PEER REVIEW REPORT

FOR

IMPORTATION OF 'HASS' AVOCADO

(*PERSEA AMERICANA*) FRUIT

FROM PERU

INTO THE CONTINENTAL UNITED STATES

September 13, 2006

USDA Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Riverdale, MD

Peer Review Report
Reviewer No. 1

I consider that the entomological content of the document "Importation of "Hass" Avocado (*Persea americana*) Fruit from Peru into the Continental United States" is a well thought out and elaborated document. However, I would suggest to consider reviewing and including the following in some of the sections of the document.

1. Pest list as relates to all appropriate plant pests, accuracy of worldwide distribution and association with the plant parts affected by the pest.

Page 9. Include Wolfe *et al*. (1969) in references for *Panonychus citri* and for *Tetranychus urticae*.

Page 10. Include Novore (2003) in the references for *Derobrachus asperatus*

Include Wolfe *et. al.* (1969) in references for *Oncideres poecilla*

Heilipus empiricus: Delete Wysoki *et al.*(2002) from the references. Wysoki *et al.*(2002) cite information only on *Heilipus lauri.*

Heilipus sp: Since only the genus is included here, in the column for plant part affected, I would include other plant parts (e.g., roots) affected by some species of *Heilipus.* For instance, *Heilipus rufipes* has been found infesting avocado roots by Laurencao *et al.* (2003).

An species of *Heilipus, H. squamosus* is cited by Wolfenbarger (1948) as having been collected from avocado in Florida. Therefore, Pena (2003) included it in the list of pests from avocado in Florida. Therefore, when *Heilipus* sp. is cited, Florida should be included in the distribution of the genus.

Anonymous (2006a) also cites *Acritus* as being present in Peru; consider its inclusion in references.

Page 11

Include: *Pelidnota clorana* (Scarabeidae) as a pest of avocados in Peru. It is cited from flowers and leaves by Arellano Cruz (1998).

Page 12

It reads Ballou (1922) in references.

Page 13

Include Seguenas and Camara (2002) in the references for *Aleurodicus cocois.*

Blackman and Eastop (2000) in references cited.

Ceroplastes floridensis: Reference for USDA 2003a or b?

Page 14.

References for USDA 2003 a or b? See references.

In the distribution of *Aspidiotus destructor* include GA and HI as cited by Miller and Davidson (2005).

Page 15

In the references for *Selenaspidus articulatus* include Wolfe et al. (1969) and Miller and Davidson (2005).

Coile and Dixon(2000). Not in references. They have been included in the references cited in this review.

Page 16

In the references for *Unaspis citri* include Wolfe et al. (1969).

Page 17

In the references for *Acromyrmex hispidus* include Arellano Cruz (1998).

In the references for *Atta sexdens* include Arellano Cruz (1998) and Wolfe et al (1969).

In the references for *Sabulodes caberata* include Wolfe *et al*. (1969).

In the references for *Phyllocnistis* n. sp., include Wolfe *et al*. (1969).

Note: Pena (2003) also cites *Phyllocnistis* n. sp. from Florida, USA.

Page 18

In the plant parts affected for *Stenoma catenifer* Sd (seed) should be included as cited by Wolfe *et al*. (1969), Wysoki *et al.* (2002).

Page 29.

I agree with the assessments (5a) regarding *Heilipus* sp. My efforts to find more information on *H. empiricus* were unsuccessful.

Page 30. The references cited in 16a,16b, concur with the statements made.

I could not find 17 in Table 3.

The studies of Dominguez Gil (1983) support the statement made in 18.

The statements made in 23,24,25 are correct.

Pages 31 –32. The discussion regarding *Anastrepha* species as pests of avocado is well done. Studies by Aluja *et al.,* (2002) and Aluja *et al*., (2004) support the re-evaluation of their status as pests of this crop. However, since there is still controversy on the possible existence of sibling species of *Anastrepha fraterculus* in South America, I strongly support the notion that data based on adult fly trapping in avocado groves and fruit cuttings for possible larval infestations should be done with Hass avocado in Peru.

Page 34. Galllegos and Bonano (1993) not in the references.

2. Evaluation of the quality and completeness of the individual components of the actual assessments.

Acutaspis albopicta

Risk values allocated for risk element #1 as high are adequate. Risk element #2 is adequate. Include guava, *Psidium guajava* L. (Myrtaceae) in the host range as cited by Vasquez *et al.* (2000).

The statement that little information is available for *A. albopicta* is correct as there is little information for the genus *Acutaspis* (Miller and Davidson, 2005; Rosen 1990a,b; Anonymous, 2006). Most of the information regarding the genus *Acutaspis* concerns with taxonomy and/or lists of pests without describing information on the biology of this genus.

Risk element #4. Rate as medium for this risk element is appropriate. Costs on avocado production will increase and if introduced may lead to losses of US California avocado markets.
Risk element # 5. *A. albopicta* is not present in Florida, but a species in the same genus, *A. perseae*, is present in Florida (Pena, 2003). However, there are no data on its impact on the environment. There is no data available on parasitoids collected from this scale. Rating as medium risk is appropriate.

Anastrepha fraterculus

This species has also been recorded from *Passiflora* spp. in Brazil. See Aguiar *et al*. (2002).
I concur with the rating as high for risk elements #3,#4, and #5.

Anastrepha striata

I agree on all risk value ratings.
Mangifera indica should be added to the host range as cited by Waite (2002).

Ceratitis capitata
I agree with all risk value ratings.

Coccus viridis
Risk Element #1. Since *C. viridis* is already present in Florida, which is included in plant hardiness zones 9-11, then the sentence “it is estimated that it could become established in US zones 9-11”, should be modified. It should read zone 8.

