flies, assigned to the genera *Asphondylia* and *Camptoneuromyia*, which cause heavy damage in watermelon and melon flowers in Tucume, Peru. Gagné (1989) indicates that the genus is strictly a New World genus, and that all camptoneuromyias may be inquilines (ie., they are regularly found in galls but are not the gall forming agent) in galls made by other cecidomyiids. At least two species are associated with goldenrod and one with *Rubus* species. Gagné (1989) does not list any as pests of Cucurbitaceae on pg. 180. USDA (1965) lists seven species in the US in either New York, New Jersey, Massachusetts, or Connecticut. If intercepted *Camptoneuromyia* specimens can not be identified to species, they will be treated as quarantine pests.

[5]Miller (1991) describes *Cucumis melo* subsp. *melo* and *Citrullus lanatus var. lanatus* as poor hosts for this pest. These hosts are laboratory infested only, never found as hosts in nature; therefore, it is not likely to follow the pathway.

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Ceratoma fascialis (Erichson) (Coleoptera: Chrysomelidae)	PE	C	L	Y	N	Alata Condor, 1973; EIS, 1996
Chrysodeixis includens (Walker) (Lepidoptera: Noctuidae)	PE, US	W	L, F, Flw, Seeds	N	Y	CPC, 1999; Eichlin & Cunningham, 1978
Delia platura (Meigen) (Diptera: Anthomyiidae)	PE, US	B	S, R, L	N	N	CPC, 1999
Diabrotica decolor Erichson (Coleoptera: Chrysomelidae)	PE	C	R, S, L, Flw.	Y	N	Alata Condor, 1973; Arnett, 1973; Blackwelder, 1946; EIS, 1996; Oakley & Dohanian, 1954
Diabrotica speciosa (Germar) (Coleoptera: Chrysomelidae)	PE	C	L, R, Flw, F - external feeder	Y	N	CPC, 1999; EIS, 1996
Diabrotica viridula (Fabricius) (Coleoptera: Chrysomelidae)	PE	C	R, S, L	Y	N	Alata Condor, 1973; Arnett, 1973; EIS, 1996; Wilcox, 1975
Diaphania hyalinata (L.) (Lepidoptera: Pyralidae)	PE, US	B	L, S, F, Flw.	N	Y	Alata Condor, 1973; CPC, 1999; Zhang, 1994
Diaphania nitidalis (Stoll) (Lepidoptera: Pyralidae)	PE, US	B	L, S, F, Flw.	N	Y	Alata Condor, 1973; CPC, 1999; Zhang, 1994
Dicyphus cucurbitaceus Spinola (Hemiptera: Miridae)	SA	M	L, S, Flw, F-im-mature.	N	N[6]	Carvalho, 1958; Henry & Froeschner, 1988; Oakley & Dohanian, 1954

[6]Information regarding specific hosts and feeding damage is lacking for this pest, but information on related species indicates that feeding on fruits is primarily at the immature stage. Henry & Froeschner (1988) indicates that previous references listing *Dicyphus agilis* Ulher in the US as a synonym are in error.

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Dysmicoccus brevipes Cockerell (Homoptera: Pseudococcidae)	PE, US	C	F, L, S, R, Flw.	N	Y	CPC, 1999; Williams & Granara de Willink, 1992
Dysmicoccus neobrevipes Beardsley (Homoptera: Pseudococcidae)	PE, US (PR, USVI, HI)	C	F, L, S, R, Flw.	Y	Y	CPC, 1999; Williams & Granara de Willink, 1992
Empoasca fabae Harris (Homoptera: Cicadellidae)	SA, PE, US	C	L, S	N	N	Alata Condor, 1973; CPC, 1999; Metcalf, 1968
Epilachna cacica (Guerin) (Coleoptera: Coccinellidae)	PE	B	L	Y	N	EIS, 1996; Gordon, 1975; Oakley & Dohanian, 1954
Epilachna paenulata (Germar) (Coleoptera: Coccinellidae)	PE	B	L	Y	N	EIS, 1996; Gordon, 1975; Oakley & Dohanian, 1954
Epitrix subrinita (Le Conte) (Coleoptera: Chrysomelidae)	PE, US (AZ, OR)	C	R, L	Y	N	Arnett, 1973; Alata Condor, 1973; Wilcox, 1975
Epitrix ubaquensis (Harold) (Coleoptera: Chrysomelidae)	PE	C	R, L	Y	N	Arnett, 1973; Alata Condor, 1973; EIS, 1996
Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae)	SA, PE, US	M	L, Flw.	N	N	CPC, 1999
Gryllus assimilis (Fabricius) (Orthoptera: Gryllidae)	PE, US	C	L, S	N	N	Alata Condor, 1973; CPC, 1999
Gyandrobrotica gestroi (Baly), Syn. *Diabrotica gestroi* (Baly) (Coleoptera: Chrysomelidae)	PE	C	R, S, L	Y	N	Alata Condor, 1973; Arnett, 1973; Blackwelder, 1946; EIS, 1996
Helicoverpa zea (Bodie) (Lepidoptera: Noctuidae)	PE, US	M	L, F, Flw.	N	Y	CPC, 1999
Leucothrips theobromae (Piersner) (Thysanoptera: Thripidae)	PE	M	L	Y	N	Alata Condor, 1973; CPC, 1999; Mound & Marullo, 1996

Scientific Name, Classification	Distribution	Host	Plant Part Affected	Quar-antine Pest	Follow Path-way	References (# indicates *Cucumis* is listed as a host, but the species is not listed.)
[7]*Liothrips* sp. (Thysanoptera: Thripidae)	PE	M	L	Y	N	Alata Condor, 1973; Mound & Marullo, 1996
Liriomyza huidobrensis (Blanchard) (Diptera: Agromyzidae)	SA, PE, US (limited greenhouse pest)	M	L	Y	N	CPC, 1999; EPPO, 1999
Liriomyza sativae Blanchard (Diptera: Agromyzidae)	SA, PE, US	B	L	N	N	CPC, 1999; EPPO, 1999
Liriomyza trifolii (Burgess) (Diptera: Agromyzidae)	SA, PE, US	B	L	N	N	CPC, 1999
Listroderes costirostris Schönherr (Coleoptera: Curculionidae)	SA, US	C	L, R	N	N	CPC, 1999
Melittia cucurbitae (Harris) (Lepidoptera: Sesiidae)	PE, US	C	S	N	N	Alata Condor, 1973; CPC, 1999; Oakley & Dohanian, 1954; Zhang, 1994
Myzus persicae (Sulzer) (Homoptera: Aphididae)	PE, US	B	L, S, Flw.	N	N	CPC, 1999; Kranz *et al.*, 1977#
Naupactus xanthographus (Germar) (Coleoptera: Curculionidae)	SA	M	L, R, F	Y	N[8]	CPC, 1999, Wibmer & O'Brien, 1986
Oryzaephilus mercator (Fauvel) (Coleoptera: Silvanidae)	PE, US	B	Seeds	N	N	CPC, 1999
Pantomorus cervinus (Boheman) (Coleoptera: Curculionidae)	PE, US	C	L, R	N	N	CPC, 1999

[7]Alata Condor (1973) lists *Liothrips* sp. as pests of melon in Peru, but the particular species are not listed. Mound & Marullo (1996) lists the following New World species of *Liothrips* as occurring in Peru: *L. epimeralis* (Hood), *L. peruviensis* (Moulton), *L. tessarie* (Hood), *L. tupac* (Hood), and *L. vigilax* (Hood). None of these species are listed as occuring in the US; however, there are several other species that do. EIS(1996) lists no species of *Liothrips* as occurring in Uruguay. All of the *Liothrips* species are leaf-feeding, and for most species, evidence for host specificity is lacking.

