Movement of Sapodilla Fruit, *Manilkara sapota*, from Hawaii into other regions of the United States

Qualitative, Pathway-Initiated Pest Risk Assessment

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A. Introduction

This pest risk assessment was prepared by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) to examine plant pest risks associated with the movement into the United States of **fresh sapodilla fruit *(Manilkara sapota)* grown in Hawaii**. This is a qualitative pest risk assessment, that is, estimates of risk are expressed in qualitative terms such as high or low as opposed to numerical terms such as probabilities or frequencies.

International plant protection organizations (*e.g.*, North American Plant Protection Organization (NAPPO), 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 plant pest risk assessment are consistent with guidelines provided by NAPPO, IPPC and FAO. The biological and phytosanitary terms (*e.g.*, introduction, quarantine pest) used in this document conforms with the *NAPPO Compendium of Phytosanitary Terms* (NAPPO 1995) and the *Definitions and Abbreviations* (Introduction Section) in *International Standards for Phytosanitary Measures, Section 1—Import Regulations: Guidelines for Pest Risk Analysis* (FAO 1995).

Pest risk assessment is one component of an overall pest risk analysis. The *Guidelines for Pest Risk Analysis* provided by FAO (1995) describe three stages in pest risk analysis. This document satisfies the requirements of FAO Stages 1 (initiation) and 2 (risk assessment).

The Food and Agriculture Organization (FAO, 1995) defines "pest risk assessment" as "Determination of whether a pest is a quarantine pest and evaluation of its introduction potential". "Quarantine pest" is defined as "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 1995; NAPPO, 1995). Thus, pest risk assessments should consider both the likelihood and consequences of introduction of quarantine pests. Both issues are addressed in this qualitative pest risk assessment.

This document presents the findings of the qualitative plant pest risk assessment. The assessment methods or the criteria used to rate the various risk elements are not described in detail. The details of the methodology and rating criteria can be found in the "template" document: ***Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, version 4.0*** (USDA, 1995); to obtain a copy of the template, contact the individual named in the proposed regulations.

B. Risk Assessment

1. Initiating Event: Proposed Action

This pest risk assessment is commodity-based, and therefore "pathway-initiated"; the assessment is in response to the request for USDA authorization to allow movement of a particular commodity presenting a potential plant pest risk. In this case, the movement of **fresh sapodilla fruits *(Manilkara sapota)* in Hawaii** into the U.S. is a potential pathway for introduction of plant pests. Regulatory authority for the movement of fruits and vegetables from Hawaii into other parts of the U.S. is found in 7 CFR §318.13.

The sapodilla family includes about 30 genera and 400 species of shrubs and small to large trees,

mainly in tropical and subtropical regions (Neal, 1965). *Manilkara zapota* is from Central America, where it forms forests on lime soil. It is a favorite fruit in tropical America.

2. Assessment of Weediness Potential of sapodilla, *Manilkara zapota*

Table 1 shows the results of the weediness screening for *Manilkara zapota.* These findings did not require a pest-initiated risk assessment.

Table 1: Process for Determining Weediness Potential of Commodity

Commodity: *Manilkara zapota* (L.) P. Royen - (Sapodilla)

Phase 1: Sapodilla is not widely prevalent in the United States but it does grow in Florida and Texas (Farr, 1989).

Phase 2: Is the species listed in:

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

Phase 3: Conclusion:

* *Sapota achras*, a synonym of *Manilkara zapota*, is listed in the *Geographical Atlas of World Weeds* as a weed of unknown importance in Jamaica.

3. Previous Risk Assessments, Current Status and Pest Interceptions

3a. Decision history for *Manilkara* spp.

There are no previous risk assessments (decision sheets) on *Manilkara zapota* from Hawaii.

3b. Interceptions from Hawaii FY 1985-95

PEST	HOST	TOTAL
BACTROCERA DORSALIS	MANILKARA ZAPOTA (FRUIT)	1
CERATITIS CAPITATA	MANILKARA ZAPOTA (FRUIT)	2

4. Pest List: Pests Associated with sapodilla in Hawaii

Table 2 shows the pest list for *Manilkara* spp. which was developed after a review of the information sources listed in USDA (1995). The pest list includes limited information on the distribution of each pest, pest-commodity association, and regulatory history.

Table 2: Pest List - *Manilkara* spp.