Host range. This scale has been collected in Florida from *Persea americana* (Pena, 2003). I agree that the host range is extensive and the rating should be high.

Environmental impact. The scale is already established in the citrus producing areas of Florida. Several entomopathogenic fungi have been observed associated with green scale on citrus and

some played an important role in the natural limitations of the scale on citrus during certain seasons of the years. It should be specified that *C. viridis* would affect citrus producing areas of Texas and California. I suggest re-assessment of the environmental impact rating.

Ferrisia malvastra

The risk assessments are correct. Very little is known about *F. malvastra*. However, its host range could be as wide as that of *F. virgata.* See Angeles Martinez (2001), Waite (2002), Pantoja *et al.* (2002).

Pseudaonidia trilibitiformis

Pseudaonidia trilibitiformis is reported by Miller and Davidson (2005) and by Coile and Dixon (2000) as established in Florida. I suggest a re-assessment of risk element #1.

Risk Element #3. As stated, the biology of the species has not been studied. It is considered one of the most important pests of citrus and has potential for dispersion (California, Texas?).

Risk element # 4: It should be noted in the economic impact that *P. trilobitiformis* is an important pest of *Vitis vinifera* in Venezuela. See: Clavijo (1976).

Stenoma catenifer

The risk assessments #1,#2,#3 and #4 are adequate and correct based on the information from the cited references.

Risk Element # 5: Environmental impact. The statement " If *S. catenifer* was (is) introduced, spray programs against adults will be similar to the ones already in existence for avocado pests" is not correct.

1. Registered pesticides against lepidopterous avocado pests are used against larvae and not against adults. There are no published results that spray programs are aimed at adults of Lepidoptera (Wysoki et al., 2002; Glenn *et al.*,2003).

2. Current lepidopterous pests in the U.S., e.g., *Amorbia cuneana* (Tortricidae), , *Sabulodes aegrotata, Epimeces detexta* (Geometridae) damage the fruit superficially(Bailey and

Olsen, 1990a,b, Glenn *et al*., 2003) but do not bore into the pulp and seed as *S. catenifer*. None of the current registered pesticides in Florida have been tested against fruit borers. Therefore, efficacy tests of currently registered pesticides and tests of pesticides to be registered need to be conducted.

3. *S. catenifer* is currently controlled in Brazil with organophosphates,carbamates and pyrethoids (Ventura *et al*., 1999). In Mexico, insecticides should be applied at least 12 times in order to be effective (Wysoki *et al*., 2002). Therefore, introduction of *S. catenifer* will stimulate and change current chemical control practices in US avocado, which could be detrimental to the beneficial fauna of the current pests.

4. The statement "It is possible that new biological control programs could be based on the reports of the larval parasitism in natural populations" should be considered with caution. Only undetermined species of the genera *Dolichogenidea* sp, *Hypomicrogaster* sp, *Apanteles* sp, *Hymenochaonia* sp.(Hymenoptera: Braconidae) and *Eudoleboea* sp., and *Pristomerus* sp. (Hymenoptera: Ichneumonidae) have been detected in Brazil (Nava *et al*. 2005). Determination of these genera at the species level, studies of specificity of the species are necessary before considering a classical biological control program.

Moreover, since the egg parasitoids *Trichogramma pretiosum* and *Trichogrammatoidea annulata* are cited as causing 40% parasitism, and one species occur in the U.S., and/or have been released against pests in the US. (e.g., *T. annulata* against the navel orarnge worm, *Amyelotis transitella*) the statement on biological control should refer to these species. Hohmann and Meneguim (1993) was not found in the references.

4. Likelihood of Introduction

The assessments for pest opportunity, e.g., ability to survive post harvest treatment, survive shipment and detection of at the port of entry (pages 50-51) are well stated as the discussion is based on evidence of shipments and pest behavior. However, in the assessment of the ability to survive habitats, (Moved to a suitable habitat), page 51, it is stated that *S. catenifer* needs specific temperature ranges based on reports of distribution on lowlands and coastal areas. However, it should be made clear that no studies have been conducted to determine the survival of immature stages of this species under lower temperature regimes.

Secondly, in the same page, it is stated that *S. catenifer* is known to feed only on avocado. According to Risk Element #2, page 47, it is stated that *S. catenifer* infests several species within the genus *Persea.* Therefore, it could be expected that *S. catenifer* could infest the native species, *Persea borbonia*, in Florida and Georgia.
My suggestion is to re-assess the rating for contact with host material for this species.

5. Completeness of the list of mitigations as well as mitigation effectiveness

Prior-Harvesting. The pest-free areas, control programs and measures for phytosanitary certification inspections are well stated.

Post-harvest and Prior shipping. In the post-harvest safeguards packing house procedures (page 58) it is stated that avocados must be protected from fruit fly infestations during their movement. An example of a type of expected protection would be adequate. Screens placed on top of boxes? All other procedures are specific and clear.

Mitigation options during shipping at U.S. Ports of Entry. Are there any specifications that would restrain movement of avocados from North Atlantic ports to avocado producing areas in the U.S.? If existent, they should be mentioned.

Quarantine Treatments. The current treatments are well stated for most of the pests as well as the lack of available data for treatment against the fruit flies *Anastrepha* and the moth *Stenoma catenifer.* In this assessment, irradiation is considered effective against larvae of the moth *Stenoma catenifer* based in the reference from CABI (2005) that pupation of this moth occurs only in the soil. However, please notice that Arellano Cruz (1998) reports that pupation can also occur inside of the seed. If pupation inside of the seed is feasible, then, irradiation might not be effective against *Stenoma catenifer.*

Monitoring, pre-shipment programs, trapping are well stated and appropriate.