[8]External feeder as adult; larvae root feeder (CPC, 2001). Adult intercepted once by APHIS, PPQ as a hitchhiker on melons from Chile.

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Peridroma saucia (Hübner) (Lepidoptera: Noctuidae)	PE, US	B	L, F, S, Flw., Seeds	N	Y	CPC, 1999
Phthia picta (Drury) (Hemiptera: Coreidae)	PE, US	C	L	N	N	Alata Condor, 1973; CPC, 1999; Henry & Froeschner, 1988
Pseudococcus jackbeardsleyi (Gimpel & Miller) (Homoptera: Pseudococcidae)	PE, US	M	L, F	N	Y	CPC, 1999
Pseudococcus viburni (Signoret) (Homoptera: Pseudococcidae)	PE, US	C	L, S	N	N	McKenzie, 1967; Williams & Granara de Willink, 1992
Spodoptera eridania (Cramer) (Lepidoptera: Noctuidae)	PE, US	W	F, L	N	Y	CPC, 1999
Spodoptera frugiperda (Smith) (Lepidoptera: Noctuidae)	PE, US	W, C	L, S, F, Flw.	N	Y	CPC, 1999
Spoladea recurvalis (Fabricius) (Lepidoptera: Pyralidae)	PE, US	W, C	L, R, Flw.	N	N	CPC, 1999
Thrips tabaci Lindeman (Thysanoptera: Thripidae)	PE, US	M	L, Flw.	N	N	CPC, 1999
Trialeurodes vaporariorum (Westwood) (Homoptera: Aleyrodidae)	SA, PE, US	B	L, S	N	N	Alata Condor, 1973; CPC, 1999
MITES						
Tetranychus cinnabarinus (Boisduval) = *Tetranychus telarius* Zacher = *Tetranychus cucurbitacearum* (Sayed) (Acari: Tetranychidae)	PE, US	B	L	N	N	Alata Condor, 1973; CPC, 1999; Anon. 1972; Jeppson *et al.*, 1975
Tetranychus desertorum (Banks) (Acari: Tetranychidae)	PE, US	M	L	N	N	Alata Condor, 1973; Jeppson *et al.*, 1975
Tetranychus ludeni Zach. (Acari: Tetranychidae)	SA, US	B	L	N	N	Anon. 1972; Jeppson *et al.*, 1975

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Tetranychus neocaledonicus André = *Tetranychus cucurbitae* (Rahman & Sapra) (Acari: Tetranychidae)	SA, US	C	L	N	N	Jeppson *et al.*, 1975
Tetranychus urticae Koch (Acari: Tetranychidae)	PE, US	B	L	N	N	Alata Condor, 1973; CPC, 1999; SENASA, 2000
NEMATODES						
Ditylenchus dipsaci (Kühn) Filip'ev [*Anguillulina dipsaci* (Kühn), *Tylenchus devastator* unknown] (Tylenchida: Anguinidae	PE, US (widespread, including HI & CA)	C	S, R	Y[9]	N	CPC, 1999
Helicotylenchus multicinctus (Cobb) Golden (Tylenchida: Hoplolaimidae)	PE, US (AL, CA, FL, HI, MD, MA, NJ)	B	R	Y	N	CPC, 1999
Helicotylenchus dihystera (Cobb) Sher (Tylenchida: Hoplolaimidae)	PE, US	W	R	N	N	CPC, 1999
Meloidogyne arenaria (Neal) Chitwood (Tylenchida: Meloidogynidae)	PE, US	W	R, soil	N	N	CPC, 1999; Netscher & Sikora, 1990
Meloidogyne exigua Goeldi (Tylenchida: Meloidogynidae)	PE	W	R, soil	Y	N	CPC, 1999; Netscher & Sikora, 1990
Meloidogyne hapla (Chitwood) (Tylenchida: Meloidogynidae)	PE, US	B	R, soil	N	N	CPC, 1999; Potter & Olthof, 1993
Meloidogyne incognita (Kofoid & White) Chitwood (Tylenchida: Meloidogynidae)	PE, US	B	R, soil	N	N	CPC, 1999; Netscher & Sikora, 1990; Potter & Olthof, 1993
Radopholus similis (Cobb) Thorne (Tylenchida: Pratylenchidae)	PE, US (FL, HI, LA, TX)	B	R	Y	N	CPC, 1999; Potter & Olthof, 1993

[9]Listed as reportable and actionable on propagative material.

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Rotylenchulus reniformis Linford & Oliveira (Tylenchida:Rotylenchulidae)	PE, US	B	R	N	N	CPC, 1999

5. Quarantine Pests

Any pest species listed in the above pest list that has a "Y" in the "Quarantine Pest" column, is considered to be a quarantine pest of commercial shipments of *Cucumis melo* subsp. *melo* or *Citrullus lanatus var. lanatus* fruit from Peru and/or Uruguay. Should any of these pests be intercepted on commercial (or any other) shipments of *Cucumis melo* or *Citrullus lanatus var. lanatus* fruit, quarantine action may be taken. Our list of quarantine pests is provided in Table 3.