D. References in the assessment

The references used in this risk assessment are appropriate. However, the reviewer could not find the citation of the following references in the text:

Page 67: Evangelou *et al*. (1993).

Page 71: McAlpine and Steyskal (1982).

References suggested by the reviewer:

I would include or review the following additional references:

Aguiar-Menezes, E., E. Menezes, P. C. Cassino and M. A. Soares. 2002. Passion Fruit. In: Pena, J., J. Sharp and M. Wysoki, eds. Tropical Fruit pests and pollinators, CAB International, Wallinford, UK., pp., 361-390.

Angeles Martinez, M. 2001 New hosts of *Ferrisia virgata* in Cuba. Revista de Proteccion Vegetal. 12:68.

Anonymous. 2006a. Coleoptera:Histeridae present in the Entomological Museum of Lund University. Downloaded as:
http://www.biomus.lu/se/zoomus/ZooDoc/VetSam/OrdCol/ListCol/027.Histeridae.html

Anonymous. 2006b. Arthropods of economic importance. Diaspididae of the world. Downloaded as:
http://ip30.eti.uva.nl/BIS/diaspididae.php?menuentry=sorten&id=80

Bailey, J.B., and K. N. Olsen. 1990a. Chemical control of amorbia an insect pest of avocado and citrus. California Agric. 44:189-198.

Bailey, J.B., and K. N. Olsen. 1990b. Supplemental chemical control of omnivorous looper on avocados. California Agric. 44:8-9.

Clavijo, S. 1976.Escamas (Homoptera:Coccoidea) en plantas de viveros en la zona de Maracay, Estado de Aragua,Venezuela. Rev. Fac. Agron. (Maracay). 9:113-122. Downloaded as:
www.redpav-fpolar.info.ve/fagr/009_2/v092m006.html

Coile, H. and Dixon, W. 2000. Trilogy. 39. Florida Department of Ag. Cons. Services. Downloaded as:

http://www.doacs.state.fl.us/pi/enpp/Do-mar-apr.htm

Glenn, H., Pena, J. E., Baranowski, R., and R. Duncan. 2003. Lepidopterous pests of Florida avocado;biodynamics, mortality factors and control. Pests of avocado in Florida. Actas, V Congreso Mundial del Aguacate, 19-24 Octubre, Granada-Malaga, 2:503-508.

Laurencao, A., Soares, H., Rosado-Neto, G. 2003. Occurrence and damage of *Heilipus rufipes* Perty (Coleoptera:Curculionidae) larvae in avocado trees (*Persea Americana* Mill.) in the state of Ceara, Brazil. Neotrop. Entomol. 32: 363-364.

Miller, D., and J. A. Davidson. 2005. Armored scale insect pests of trees and shrubs (Hemiptera:Diaspididae). Comstock Publishing Associates; Cornell Univ. Press, Ithaca, NY. 442 pp.

Nava, D., Parra, J., Costa, V., Guerra, T., and Consoli, F. 2005. Population dynamics of *Stenoma catenifer* (Lepidoptera:Elachistidae) and related larval parasitoids in Minas Gerais, Brazil. Florida Entomol. 88:441-446.

Novore, F.T. 2003. Checklist of the Cerambycidae and Disteniidae of Costa Rica. Downloaded as:
www.novore.com/pdf/Cerambycidae_of_Costa_Rica_2003.pdf

Pantoja, A., P. A. Follett and J. A. Villanueva. 2002. Passion Fruit. In: Pena, J., J. Sharp and M. Wysoki, eds. Tropical Fruit pests and pollinators, CAB International, Wallinford, UK., pp., 131-156.

Pena, J. E. 2003. Pests of avocado in Florida. Actas, V Congreso Mundial del Aguacate, 19-24 Octubre, Granada-Malaga, 2:487-494.

Petty, G., G. R. Stirling and D. P. Bartholomew. 2002. Pests of Pineapple. In: Pena, J., J. Sharp and M. Wysoki, eds. Tropical Fruit pests and pollinators, CAB International, Wallinford, UK., pp., 157-198.

Rosen, D. 1990a. Armored scale insects, their biology, natural enemies and control, Vol A., Elsevier, NY 383 p.

Rosen, D. 1990b. Armored scale insects, their biology, natural enemies and control, Vol B., Elsevier, NY 688 p.

Seguenas, Y., E., and C. Corman Camara. 2002. Efecto del Neem *Azadirchacta indica* (Triology 70 y Neemix 4.5) en el control de mosca blanca *Aleurodicus cocois* en el palto cultivado en Huimanal XLIV Convencion Nacional de Entomologia, Lima, 3-7 Nov. 2002. 100 Universidad Nacional Agraria La Molina.
Downloaded as:
www.lamolina.edu.pe/convencionentomologia/insecticidas_botanicos.htm

Vasquez, J., Delgado, C., Couturi, J., and Matile-Ferrero. 2002. Harmful insects for the guava tree (*Psidium guajava* L: Myrtaceae) in Peruvian Amazonia. Fruits 57: 323-334.

Ventura, M., Destro, D., Lopes, E., Montalvan, R. 1999. Avocado moth (Lepidoptera:Stenomidae) damage in two avocado cultivars. Florida Entomol. 82: 625-631.

Waite, G. 2002. 2002. Pests and pollinators of mango. In: Pena, J., J. Sharp and M. Wysoki, eds. Tropical Fruit pests and pollinators, CAB International, Wallinford, UK., pp., 103-130.

Wolfenbarger, D. O. 1948. *Heilipus squamosus* Lec., A new enemy of the avocado. California Avocado Society 1948 Yearbook. 33: 98-102.

Peer Review Report
Reviewer No. 2

Review of Pest Risk Assessment "Importation of 'Hass' Avocado (*Persea americana*) Fruit from Peru into the Continental United States

As requested I have reviewed the Pest Risk Assessment (PRA) titled "Importation of 'Hass' Avocado (*Persea americana*) Fruit from Peru into the Continental United States". As agreed, this review covers only fungal, bacterial, viral and algal pathogens and nematodes covered by the PRA. It does not cover the insects. In the review process, I used as source material many of the same references and data bases used by the authors of the document, with special emphasis on any new information and new reports of relevant pathogenic organisms on avocado since the PRA was prepared in 2004. Additional sources included data bases, especially those related to taxonomy and nomenclature of fungi and other organisms, not used in the original document as well as relevant new papers published in scientific journals since the PRA was prepared. These sources are listed at the end of the section on Taxonomy and Nomenclature of Pathogens and Nematodes Listed in Table 3.

Pest List – Pests Reported on Avocado in Table 3 of the PRA

No additional pathogens or nematodes were found that should be listed in Table 3. Under the guidelines used, this list appears to be complete as of the date of this review. As far as I could determine, the geographic distribution and association of these organisms with plant parts as presented in Table 3 are accurate except for *Armillaria mellea*. This fungus is not likely to be found on leaves, and its occurrence in Peru is doubtful (see next section). With two exceptions, the quarantine pest status of the organisms listed appear to be accurate. *Ceratocystis fimbriata* should be listed as a quarantine pest, while *Rosellinia bunodes* should not (see Cline and Farr 2006). I could not find any substantiating information on the alga *Cephaleuros virescens*, which is listed as a quarantine pest in the PRA.

Taxonomy and Nomenclature of Pathogens and Nematodes Listed in Table 3.

General comments: In column 1 of Table 3 (Scientific Name, Classification) there are several fungi in which the currently accepted name is not listed first; for example *Curvularia lunata* is the accepted name for *Acrothecium lunata*. I think it would be better to list the accepted name first in the table. If both the anamorph and teleomorph are known, the teleomorph is usually the accepted name and would be listed first. I didn't know if there was some reason for not doing this so I did not make any changes in this regard. There are also classification errors for some of the organisms listed. Below is the list of organisms from Table 3 with suggested changes and/or general notes. Those organisms for which some change has been suggested are marked with an asterisk.

*Xiphinema floridae Lamberti & Bleve-Zecheo. Note: Authorities are added for this species. Check for correct designation for footnote 6 for all nematodes listed only to genus. Information on all of the other nematode species appears to be accurate.

**Cephaleuros virescens* Künze. Trentepohliales, Trentepohliaceae. Note: Listed under Bacteria, but organism is an alga. On what basis is this organism considered a quarantine pest?

* *Curvularia lunata* (Wakk.) Boedijn. (= *Acrothecium lunatum* Wakk.). Teleomorph: *Cochliobolus lunatus* R.R. Nelson & Haasis. Pleosporales, Pleosporaceae. Note: Currently accepted name is *Curvularia lunata*.

**Armillaria mellea*. Agaricales, Marasmiaceae. Note: As currently accepted, *Armillaria mellea* is a northern hemisphere species except for a single introduction into South Africa (Coetzee et al. 2001). Reports of its occurrence in South America are likely to be in error. A recent study (Coetzee and Wingfield 2003) identified *Armillaria luteobubalina* and *A. novae-zelandiae* from Chile and Argentina. Both of these species occur in Australia and New Zealand, but not in the US. [This fungus is not likely to be present on leaves (see column 3)] [Reference by Gonzales and Abad (see column 6) is not included in the Literature Cited]

**Aspergillus nigerTiegh*. Anamorphic *Emericella*, Eurotiales, Trichocomaceae.

**Botryodiplodia* sp. Anamorphic Ascomycetes. Note: See footnote 6 as relates to being considered a quarantine pest.

**Botryosphaeria dothidea* (Moug.) Ces. & de Not. (=Physolospora perseae Doidge). Anamorph: *Fusicoccum* sp. Dothideales, Botryosphaeriaceae.

Botrytis cinerea Pers:Fr. Anamorphic *Botryotinia*. Helotiales, Sclerotiniaceae.

**Ceratocystis fimbriata* Ellis & Halst. Microascales, Ceratocystidaceae. Note: Because of its wide distribution in both tropical and temperate regions, as well as its numerous hosts which include both woody and herbaceous plant species, considerable attention has been given to the possible occurrence of host-specific pathogenic strains. For example, Wellman (1972) informally recognized "races" that were associated with rubber, cocoa, coffee, *Dioscorea* spp., and *Xanthosoma* in the tropics. Morgan-Jones (1967) noted the occurrence of wide variation in host susceptibility to the pathogen, but did not propose any subspecific taxa. Mourichon (1994) reported *C. fimbriata* to cause dieback on citrus in Colombia. However, the fungus has been reported to occur on several *Prunus* spp. in California, but is not known there on citrus (DeVay et al. 1968). Until recently, the only subspecific taxon recognized was *C. fimbriata* f. *platani*, which causes canker stain on *Platanus* spp. in the northern hemisphere. In 2000, studies by Harrington based on phylogenetic analysis revealed three geographic clades within *C. fimbriata* that were centered in Asia, North America and Latin America. Within the Latin American clade, isolates from cacao, sweet potato and sycamore formed three distinct genotypes (Baker et al. 2003). The genotypes from cacao and sycamore were described as new species, *Ceratocystis cacaofunesta* and *C. platani*, respectively, while the sweet potato genotype, which was originally described on that host, was retained in *C. fimbriata*. It appears that sweet potato is the only host of *C. fimbriata sensu stricto* (Baker et al. 2003). Isolates from Prunus spp. in the United States (including California), previously referred to as *C. fimbriata*, belong to the North American clade (Johnson et al. 2005) and can be placed in the already existing species *C. variospora* along with isolates from *Quercus* spp. The

isolates from citrus in Colombia belong to the Latin American clade (Harrington, 2006, personal communication). None of the isolates used in the above studies came from Peru, so the form(s) of the fungus that might occur there are not known. **Because of the uncertainty of the forms of the fungus that may be currently present in California and that may be associated with avocado in Peru, it may be advisable to subject *Ceratocystis fimbriata* to further analysis. Although not listed as such in Table 3, the fungus is on the APHIS Regulated Plant Pest List (see Cline and Farr 2006).**