Table 3: Quarantine Pests: Melon and Watermelon Fruit from Peru and/or Uruguay	
Fungi	*Phaeoramularia cucurbiticola* (Henn.) Deighton
Arthropods	*Acalymma bivittula* (Kirsch) *Acalymma demissa* (Erichson) *Acalymma pallipes* (Olivier) *Acalymma venalis* (Erichson) *Acalymma vittigera* (Boh.) *Acanonicus hahni* (Stal) *Agrotis experta* (Walker) *Anasa guttifera* (Berg) *Anastrepha grandis* (Macquart) *Anastrepha shannoni* (Stone) *Asphondylia* sp. (Loew) *Atta sexdens* (L.) *Camptoneuromyia* sp. (Felt) *Ceratitis capitata* Wiedemann *Ceratoma fascialis* (Erichson) *Diabrotica decolor* Erichson *Diabrotica speciosa* (Germar) *Diabrotica viridula* (Fabricius) *Dichroplus elongatus* (Giglio-Tos) *Dysmicoccus neobrevipes* Beardsley *Epilachna cacica* (Guerin) *Epilachna paenulata* (Germar) *Epitrix subrinita* (Le Conte) *Epitrix ubaquensis* (Harold) *Gyandrobrotica gestroi* (Baly) *Leucothrips theobromae* (Piersner) *Liothrips* sp. *Liriomyza huidobrensis* (Blanchard) *Naupactus xanthographus* (Germar) *Rachiplusia nu* (Guenée)
Nematodes	*Ditylenchus dipsaci* (Kühn) Filip'ev *Helicotylenchus multicinctus* (Cobb) Golden *Meloidogyne exigua* Goeldi *Radopholus similis* (Cobb) Thorne

6. Quarantine Pests Likely to Follow Pathway and Selected for Further Analysis

Only those quarantine pests that can reasonably be expected to follow the pathway, that is, included in commercial shipments of *Cucumis melo* subsp. *melo* or *Citrullus lanatus var. lanatus* fruit, were analyzed in detail. Only quarantine pests that have a "Y" in the "Quarantine Pest" column and a "Y" in the "Likely to Follow Pathway" column in Table 2 were selected for further analysis and subjected to steps 7-9 below (USDA, 2000).

Quarantine pests likely to follow the pathway include: (1) *Anastrepha grandis* and (2) *Dysmicoccus neobrevipes*. The prevalence of *Anastrepha grandis* in the areas of production for these commodities in Peru was not evaluated in this risk assessment.

Other plant pests in this Assessment, not chosen for further scrutiny, may be potentially detrimental to the agricultural production systems of the United States; however, there were a variety of reasons for not subjecting them to further analysis. Examples include: 1) they are associated mainly with plant parts other than the commodity; 2) they may be associated with the commodity, however, it was not considered reasonable to expect these pests to remain with the commodity during processing; or 3) they have been intercepted as biological contaminants of these commodities during inspection by Plant Protection and Quarantine Officers but would be expected to be present with only occasional shipments. In addition, the biological hazard of organisms identified only to the generic level is not assessed due to the lack of adequate biological/taxonomic information.

This lack of biological information on any given insect or pathogen should not be equated with low risk. By necessity, pest risk assessments focus on those organisms for which biological information is available. By developing detailed assessments for known pests that inhabit a variety of niches on the host species, e.g., on the surface of or within the bark/wood, on the foliage, etc., effective mitigation measures can be developed to eliminate the known organism and any similar unknown ones that inhabit the same niches.

7. Consequences of Introduction

The consequences of introduction were considered for each quarantine pest selected for further analysis. Each pest was rated based on five biological features referred to here as Risk Elements. Details of the five Risk Elements and the rating criteria are provided in USDA (2000). The ratings for these five Risk Elements are shown in Table 4. The cumulative (Total) score for Risk Elements 1-5 (i.e., the "Consequences of Introduction Risk Rating") is considered to be a biological indicator of the potential destructiveness of the pest.

Table 4. Risk Rating for Consequences of Introduction						
Pest	Climate/Host Interaction	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Cumulative Risk Rating[1]
	L, M, H (1, 2, 3)	L, M, H (1, 2, 3)	L, M, H (1, 2, 3)	L, M, H (1, 2, 3)	L, M, H (1, 2, 3)	L, M, H (5 - 15)
Anastrepha grandis	medium (2)	medium (2)	high (3)	high (3)	high (3)	high (13)
Dysmicoccus neobrevipes	medium (2)	high (3)	high (3)	high (3)	high (3)	high (14)

[1] low=5-8, medium=9-12, high=13-15

Climate-Host Interaction

Ratings determined as follows:

High: Pest able to establish breeding colony in four or more plant hardiness zones (USDA, 1990).

Medium: Pest able to establish breeding colony in two or three plant hardiness zones.

Low: Pest able to establish breeding colony in at most a single plant hardiness zone.

Anastrepha grandis

Norrbom, (1991) reports that this pest occurs along the Andean Cordillera from Venzuela, Colombia, Ecuador, and Peru, to Bolivia and in northern Argentina and Paraguay, and in southern subtropical Brazil in the states of Bahia, Mato Grasso, and Goias. It appears to be restricted to lower elevations of the Andes and bordering areas in Bolivia and northward. According to Harper (1987) it has not been detected in the low-land coastal melon-growing region of Ecuador. Korytowski and Ojeda Pena (1969) demonstrated the presence of *A. grandis* in four of 10 different ecological zones in the northern areas of Peru alone (one was collected in the dry coastal desert region of Lambayeque, and the others in Andean region of Cajamarca), and rainfall did not seem to be critical, varying from less than 30 mm to 2,000 mm (Harper, 1987). Norrbom (1991) lists the following as hosts: the native species of squash and pumpkin, *Cucurbita pepo* L., *C. moschata* (Duchesne) Poiret, and *C. maxima* Duchesne, and the introduced cucurbits such as watermelon, melon, cucumber (*Cucumis sativus* L.), and calabash gourd [*Lagenaria siceraria* (Mol.) Standl.]. Records for guava and citrus as hosts are considered abnormal or doubtful.

In the United States, suitable climates would most likely be found in U.S. Plant Hardiness Zones 8-10 and suitable hosts could be found in those same zones; therefore, the climate/host rating is medium. The states with the largest commercial production of melons, watermelons, and cucumbers are Michigan, North Carolina, Florida, Texas, California, Georgia, and Arizona, which, excluding

Michigan, includes U.S. Plant Hardiness Zones 8-10 Production for local markets or home gardening occurs throughout the United States. Cucurbits are frost sensitive, but they differ in their cold and heat tolerance. They can be grown in diverse habitats including mountains, lowlands, and in tropical, desert, and temperate regions (Zitter et al., 1996). Furthermore, wild or native populations of potential cucurbit hosts occur in many parts of the southern and mid-western United States. The Dudaim group of *C. melo* subsp. *melo* is naturalized in parts of Louisiana and Texas (Zitter *et al.*, 1996). *Cucurbita pepo* (L.) varieties *melopepo* (L.), *ovifera* (L.), *ozarkana* B. D. Sm. & C.W. Cowan, and *texana* (Scheele) D. Decker occur in one or more of the following states: New Mexico, Texas, Louisiana, Arkansas, Mississippi, Missouri, Georgia, Kentucky, Illinois, and Virginia (USDA, NRCS 1999).

Dysmicoccus neobrevipes

Worldwide distribution of *D. neobrevipes* is reported as: Australasian: American Samoa, Cook Islands, Fiji, Guam, Hawaiian Islands, Kiribati, Gilbert Island, Marshall Islands, Northern Mariana Islands, Western Samoa; Nearctic: Mexico; Neotropical: Antigua and Barbuda, Bahamas; Brazil; Colombia; Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Panama, Peru, Puerto Rico and Viegues Island, Suriname, Trinidad and Tobago, U.S. Virgin Islands; Oriental: Philippines, Vietnam; and Palaearctic: Sicily (Ben-Dov, 1994 and references therein, and Williams and Granara de Willink, 1992). APHIS has intercepted this pest from almost all of these countries and also primarily from the tropical rainy south-east Asia and Pacific island countries or territories of India, Myanmar, Sri Lanka, Laos, Cambodia, Thailand, Indonesia, Philippines, Malaysia, American Samoa, and China (including Hong Kong). Less frequent pest interceptions from more temperate regions such as Korea, Australia, France, the Netherlands, Jordan, and Armenia may be transshipments or errors, because according to Doug Odermatt, APHIS Coccoidea specialist, USDA (personal communication), recent literature does not indicate that it occurs in those regions. Based on climates in which this pest has been found, we estimate that suitable climates could be found in U.S. Plant Hardiness Zones 8 - 10 in the continental U.S.. *D. brevipes* and *D. neobrevipes* have similar geographical distributions (CPC, 1999) and in the United States, *D. brevipes* is reported to occur in Hawaii, Florida, Louisiana, and California (CPC, 1999; Ben-Dov, 1994). These states include U.S. Plant Hardiness Zones 8-10.

Hosts include a variety of species from at least 33 plant families (Ben-Dov, 1994 and references therein). These include a number of tropical and temperate species from several plant families that occur or are cultivated in the continental United States within zones U.S. Plant Hardiness Zones 8 - 10; therefore, the climate/host rating is medium. Examples include, e.g., *Cucurbita* sp., *Cucurbita maxima*, and *Sechium edule* (Cucurbitaceae); *Helianthus* sp. (Asteraceae) (Nakahara, 1982); *Agave* sp. and *Yucca* sp. (Agavaceae); *Gossypium* sp. (Malvaceae); Cactaceae; *Cajanus cajan*, *Piscidia piscipula*, and *Acacia* sp. (Fabaceae); *Citrus sinensis* (Rutaceae); *Codiaeum* sp. (Euphorbiaceae), *Cocos nucifera* (Arecaceae), *Mangifera indica* (Anacardiaceae); *Litchi chinensis* and *Dimocarpus longan* (Sapindaceae); and *Psidium guava* (Myrtaceae) (host references: Ben-Dov, 1994; Williams and Granara de Willink, 1992; APHIS PIN 309 pest interception data; host distribution references: McGregor, 1987; Wiersema and Leon, 1999).

Host Range

Ratings are determined as follows:

High: Pest attacks multiple species within multiple plant families.
Medium: Pest attacks multiple species within a single plant family.
Low: Pest attacks a single species or multiple species within a single genus.

Anastrepha grandis
Because *A. grandis* attacks several species in the Cucurbitaceae family (Norrbom, 1991; for species, see Risk Element 1), it was given a rating of medium.

Dysmicoccus neobrevipes
Because *D. neobrevipes* attacks several species in multiple plant families (Ben-Dov, 1994 and references therein; for host species, see Risk Element 1), it was given a rating of high.

Dispersal Potential

Ratings are determined as follows:

High: Pest has high reproductive potential (*e.g.*, many generations per year, many offspring per reproduction, high innate capacity for population increase (*i.e.*, "r-selected" species), *AND* evidence exists that the pest is capable of rapid dispersal (*e.g.*, over 10 km per year) either under its own power, human-assisted, or by natural forces such as wind, water or vectors.
Medium: Pest has either high reproductive potential *OR* the species is capable of rapid dispersal.
Low: Neither high reproductive potential nor capable of rapid dispersal.

Anastrepha grandis
A. grandis has both a high reproductive potential and is capable of rapid dispersal, and was therefore given a rating of high. Adult female flies are capable of laying a moderate number of eggs, i.e., from 10 to 110 eggs per puncture in young or mature fruit (Silva, 1991). The average life cycle (egg, to larvae, to pupae, to ovipositing adult female) is 55 days under laboratory conditions (~25 C, 70% relative humidity) (Silva and Malavasi, 1993a; COSAVE data sheet on *A. grandis*), therefore there are probably several generations per year as long as suitable hosts are present. Tropical pest species of *Anastrepha* are typically mutivoltine (White and Elson-Harris, 1992). No data was found on long distance movement of adult *A. grandis*, but long distance movement or migration of other *Anastrepha* species varies; with at least one species (*A. ludens*) capable of long-distance migratory flights of possibly up to 150 km (Fletcher, 1989). But the primary mode of long distance dispersal is mainly as larvae in infested fruit. Under natural infestation conditions in Laranjal Paulista, State of Sao Paulo, Brazil, the mean number of individuals obtained from pumpkins and melons were 42.6 and 22.4 per fruit, respectively (Silva and Malavasi, 1993b). There is also a risk from the transport of pupae in soil or packaging with infested fruit. Since 1971, unidentified species of *Anastrepha* have been intercepted in *Cucurbita* sp. fruit at least once from both Brazil and Peru (Whittle and Norrbom, 1987).

Dysmicoccus neobrevipes

Beardsley (1959) describes the normal mode of reproduction in Hawaiian populations of *D. neobrevipes* as being viviparous (producing crawlers instead of eggs) and biparental (as opposed to the parthenogenic Hawaiian *D. brevipes*) and indicates that the gray mealy bug strains from Oahu used for life-history studies conducted by Ito (1938) were in fact *D. neobrevipes*. Those studies indicate that the average number of days from first instar through pre-larvaposition in mated females was 60.3. Larvaposition then occurs over a period of about 30 days with an average and maximum number of first instars produced per female of 346.65 and 908, respectively. Several generations can occur in one year. *Dysmicoccus* species appear to have a slow innate dispersal rate. The main dispersal stage of *D. brevipes* is the first instar which crawls about actively for only about one day for short distances on the same plant or to neighboring plants (CPC, 1999). Within-field dispersal rates for *D. neobrevipes* in Hawaiian pineapple fields, which is assisted to some extent by their association with big-headed ants, was measured at 27.5 m in 3 months (Beardsley et al., 1982). Only the male *D. neobrevipes* has wings (Beardsley, 1959). *Dysmicoccus* sp. can also be dispersed by wind and animals (CPC, 1999). Primary long distance dispersal of all life stages in trade on consignments of plant material and fruit is quite common, as APHIS has intercepted *D. neobrevipes* over 1,317 times on many host plants from over 40 countries. Because of its potentially high reproductive potential and documented long distance dispersal in trade, *D. neobrevipes* was given a rating of high for this sub-element.