**Cercospora lingue* Speg. Anamorphic Mycosphaerellales, Mycosphaerellaceae. Note: Status unclear, not a cercosporoid fungus. (see Crous and Braun 2003. This book is much more up-to-date than Chupp).

Cercospora perseae Ellis & Mart. Anamorphic Mycosphaerellales, Mycosphaerellaceae.

**Pseudocercospora purpurea* (Cooke) Deighton (= Cercospora purpurea Cooke). Anamorphic Mycosphaerellales, Mycosphaerellaceae. Note: see Crous and Braun 2003. Also see spelling of *purpurea.*

Cladosporium sp. Anamorphic Mycosphaerellales, Mycosphaerellaceae.

**Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. in Penz. (Teleomorph: *Glomerella cingulata* (Stone.) Spauld. & H. Schrenk). (taxonomic position of order uncertain), Glomerellaceae. Note: See *Glomerella cingulata* below. There is no need to list under both anamorph and teleomorph names. I suggest listing under the teleomorph.

**Corticium salmonicolor Berk*. & Broome. (=*Erythricium salmonicolor* (Berk. & Broome) Burd. Polyporales, Phanerochaetaceae. Note: In 1985 Burdsall (Mycol. Mem. 10: 151) transferred this fungus to *Erythricium salmonicolor*. The new name was accepted by many and has been used in recent literature, and is the accepted name in the SBML Fungal Data Base (Farr et al. 2006). However, Index Fungorum currently recognizes *C. salmonicolor* as the correct name, and in a recent personal communication, Burdsall told me that he was in error in transferring the fungus to *Erythricium*.

**Fusarium lateritium* Nees. Teleomorph *Gibberella baccata* (Wallr.) Sacc. Hypocreales, Nectriaceae.

**Fusarium roseum* Link. Teleomorph *Gibberella zea* (Schwein.) Petch. Hypocreales, Nectriaceae.

**Fusarium oxysporum* Schlecht. Anamorphic *Gibberella*. Hypocreales, Nectriaceae.

**Fusarium solani* (Martius) Sacc. Teleomorph *Nectria haematococca* (Wollenw.) Gerlach. Hypocreales, Nectriaceae.

**Gibberella avenacea* R.J. Cook Anamorph *Fusarium avenaceum* (Fr.) Sacc. Hypocreales, Nectriaceae.

**Glomerella cingulata* (Stonem.) Spauld. & Schrenk. Taxonomic position of order uncertain, Glomerellaceae. Note: Already listed above under its anamorph *Colletotrichum gleoesporioides.*

**Lasiodiplodia theobromae* (Pat.) Griffiths & Maubl. Dothideales, Botryosphaeriaceae. Note: There seems to be some uncertainty as to the correct teleomorphic connection of this species. I suggest listing it as anamorphic *Botryosphaeria*. In any case, the current correct name for *Physalospora rhodina* is *Botryosphaeria rhodina* (Cooke) Arx.

Macrophomina phaseolina (Tassi) Goid. Anamorphic Ascomycetes.

**Mucor* sp. Mucorales, Mucoraceae. Note: See footnote 6.

**Mycena citricolor* (Berk. & Curtis) Sacc. Anamorph *Stilbella flavidum* (Cooke) Henn. Agaricales, Tricholomataceae. Note: I was unable to find any new reports on the occurrence of this fungus in Florida.

**Nectria rigidiuscula* Berk. & Broome. Anamorph *Fusarium rigidiusculum* W.B. Snyder & H.P. Hansen. Hypocreales, Nectriaceae.

**Nigrospora oryzae* (Berk. & Broome) Petch. Teleomorph *Khuskia oryzae* H.J. Huds.. Trichosphaeriales, Taxonomic position of family uncertain.

Oidium sp. (powdery mildew). Anamorphic Erysiphales, Erysiphaceae. Note: See footnote 6.

**Pellicularia koleroga* Cooke (=*Corticium koleroga* (Cooke) Höhn.). Ceratobasidiales, Ceratobasidiaceae. Note: There does not appear to be agreement on which of these is the correct name. I would leave it as is.

**Pestalotiopsis guepinii* (Desm.) Steyaert. (=Pestalotia guepinii Desm.). Anamorphic *Pestalosphaeria*. Xylariales, Amphisphaeriaceae. Note: See Index Fungorum.

**Pestalotia leprogena* Speg. Anamorphic *Broomella*. Xylariales, Amphisphaeriaceae.

**Pestalotiopsis neglecta* (Thüm.) Stayaert . (=*Pestalotia neglecta* Thüm). Anamorphic *Pestalosphaeria*. Xylariales, Amphisphaeriaceae. Note: See Index Fungorum.

**Phomopsis* sp. Anamorphic *Diaporthe*. Diaporthales, Valsaceae.

**Phytophthora cactorum* (Lebert & Cohn) J. Schröt. Pythiales, Pythiaceae. Note: All species of *Phytophthora* and *Pythium* have been moved from the Kingdom Fungi and placed in the Kingdom Straminipili, and are no longer considered true fungi (Dick 2001). However, the order and family names remain the same. For the purposes of this

document, I don't see any advantage to separating them out into a separate group. They are currently considered as "fungus-like organisms" by some.