Economic Impact

Ratings for economic impact were determined as follows:

High: Pest causes lower yield of the host crop (*e.g.*, by causing plant mortality, or by acting as a disease vector); pest causes lower value of the commodity (*e.g.*, by increasing costs of production, lowering market price, or a combination thereof); or, pest causes the loss of foreign or domestic markets due to presence of new quarantine pest.

Medium: Pest causes any two of the above impacts.

Low: Pest causes any one or none of the above impacts.

Anastrepha grandis

Feeding by larvae usually destroys the pulp of the cucurbit fruit, making them unfit for consumption, thus lowering commodity value. Immature fruits are preferred, and infestation can cause the fruit to drop from the stem, and therefore may reduce yield (Whittle and Norrbom, 1987). If introduced into the continental United States, it could cause loss of domestic markets in Hawaii where it could likely establish if introduced. *Anastrepha* spp. are listed as A1 pests of quarantine significance by Uruguay and Argentina (COSAVE list of quarantine pests) Otherwise, the pest does not appear to be recognized as a pest of quarantine significance based on a search of quarantine pests for the Regional Plant Protection Organizations (those listed in the FAO Global Plant and Pest Information System database (1993) and by EPPO at *http://www.eppo.org/QUARANTINE/lists.html#a1*. Based on this analysis, the economic impact analysis rating is high.

Dysmicoccus neobrevipes

As with *D. brevipes*, *D. neobrevipes* is a serious economic pest particularly in pineapple, but also in a number of other primarily tropical or subtropical hosts. In pineapple, colonization and feeding occur on the basal part of the leaves and fruit, and in pineapple and other host plants, honeydew deposited on the leaves and fruit by the mealybugs serves as a medium for the growth of black sooty moulds which reduces their market value (CPC, 1999). Perhaps because of its already fairly wide distribution, *D. neobrevipes* does not appear to be officially recognized as a pest of quarantine significance by many national plant protection organizations based on a search of quarantine pests for the Regional Plant Protection Organizations listed in the FAO Global Plant and Pest Information System database (1993). Because many host plants of this pest, including some cucurbits, are of commercial or environmental interest to Florida, Texas, Arizona, and California, introduction into any one of these states may cause loss of domestic markets. Because this pest can lower yield and reduce market value of at least some host crops and could potentially cause a loss of domestic markets, the economic impact analysis rating is high.

Environmental Impact

Ratings for environmental impact were determined as follows:

High: Two or more of the following would occur:

- Introduction of the pest is expected to cause significant, direct environmental impacts, *e.g.*, ecological disruptions, reduced biodiversity. When used within the context of the National Environmental Policy Act (NEPA) (Title 7 Code of Federal Regulations §372), significance is qualitative and encompasses both the likelihood and severity of an environmental impact.
- Pest is expected to have direct impacts on species listed by Federal Agencies as endangered or threatened (Title 50 Code of Federal Regulations §17.11 and §17.12), by infesting/infecting a listed plant. If the pest attacks other species within the genus or other genera within the family, and preference/no preference tests have not been conducted with the listed plant and the pest, then the plant is assumed to be a host.
- Pest is expected to have indirect impacts on species listed by Federal Agencies as endangered or threatened by disrupting sensitive, critical habitat.
- Introduction of the pest would stimulate chemical or biological control programs.

Medium: One of the above would occur.

Low: 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).

Anastrepha grandis and *Dysmicoccus neobrevipes*

We estimate that the introduction of either *A. grandis* or *D. neobrevipes* would stimulate the development of control programs which could include chemical or biological control. Previous introduction of other fruit fly and mealybug pests into California have prompted the implementation of both biological control and spray programs. Malathion has been used to control fruit flies;

parathion and introduction of a lady-beetle predator and two hymenopterous parasites have been used to control other mealybugs (*Pseudococcus fragilis* and *Planococcus citri*) that attack citrus and other ornamental hosts (McKenzie, 1967). Both *A. grandis* and *D. neobrevipes* could also infest plants listed as endangered or threatened. Both pests (particularly *A. grandis*) attack members of the genus *Cucurbita* (Norrbom and Kim, 1988) and there is a member of the genus *Cucurbita* listed as endangered, i.e. *Cucurbita okeechobeensis* subsp.*okeechobeensis*. This subspecies exists in Florida in wet tropical climates which are potentially suitable for both *A. grandis* and *D. neobrevipes*. This endangered species is resistant to cucumber mosaic virus, powdery mildew, bean yellow mosaic virus, tobacco ringspot virus, tomato ringspot virus, and squash mosaic virus and its germplasm is valuable in breeding economically valuable cultivated members of the Cucurbitaceae family (FWS, 1995). In addition, both pests could also potentially infest other native *Cucurbita* and *Cucumis* species that exist in the southern United States, as mentioned above.

An established population of *D. neobrevipes* in a Florida nursery was reported to have been eradicated with insecticides in the late 1970's (Hamon, 1980). In Brazil, at least four chemicals have been found to be effective against *D. brevipes* on pineapple (CPC, 1999). In Hawaii, chemical control of the ants that are associated with both *D. neobrevipes* and *D. brevipes* is used to control these pests on crops (Beardsley et al., 1982). Several parasites and predators have been introduced into Hawaii for the biological control of *D. brevipes*, and have become established; and of these, the encyrtid parasitoids and a cecidomyid predator *Lobodiplosis pseudococci*, are the most effective (Rohrbach *et al.*, 1988). Biological control is also used to control *D. neobrevipes* in Thailand (Doug Odermatt, APHIS, personal communication). *Dysmicoccus neobrevipes* is polyphagous and could potentially infest other plants listed as threatened or endangered.

Based on the above factors, both pests receive an environmental impact rating of high.

8. 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. Second, we consider five biological features (i.e., risk elements) concerning the pest and its interactions with the commodity. The resulting risk ratings are specific to each pest. Details of elements and rating criteria are provided in USDA (2000). The cumulative risk rating for introduction is considered to be an indicator of the likelihood that a particular pest would be introduced.

Table 5. Risk Rating: Likelihood of Introduction							
Pest	Quantity imported annually	Survives post - harvest treatment	Survives shipment	Not detected at port of entry	Moved to suitable habitat	Finds suitable host	Risk Rating[1] (Total)
Anastrepha grandis	high (3)	high (3)	high (3)	high (3)	high (3)	high (3)	High (18)
Dysmicoccus neobrevipes	high (3)	high (3)	high (3)	medium (2)	high (3)	high (3)	High (17)
1 = Low (6 - 9) Medium (10 - 14) High (15 - 18)							

Quantity Imported Annually

Ratings for quantity of imports were based on the number of 40 foot shipping containers per year as follows:

Low (1 point): < 10
Medium (2 points): 10 - 100
High (3 points): > 100

Anastrepha grandis and *Dysmicoccus neobrevipes*

From the estimated export volumes indicated by SENASA (letter 1287 dated June 2, 2000) for each of the seven proposed production areas, we estimated that a total of 5,635 metric tons (tm) (12,423,033 lbs) of melon and 26,745 metric tons (58, 962,562 lbs) of watermelon will be imported. Based on recommended packaging and loading practices for 40 ft. refrigerated high cube van containers for melons (McGregor, 1987), this volume converts to approximately 434 shipping containers per year for melon alone. The number for watermelons would be at least 4.5 times greater based on volume. Therefore, both pests received a rating of high for volume of imports.

Survives postharvest treatment

Ratings for this sub-element were determined as follows:

High (3 points): > 10% (greater than one in ten) chance that the pest will survive postharvest treatment (any manipulation, handling or specific phytosanitary treatment to which the commodity is subjected). Examples of postharvest treatments include culling, washing, chemical treatment, cold storage, etc. If there is no postharvest treatment, estimate the likelihood of this sub-element as High.

Medium (2 points): Between 0.1% - 10% (between one in one thousand to one in ten) chance.
Low (1 point): < 0.1% (less than one in one thousand) chance.

Anastrepha grandis and *Dysmicoccus neobrevipes*

No approved post-harvest treatment is available for *Anastrepha grandis* (COSAVE datasheet on *A. grandis*, and Wilmer Snell, APHIS, personal communication). Because *D. neobrevipes* is an external feeder, approved methyl bromide treatments for external feeders on cantaloupe and melon (including watermelon) might be effective to control this pest (USDA Treatment Manual 98-04). Because no mandatory postharvest treatment was indicated, both pests were rated high.

Survives shipment

Ratings for this sub-element were determined as follows:
High (3 points): > 10% (greater than one in ten) chance that the pest will survive shipment from the exporting country to the United States, assuming standard shipping practices.
Medium (2 points): Between 0.1% - 10% (between one in one thousand to one in ten) chance.
Low (1 point): < 0.1% (less than one in one thousand) chance.

Anastrepha grandis

Recommended storage and transit conditions for melons and watermelons would seem to be favorable for pest survival, i.e, high humidity, moderate temperature (45-50 °F for melons; 50-60 °F for watermelon), and moderately long storage life (2-3 wks.) (McGregor, 1987). Conditions for melon are similar to those of *Cucurbita* sp. Insects identified as *Anastrepha* sp. have been intercepted in commercial shipments of *Cucurbita* sp. at least four times since 1981, three times from Brazil, and once from Peru (Whittle and Norrbom, 1987, and USDA PIN 309 pest interception data 1985-2000, see Appendix I). *A. grandis* is the only species of *Anastrepha* listed as a pest of fruit of *Cucurbita* sp., melon or watermelon (Norrbom and Kim, 1988). *A. grandis* larvae burrow into the fruit and are difficult to identify at the species level at this stage. Currently melon and watermelon from counties with *A. grandis* are only allowed entry from pest-free zones. This may account for there being no pest interception data specifically for *A. grandis* for the years examined (1954-63 and 1971-present). Korytkowski (1969) has suggested that the historical records indicate that *Cucurbita sp.* are more favorable hosts for *A. grandis* than melon and watermelon. We are aware of no definitive studies on pest survival in different hosts during storage for *A. grandis*. Based on *Cucubita* sp. interception data, we estimate the shipment survival rating to be high.

Dysmicoccus neobrevipes

Since 1985, there have been at least 1,317 interceptions of this pest from about 40 countries on at least 57 different plant genera, mostly on tropical fruits. There has been one interception on *Nephelium lappaceum* in 1998 from Peru. On Cucurbitaceae, it has been intercepted in *Cucurbita* sp. fruit from Haiti in 1986 and on *Sechium edule* fruit from Brazil in 1994. Because of its demonstrated survival in international commercial shipments of many fruits, this pest was rated high for shipment

survival.

Not detected at port of entry

Ratings for this sub-element were determined as follows:

High: > 10% (greater than one in ten) chance that the pest will not be detected during port of entry inspection, assuming standard inspection protocols for like commodities are employed.
Medium: Between 0.1% - 10% (between one in one thousand to one in ten) chance.
Low: < 0.1% (less than one in one thousand) chance.

Anastrepha grandis

Fruit infested with *A. grandis* can appear undamaged externally (Whittle and Norrbom, 1987). The outer skin can remain firm over a hollow inside tunneled by larvae which when full-grown reach a length of 16 - 16.3 mm. Oviposition punctures are small (about 1.0 mm in diameter), slightly transparent circles with a black center. Exit holes may be visible, but are likely to be difficult to detect given the small diameter of the larvae (2.7 mm). It may be necessary to cut open the fruit to detect the pest. For these reasons, *A. grandis* was rated as high for this sub-element.

Dysmicoccus neobrevipes

Heavy infestations of mealybugs are easily detected because, as they are external feeders/colonizers, the white waxy adults appear on the outside of infested fruit. They could also occur on the growing points, around the stem nodes, and on the undersides of leaves if these plant tissues are still attached. APHIS officials have intercepted this pest at least 1,317 times since 1985, mostly on tropical fruits. Because the pest is small (2-3 mm long), light infestations may not be as readily visible, particularly on popular netted varieties of cantaloupe. For this reason, *D. neobrevipes* was rated medium for this sub-element.

Moved to suitable habitat

Ratings for this sub-element were determined as follows:

High: > 10% (greater than one in ten) chance that, considering the geographic location of likely markets, the commodity will be imported or moved subsequently to an area with an environment suitable for pest survival.
Medium: Between 0.1% - 10% (between one in one thousand to one in ten) chance.
Low: < 0.1% (less than one in one thousand) chance.

Anastrepha grandis and *Dysmicoccus neobrevipes*

SENASA (2000) has indicated that the months of exportation would vary between September and April. But in Peru, melon and watermelon seeds are generally planted in September (Cheng, 1990); therefore we deduce that the bulk of exportation will occur during the latter part of this time frame, from November to April. Therefore, melons or watermelons would be expected to be imported into

the United States from Peru between November and March or April. Based on the fact that this primarily falls in the off-season for melon and watermelon production in the U.S., the imported fruit would likely enter and be distributed to many markets throughout the U.S. Based on the known distribution of *A. grandis* and *D. neobrevipes* (see previous Climate/Host analysis), the only U.S. ports and locations with suitable habitats at that time of year would be in Florida, Texas, Louisiana, and California. These states have eight of the 20 most populated cities and seven of the 20 most populated urban areas in the United States (Gibson, 1998), therefore, it is reasonable to expect that a large proportion of melons and watermelons will be destined for markets in those states. Most of the melons and watermelons from the Caribbean and Central America come in through ports in Florida (Miami, Fort Lauderdale, Tampa) and in Gulfport, Mississippi (Fernanado Palmer, USDA, Market News, Fruits and Vegetables, personal communication to Susan Koehler). Based on this analysis we have rated both pests as high for this sub-element.