**Phytophthora cinnamomi* Rands. Pythiales, Pythiaceae.

**Phytophthora citrophthora* (R.H. Sm. & E. Sm.) Leonian. Pythiales, Pythiaceae.

**Phytophthora nicotianae* Breda de Haan var. *parasitica* (Dastur) G.M. Waterhouse. Pythiales, Pythiaceae.

**Phytophthora palmivora* (E.J. Butler) E.J. Butler. Pythiales, Pythiaceae.

**Polyporus hirsutus* (Wulfen) Fr. Polyporales, Polyporaceae.

**Pycnoporus sanguineus* (L.) Murrill (=*Polyporus sanguineus* (L.) Fr.). Polyporales, Polyporaceae. Note: Current correct name is *Pycnoporus sanguineus*.

Pythium ultimum Trow. Pythiales, Pythiaceae.

**Rhizoctonia solani* Kühn. Teleomorph *Thanatephorus cucumeris* (Frank) Donk. Ceratobasidiales, Ceratobasidiaceae. Note: See spelling for Kühn.

**Rhizoctonia* sp. Anamorphic Ceratobasidiales, Ceratobasidiaceae. Note: See footnote 6.

**Rigidoporus microporus* (Sw.) Overeem. Polyporales, Meripilaceae. Note: See change in authority.

**Rosellinia bunodes* (Berk. & Br.) Sacc. Xylariales, Xylariaceae. Note: See change in order and family. I don't believe that this fungus is listed as a quarantine pest.

Sclerotinia sclerotiorum (Lib.) de Bary. Helotiales, Sclerotiniaceae

**Sclerotium rolfsii* Sacc. Teleomorph *Athelia rolfsii* (Curzi) C.C. Tu & Kimbr. Polyporales, Atheliaceae.

**Sphaceloma perseae* Jenk. Anamorphic *Elsinöe*. Myriangiales, Elsinoaceae.

**Sphaeropsis tumefaciens* Hedges. Anamorphic Ascomycetes. Note: NOT anamorphic Actinomycetes.

**Verticillium dahliae* Kleb. Anamorphic *Hypomyces*. Hypocreales, Hypocreaceae.

Literature Cited with Reference to Suggested Changes
To Organisms Listed in Table 3.

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DeVay, J.E.; Lukezic, F.L.; English, H.; Trujillo, E.E.; Moller, W.J. 1968. Ceratocystis canker of deciduous fruit trees. Phytopathology 58: 949-954.

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Engelbrecht, C.J.B., Harrington, T.C. 2005. Intersterility, morphology and taxonomy of *Ceratocystis fimbriata* from sweet potato, cacao and sycamore. Mycologia 97: 57-69.

Harrington, T.C. 2000. Host specialization and speciation in the American wilt pathogen Ceratocystis fimbriata. Fitopath. Bras. 25S: 262-263.

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Johnson, J.A., Harrington, T.C., Engelbrecht, C.J.B. 2005. Phylogeny and taxonomy of the North American clade of the Ceratocystis fimbriata complex. Mycologia 97: 1067-1092.

Morgan-Jones, G. 1967. Ceratocystis fimbriata. C.M.I. descriptions of pathogenic fungi and bacteria. No. 141. Kew, Surrey, United Kingdom: Commonwealth Mycological Institute. 2 p.

Mourichon, X. 1994. Serious citrus dieback in Colombia caused by Ceratocystis fimbriata. Fruits Paris 49: 5-6, 415-416.

Wellman, F.L. 1972. Tropical American Plant Disease. Metuchen, N.J., The Scarecrow Press, Inc. 989 pp.

General Note: One reference not used in preparing this PRA, and not mentioned in the Literature Cited addendum listed above, is the North American Forestry Commission Forest Pest Information System (EXFOR). This online information system (http://www.spfnic.fs.fed.us/exfor/) contains documents on many forest tree pathogens and insects that are prepared as pest risk assessments. Documents on two of the fungi in this PRA [*Ceratocystis fimbriata* and *Corticium salmonicolor* (as *Erythricium salmonicolor*)] are included in EXFOR.

Quarantine Pests Selected for Further Analysis

Only one quarantine pest, the potato spindle tuber viroid, was selected for further analysis from among the pathogens and nematodes listed in Table 3, and is the only organism on the list that is both a quarantine pest **and** is likely to follow the pathway. I concur that this organism should be selected and also concur with the high risk rating for consequences and likelihood of introduction. Although I cannot find fault with the analysis that resulted in a finding of a low risk of establishment, I do have some concern because of the potential for high economic losses should the viroid become established in the US.

As discussed above, I recommend that the fungus *Ceratocystis fimbriata* be selected for further analysis. This is primarily because of the taxonomic uncertainty of the forms of the fungus that occur in Peru and California, and the possibility of the existence of different pathotypes. This fungus is also included in the APHIS Regulated Plant Pest List (Cline and Farr 2006).

The species of *Armillaria* reported from Peru is also uncertain, but is unlikely to be *Armillaria mellea* as originally identified. However, regardless of the species present in Peru, it would not be likely to follow the pathway and should pose no risk.

List and Effectiveness of Mitigations

The section on mitigation in the PRA is heavily oriented toward insects, and rightfully so. However, I think that it would be helpful to at least list possible mitigations aimed specifically at the potato spindle tuber viroid, and perhaps *Ceratocystis fimbriata* if that organism is selected for further analysis. With the exception of the viroid, most, if not all of the potentially dangerous pathogens listed in Table 3 could be successfully mitigated by a combination of orchard certification, fungicidal sprays, orchard sanitation, packing house examination and treatments, especially washing or brushing with disinfectants, and inspection on arrival in the US. I am not familiar enough with the biology of the viroid to suggest specific mitigation measures that might be effective.