Finds suitable host

Ratings for this sub-element were determined as follows:

High: > 10% (greater than one in ten) chance that, considering the complete host range of the pest species and in order for the pest to survive, imported pests will come into contact with host material suitable for reproduction.
Medium: Between 0.1% - 10% (between one in one thousand to one in ten) chance.
Low: < 0.1% (less than one in one thousand) chance.

Anastrepha grandis

The host plants of *A. grandis* are discussed in the Climate/Host analysis. Generally recognized host plants are limited to several Cucurbitaceae species. The only cucurbit production in the United States during the anticipated times of import would occur in those areas not prone to frost, the southern states and California. There is no greenhouse cucurbit industry in the United States. Based on harvest and distribution data and state production levels (Zitter *et al.*, 1996; McGregor, 1987; USDA, NASS, 2000), the following crops could serve as host plants for *A. grandis* should it enter on imported fruit into California, Florida, or Texas: from November to December - melons, cucumbers, squash, and pumpkins; from January through March - squash, and immature cucumbers and watermelon. Because *Cucurbita* species appear to be more favorable hosts for *A. grandis*, and these species are grown year round in the states with both suitable climate for *A. grandis* and likely import or distribution centers for the imported fruit, this pest is rated high for this sub-element.

Dysmicoccus neobrevipes

The host plants of *D. neobrevipes* are discussed in the Climate/Host analysis. Several suitable hosts listed in that section are likely to be available during the import period and in suitable habitats. These include many native species that are present year-round in those habitats. For these reasons, this pest is rated high for this sub-element.

9. Conclusion: Pest Risk Potential and Phytosanitary Measures

The measure of pest risk potential combines the risk ratings for consequences and likelihood of introduction (USDA, 2000). Our rating of the overall pest risk potential (PRP) for each quarantine pest selected for further analysis is shown in Table 6. As noted previously, the prevalence of *Anastrepha grandis* in the areas of production for these commodities in Peru was not evaluated in this risk assessment. The validity and significance of trapping data for this pest will be evaluated by APHIS during the Risk Management phase. *Dysmicoccus neobrevipes* has also been reported in Peru.

Table 6: Pest Risk Potential, Quarantine Pests Likely to Follow the Pathway

Pest	Pest Risk Potential[1]
Anastrepha grandis (Macquart)	high (31)
Dysmicoccus neobrevipes Beardsley	high (31)

[1] Low (11 - 18)
Medium (19 - 26)
High (27 - 33)

Plant pests with a medium or high Pest Risk Potential may require specific phytosanitary measures. The choice of appropriate phytosanitary measures to mitigate risks is undertaken as part of Risk Management and is not addressed, *per se*, in this document. 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. Details of APHIS risk management programs are published, primarily in the *Federal Register* as quarantine notices.

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APPENDIX 1.

Pest Interception Data for Curcurbitaceae from South America, 1985-2000. (No pest interceptions were identified for the following countries: Peru, Uruguay, French Guiana, Bolivia, Paraguay)

Origin and Host Plant	Pest	Total
ARGENTINA		
CUCUMIS SATIVUS (FRUIT)	AGROMYZIDAE, SPECIES OF	1
CUCUMIS SATIVUS (FRUIT)	CLADOSPORIUM SP.	1
BRAZIL		
CUCUMIS MELO (FRUIT)	BLAPSTINUS SP.	1
CUCUMIS MELO (FRUIT)	CONODERUS SP.	1
CUCUMIS MELO (FRUIT)	ELASMOLOMUS SORIDIDUS	3
CUCUMIS MELO (FRUIT)	MEMBRACIS MEXICANA	1
CUCUMIS SATIVUS (FRUIT)	CLADOSPORIUM SP.	1
CUCUMIS SATIVUS (FRUIT)	NEOLEUCINODES ELEGANTALIS	1
CUCURBITA MAXIMA (FRUIT)	FUSARIUM SP.	1
CUCURBITA MOSCHATA (FRUIT)	ANASTREPHA SP.	1
CUCURBITA PEPO (FRUIT)	CLADOSPORIUM SP.	1
CUCURBITA SP. (FRUIT)	ANASTREPHA SP.	1
CUCURBITA SP. (FRUIT)	DIPTERA, SPECIES OF	1
CUCURBITA SP. (FRUIT)	TEPHRITIDAE, SPECIES OF	1
CUCURBITA SP. (FRUIT)	TORTRICIDAE, SPECIES OF	1
CUCURBITACEAE (LEAF)	MICROTHECA SP.	1
SECHIUM EDULE (FRUIT)	COCCIDAE, SPECIES OF	1
SECHIUM EDULE (FRUIT)	DYSMICOCCUS NEOBREVIPES	1
SECHIUM EDULE (FRUIT)	FUSARIUM SP.	1
SECHIUM EDULE (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	1
SECHIUM EDULE	PLANOCOCCUS MINOR	1
COLOMBIA		
CUCURBITA SP. (FRUIT)	CLADOSPORIUM SP.	1
CUCURBITA SP. (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	1
CUCURBITA SP.	PENTATOMIDAE, SPECIES OF	1
CUCURBITA SP.	TEPHRITIDAE, SPECIES OF	1
MOMORDICA BALSAMINA (LEAF)	OLETHREUTINAE, SPECIES OF	1
MOMORDICA CHARANTIA (STEM)	APHIDIDAE, SPECIES OF	1
MOMORDICA SP. (FRUIT)	ANASTREPHA SP.	1
SECHIUM EDULE (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	1
SECHIUM EDULE (FRUIT)	THRIPIDAE, SPECIES OF	1

ECUADOR		
COCCINEA SP.	APHIDIDAE, SPECIES OF	2
CUCUMIS MELO (FRUIT)	AEOLUS SP.	9
CUCUMIS MELO (FRUIT)	AMPHICERUS SP.	1
CUCUMIS MELO (FRUIT)	BLAPSTINUS SP.	30
CUCUMIS MELO (FRUIT)	BLISSUS SP.	1
CUCUMIS MELO (FRUIT)	CRYPTOTERMES SP.	1
CUCUMIS MELO (FRUIT)	CURCULIONIDAE, SPECIES OF	2
CUCUMIS MELO (FRUIT)	DIAPHANIA SP.	2
CUCUMIS MELO (FRUIT)	DYSDERCUS SP.	1
CUCUMIS MELO (FRUIT)	GRYLLIDAE, SPECIES OF	1
CUCUMIS MELO (FRUIT)	GRYLLUS CAPITATUS	1
CUCUMIS MELO (FRUIT)	GRYLLUS SP.	2
CUCUMIS MELO (FRUIT)	ISCHNODEMUS SP.	1
CUCUMIS MELO (FRUIT)	LYGAEOIDEA, SPECIES OF	1
CUCUMIS MELO (FRUIT)	MYOCHROUS SP.	1
CUCUMIS MELO (FRUIT)	PRYTANES SP.	1
CUCUMIS MELO (FRUIT)	PYRALIDAE, SPECIES OF	1
CUCUMIS SATIVUS (FRUIT)	PYRALIDAE, SPECIES OF	1
CUCURBITA PEPO (FRUIT)	PHOMOPSIS SP.	1
CUCURBITA SP. (FRUIT)	CURCULIONIDAE, SPECIES OF	2
CUCURBITACEAE (LEAF)	PHENACOCCUS SP.	1
MOMORDICA CHARANTIA (LEAF)	PYRALIDAE, SPECIES OF	1
MOMORDICA SP. (STEM)	NOCTUIDAE, SPECIES OF	1
SECHIUM EDULE (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	1

CHILE		
CITRULLUS LANATUS (FRUIT)	MICROGRYLLUS PALLIPES	1
CUCUMIS MELO (FRUIT)	HYLURGUS LIGNIPERDA	1
CUCUMIS MELO (FRUIT)	SITONA HUMERALIS	1
CUCUMIS MELO (FRUIT)	BLAPSTINUS PUNCTULATUS	5
CUCUMIS MELO (FRUIT)	BLAPSTINUS SP.	2
CUCUMIS MELO (FRUIT)	CAENURGIA RUNICA	1
CUCUMIS MELO (FRUIT)	CALOPHYA SP.	1
CUCUMIS MELO (FRUIT)	CHELYMORPHA VARIANS	1
CUCUMIS MELO (FRUIT)	CHONDRODERA CHILENSIS	1
CUCUMIS MELO (FRUIT)	CONODERUS RUFANGULUS	2
CUCUMIS MELO (FRUIT)	CURCULIONIDAE, SPECIES OF	1

CUCUMIS MELO (FRUIT)	DIAPHANIA SP.	1
CUCUMIS MELO (FRUIT)	ECTOMYELOIS SP.	1
CUCUMIS MELO (FRUIT)	GEOMETRIDAE, SPECIES OF	1
CUCUMIS MELO (FRUIT)	GRYLLIDAE, SPECIES OF	2
CUCUMIS MELO (FRUIT)	GRYLLUS SP.	4
CUCUMIS MELO (FRUIT)	HOPLOSPHYRUM GRISEUS	3
CUCUMIS MELO (FRUIT)	LISTRODERES SP.	1
CUCUMIS MELO (FRUIT)	MICROGRYLLUS PALLIPES	30
CUCUMIS MELO (FRUIT)	MICROGRYLLUS SP.	1
CUCUMIS MELO (FRUIT)	NAUPACTUS XANTHOGRAPHUS	1
CUCUMIS MELO (FRUIT)	NEMATUS SP.	1
CUCUMIS MELO (FRUIT)	NEOTERMES CHILENSIS	5
CUCUMIS MELO (FRUIT)	NOCTUIDAE, SPECIES OF	1
CUCUMIS MELO (FRUIT)	NYSIUS SP.	4
CUCUMIS MELO (FRUIT)	OECOPHORIDAE, SPECIES OF	1
CUCUMIS MELO (FRUIT)	POROTERMES QUADRICOLLIS	5
CUCUMIS MELO (FRUIT)	PYRALIDAE, SPECIES OF	3
CUCUMIS MELO (FRUIT)	RHOPALIDAE, SPECIES OF	1
CUCUMIS MELO (FRUIT)	SIBINE SP.	1
CUCUMIS MELO (FRUIT)	SPHINGONOTUS SP.	1
CUCUMIS MELO (FRUIT)	TORTRICIDAE, SPECIES OF	1
CUCUMIS METULIFERUS (FRUIT)	GELECHIIDAE, SPECIES OF	1
CUCUMIS SP. (FRUIT)	BLAPSTINUS SP.	2
CUCURBITA MAXIMA (FRUIT)	CYRTOPELTIS SP.	1
CUCURBITA MAXIMA (FRUIT)	MIRIDAE, SPECIES OF	1
CUCURBITA MAXIMA (FRUIT)	TORTRICIDAE, SPECIES OF	1
CUCURBITA MOSCHATA (FRUIT)	MIRIDAE, SPECIES OF	1
CUCURBITA MOSCHATA (FRUIT)	NEOTERMES CHILENSIS	2
CUCURBITA SP. (FRUIT)	NOCTUIDAE, SPECIES OF	1
CUCURBITA SP. (FRUIT)	PSYLLIDAE, SPECIES OF	1
GUYANA		
CUCURBITA SP. (FRUIT)	NEOLEUCINODES SP.	1
CUCURBITACEAE (FRUIT)	PYRAUSTINAE, SPECIES OF	1
MOMORDICA BALSAMINA (LEAF)	DIAPHANIA SP.	1
MOMORDICA BALSAMINA	DIAPHANIA SP.	1
MOMORDICA CHARANTIA (LEAF)	CASSIDA SP.	1
MOMORDICA CHARANTIA (LEAF)	DIAPHANIA SP.	1
MOMORDICA CHARANTIA (LEAF)	PTEROPHORIDAE, SPECIES OF	1
MOMORDICA CHARANTIA	DIAPHANIA SP.	2

SURINAME		
MOMORDICA SP. (FRUIT)	OECOPHORIDAE, SPECIES OF	1
VENEZUELA		
CITRULLUS LANATUS (FRUIT)	PYRALIDAE, SPECIES OF	1
CUCUMIS MELO (CRATING)	SINOXYLON CONIGERUM	1
CUCUMIS MELO (FRUIT)	BLAPSTINUS SP.	1
CUCUMIS MELO (FRUIT)	BLAPSTINUS SP.	1
CUCUMIS MELO (FRUIT)	CONODERUS VARIANS	1
CUCUMIS SATIVUS (FRUIT)	NEOLEUCINODES ELEGANTALIS	2
CUCUMIS SATIVUS (FRUIT)	NOCTUIDAE, SPECIES OF	1
CUCUMIS SATIVUS	FUSARIUM SP.	1
CUCUMIS SP. (FRUIT)	MELANAETHUS SPINOLAE	1
CUCURBITA SP. (FRUIT)	ARVELIUS SP.	1
SECHIUM EDULE (FRUIT)	CLADOSPORIUM SP.	1
SECHIUM EDULE (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	1
SECHIUM EDULE (FRUIT)	PSEUDOCOCCUS SP.	1
SECHIUM EDULE (FRUIT)	TARSONEMUS SP.	1
SECHIUM SP. (FRUIT)	PSEUDOCOCCIDAE, SPECIES OF	1