Peer Review Report
Reviewer No. 3

I reviewed the Pest Risk Assessment prepared by CPHST-PERAL for the importation of Hass avocados from Peru. In general, the PRA appears to be a thorough and well written evaluation of the significant risks posed by importation, and the document is sufficiently complete to move forward to the risk mitigation phase and preparation of a work plan. A few comments on the PRA and mitigation options follow:

1. It would have been useful to have access to the report "The phytosanitary status of the avocado (*Persea americana* Miller) in Peru", which was submitted by Peru in support of the pest risk assessment. This report might have helped make clear what background information on Peruvian avocado pests is available. The report "Draft proposal for the application of pest risk mitigation measures in the exportation of avocado (*Persea americana*) to the United States from Peruvian sites where the avocado seed moth (*Stenoma catenifer*) is not known to occur (SENASA)" should be made available to reviewers of the risk mitigation strategies or at the time the Proposed Rule is published.

2. Where is the hard data on the host suitability of avocado to *Anestrepha fraterculus*, *A. striata*, and *Ceratitis capitata*? This information is needed to develop risk mitigation strategies.

3. The title of the PRA includes only the Continental US: is Hawaii excluded from the proposed importation? If so this should be stated and all references to Hawaii pests and endangered species should be excluded. Or is the presumption that any avocados imported from Peru will land in the continental US first before subsequent distribution? And what about Puerto Rico? Perhaps a section on what constitutes the continental US would be helpful.

4. Under the section on weediness potential section it should be noted that backyard and commercial plantings of avocados occur in Hawaii as well as California and Florida. Texas also grows avocados.

5. page 32: The statement, "…do not serve as hosts for the *Anastrepha* spp. in question" referring to the Mexico studies is confusing and should be corrected. *A. striata* was included in the Aluja et al (2004) study but *A. fraterculus* was not. A. ludens showed some ability to develop in avocado (Aluja et al. 2004). What data are required to demonstrate the host status of Peruvian avocados to *Anastrepha* fruit flies is debatable. Simply trapping for adult flies and cutting fruit for evidence of larval infestations (as suggested in the last sentence on this page) may not be sufficient.

6. Risk element #4: Economic impact – this analysis for each quarantine pest should focus on U.S. crops not foreign crops. For example, under *Coccus viridis*, the focus is on its importance as a coffee pest outside the U.S. Hawaii grows the only coffee in the U.S. and no coffee is grown in the continental U.S.

7. Risk element #5, Environmental impact – Hawaii should not be included in the analysis if the PRA is for the continental U.S only. Also, Hawaii endangered species should not be mentioned under *Coccus viridis* and *Ceratitis capitata* because these pests are already established in Hawaii. Likewise, *C. viridis* is established in Florida.

8. Under the Consequences of Introduction and Likelihood of Introduction sections, *Stenoma catenifer* is given an overall Medium rating. In my opinion, this rating probably should be raised to High. As an internal pest that cannot be inspected for, a pest that has been intercepted from Peru, and a serious pest of avocados where it occurs, it requires mitigation. The current

evaluation is too strongly influenced by the moth's limited diet breadth, i.e. monophagy/oligophagy.

9. Seed weevils from genera *Heilipus* and *Conotrachelus* are known to be in the pathway on avocados imported in the United States from various countries, but little is known about the weevils in Peru. Pest surveys should be recommended to clarify the situation.

10. The first sentence in the Risk Mitigation (p. 55) section "The appropriate level of protection for an imported commodity can be achieved by the application of a single phytosanitary measure, such as inspection, quarantine treatment, or a combination of measure", is confusing and should be corrected. The remainder of the paragraph is also confusing as the difference between mitigations and measures is not stated, nor is the meaning of efficacious made clear, e.g., if a mitigation is sufficiently efficacious it does not need to be surrounded by a systems approach at all.

11. The inclusion of risk mitigation options (pages 55-64) is not typically presented in the pest risk assessment. Why is this done here? This section is 10 pages long! My understanding was that the pest risk assessment is circulated for comment before conducting a risk mitigation analysis. If the intent is simply to follow the Mexican systems approach, say so, and give details for all the components of that program, i.e., the risk mitigation analysis is done. The presentation of risk mitigation information in this PRA straddles the fence between saying "this is what will/must be done" and "these are the options". You say the PRA "does not purport to establish specific work plans or to evaluate the quality of a specific program or systems approach" (p. 61), but that is exactly how it reads. This entire phytosanitary measures section could be removed and the pest risk assessment could stand on its own.

12. page 55, III Risk mitigation – what does the III refer to? Where are I and II?

13. page 61, 3. Monitoring – what does the 3. refer to? where are 1. and 2.? (ditto, 4. Conclusions). Check organization and numbering system.

14. page 57, Pest Free Areas: "Currently, this program includes trappings for fruit flies during the avocado growing season (SENASA, 2005). We consider that a pre-harvest trapping program could be as important as the monitoring the population levels during the harvest season." Is the second sentence a comment on the current trapping practices referred to in the first sentence? If so, it doesn't make sense.

15. pages 60-61, Irradiation: Avocado is very sensitive to irradiation. A "low" irradiation dose (e.g. 150 Gy) is not an option for fresh avocado. We have tested Hass and Sharwil avocados at doses as down to 80 Gy and still get significant vascular streaking (Follett unpublished data)

More detailed information on the avocado pests in Peru (e.g. prevalence of weevils and *Stenoma*) and the efficacy of various mitigation options (pest free areas, efficacy of quarantine treatments, sampling and inspection protocols for the suite of pests) may be needed before proceeding to the risk mitigation phase and preparation of a work plan.

Peer Review Report
Reviewer No. 4

Review of : Importation of ‘Hass’ Avocado (*Persea americana*) Fruit from Peru into the Continental United States.

This is a typical and appears to be complete summary of pests relevant for decisions concerning importation of Hass avocados from Peru into the continental U.S. The document draws from the literature typically used in these studies. The summary of the development of this issue shows that there has been considerable communication between officials in Senasa and APHIS IS in developing the PRA.

My review will only deal with the issue of Tephritidae. The document lists two species of importance, Anastrepha fraterculus and Ceratitis capitata based on interceptions and previous literature (other species are discussed later). Most knowledgeable scientists in countries infested by these two species agree that they are not economic problems for avocados in those countries. Based on experiments carried out in Hawaii, Argentina and Mexico concerning avocados as a host for these species I would predict that host status will be the most important factor to rate the overall risk of importing larvae of either of these species and discussion will be similar to the risk in the systems approach used for Mexican avocados.

In 1991-92, when the first proposal for host status studies for avocados were proposed it was suggested that the chemical nature of host resistance be described and that research to identify insecticidal compounds in avocados and their persistence after harvest be identified. That suggestion was rejected as too complicated, but since then scientists such as John Trumble and Mary Lu Arpaia at UC Riverside have identified a series of these compounds and shown that they do not persist after harvest.

My own evaluation is that under conditions for production of export quality (quality sufficient for profitable export to the U.S.) avocados, fruit harvested under the conditions required under the systems approach used for Mexican avocados would have about the same risk of infestation as those imported from Peru.

Publications and other documents relevant to the export of Hass avocados from Mexico have argued that Hass are somehow unique and that even though other avocado varieties have been shown to be hosts for Tephritidae, Hass have not and therefore there is no historical evidence that they are hosts. Lack of variety identification is also mentioned in this document (footnote 16b p. 30). To my knowledge no varietal comparisons of avocados that included Hass have been made in either the field or laboratories that support this argument.

The tables of risk (p. 38-42) indicate (and I agree) that introduction of the Tephritidae species of concern carries a high risk for nearly all components. I am not satisfied that of the supposed 80+ species of Tephritidae (mostly *Anastrepha*) in South America that all possible Tephritid threats are identified. Perhaps a summary section giving a list of all publications mentioning the fruit flies and host plants for the Andean countries could be given. I assume the communications between Senasa and APHIS-IS reviewed this literature. My guess would be that few studies have been done and this PRA should include this fact.

The Peru situation has several unique characteristics that may be regarded as caveats to this evaluation and I would recommend that this document include at least a mention of these issues.

1. In addition to the arguments discussed concerning the variability in *A. fraterculus* (p. 32), literature published by scientists in Argentina and Brazil has also suggested that *A. fraterculus* is a complex of species (I have heard presentations and recent publications suggesting as many as 7 species) that are genetically distinct and have some mating isolation (other than geographic distance). Given the historical (very rare but credible) evidence of infestation of avocados by this species, I recommend that this document should suggest that populations of *A. fraterculus* be analyzed at the molecular genetics level and classified within the developing taxonomy of this complex. As a minimum effort, specimens from the production regions should be collected and appropriately preserved for genetic analysis should interceptions or outbreaks possibly related to imports of Peruvian Hass avocados occurs. It should also be considered that the arguments in Aluja concerning host usage by the Mexican morphotype should not have been used as an excuse to preclude studies of this group as a concern for avocados. Reviewers of the Mexican studies

agreed to preclude *A. fraterculus* because it had never been reported from the Michoacan production areas.

2. My own visits to Lima and Ica suggested that production is in arid environments where heat and desiccation stress may be production factors. These were temporary (el nino) effects that were claimed to be culprits in the Hawaiian avocado export experience. Terms such as "undamaged" should be clearly defined to include scald or desiccation peel damage as well as disease conditions such as the "ring-neck" damage to the peel near the peduncle.

3. There is very little discussion of host status studies for the medfly, *C. captitata.* In most of S. America in areas where the *Anastrepha* and *Ceratitis* occur, *Ceratitis* is the dominant species. Peruvian *C. capitata* may also have some taxonomic or unique ecological characteristics. To my knowledge the region of Southern Lima and Ica are the only locations throughout the range of *C. capitata* where this species uses olives as a host plant and reports from my co-workers have suggested a high infestation rate. This could indicate that populations of *C. captitata* at least in these isolated oases along the Pacific coast have adapted a higher host range than is typical for the species. In the studies done in Hawaii, oriental fruit fly and melon fly were regarded as more threatening to avocados than medfly. However medflies in Peru are already known to be different than in most of the world (using olives) and may also have higher propensity to shift to other fruit such as avocados under certain conditions.

The phytosanitary requirements given on page 56 are well defined and adequate. I think that main issue will be degree of low prevalence that will be required given the generally poor host status that is recognized for these species. I have recently reviewed a manuscript from Argentina concerning host status of avocados for medfly (conclusions-not a host even under laboratory forced oviposition conditions) but that is the only test I have seen. That test did not have a control so I doubt that much was shown. However I think that the above factors mentioned in the discussion of host status may clarify the PRA.

The section discussing post harvest activities and quarantine treatments lists treatments that are generally considered by most avocado packers too damaging for avocados or for other reasons

are not used. If exports are to be successful the consideration of poor or non host combined with the other post harvest mitigation activities (culling) will probably be the best option for exporters. For this reason I think that clarifying the questions about host status should be emphasized in this document.