Scientific Name, Classification	Distribution[1]	Comments[2]	References
Algae			
***Cephaleuros virescens* Kunze**	**HI,US**	**a,c,o**	**Raabe *et. al.*, 1989; Alfieri *et. al.*, 1994**
Pathogens			
Aspergillus niger Tiegh. (Fungi Imperfecti: Hyphomycetes)	HI,US	c	Raabe *et. al.*, 1981; Abu-Bakar & Adbul Karim, 1990; Farr *et. al.*, 1989
Colletotrichum gloeosporioides (Penz.) Penz. & Sacc. in Penz. (Fungi Imperfecti: Coelomycetes)	HI,US	a,c,m,	Raabe *et. al.*, 1981; Alfieri *et. al.*, 1994; Farr *et. al.*, 1989
Lasiodiplodia theobromae (Pat.) Griffon & Maubl. (Fungi Imperfecti: Coelomycetes)	HI,US	c	Raabe *et. al.*, 1981; Farr *et. al.*, 1989; Khurana & Singh, 1972
Penicillium italicum Wehmer (Fungi Imperfecti: Hyphomycetes)	HI,US	c	Raabe *et. al.*, 1981; Farr *et. al.*, 1989; Kusum-Badyal *et. al.*, 1990
Phytophthora palmivora (E. H. Butler) E. J. Butler (Oomycetes: Peronosporales)	HI,US	a,c,m,o	Holliday, 1980; Raabe *et. al.*, 1981; Farr *et. al.*, 1989
Pythium irregulare Buisman (Oomycetes: Peronosporales)	HI,US	a,c,m,o	Raabe *et. al.*, 1981; Alfieri *et. al.*, 1994; Farr *et. al.*. 1989

Pythium splendens H. Braun (Oomycetes: Peronosporales)	HI,US	a,c,m,o	Raabe *et. al.,* 1981; Alfieri *et. al.,* 1994; Farr *et. al.,* 1989
Rhizoctonia solani Kuehn. (Fungi Imperfecti: Agonomycetes)	HI,US	a,c,m,o	Raabe *et. al.,* 1981; Alfieri *et. al.,* 1994; Farr *et. al.,* 1989

Arthropods

Bactrocera dorsalis (Hendel) (Diptera: Tephritidae)	HI,US[3]	h,z_i	USDA, 1983
Ceratitis capitata (Wiedemann) (Diptera: Tephritidae)	HI,US[3]	h,z_i	White, 1992
Coccus viridis (Green) (Homoptera: Coccidae)	HI,FL,PR	a,g,n,x	USDA, 1996
Dysmicoccus neobrevipes Breadsley (Homoptera: Pseudoccidae)	HI,FL	g,m,n,x,y,z_e	USDA, 1996; Harris & Maramorosch, 1980
Hypocala deflorata (Fabricius) (Lepidoptera: Noctuidae)	HI		Anon., 1994
Maconellicoccus hirsutus (Green) (Homoptera: Pseudoccidae)	HI	m,n,z_e	Francis-Ellis, 1995; Anon., 1994

[1] Distribution legend: HI = Hawaii; US = United States; FL = Florida; PR = Puerto Rico

[2] Comments:
- a = Pest mainly associated with a plant part other than the commodity.
- c = Listed in non-reportable dictionary as non-actionable.
- g = Quarantine pest: pest has limited distribution in the U.S. and is under official control as follows: pest listed by name in USDA's pest dictionary, official quarantine action may be taken on this pest when intercepted on this commodity.
- h = Quarantine pest: pest has limited distribution in the U.S. and is under official control as follows: (1) pest listed by name in USDA's pest dictionary, (2) pest is a program pest.
- m = The pest occurs within the PRA area and has been reported to attack the specific host species in other geographic regions: but has not been reported to attack the specific host in the PRA area.
- n = Listed in the USDA catalogue of intercepted pests as actionable.
- o = Pest does not meet the geographic or regulatory definition of a quarantine pests.
- x = Multiple interception records exist.
- y = Pest is a vector of plant pathogens.
- z_e = External pest: is known to attack or infest *Manilkara zapota* fruits and it would be reasonable to expect the pest may remain with the commodity during processing and shipping.
- z_i = Internal pest: is known to attack or infest *Manilkara zapota* and it would be reasonable to expect the pest may remain with the commodity during processing and shipping.

3. *Bactrocera dorsalis* and *Ceratitis capitata* have been detected on occasion in the United States. Whenever they are detected, a quarantine is established and an eradication program implemented. These fruit flies are considered to be quarantine pests in the United States.

5. List of Quarantine Pests

The list of quarantine pests for commercial shipments of sapodilla fruits from Hawaii is provided in Table 3. Should any of these pest be intercepted on commercial (or any other) shipments of sapodillas, quarantine action will be taken.

Table 3: Quarantine Pests: Sapodilla fruits

Arthropods	*Bactrocera dorsalis*
	Ceratitis capitata
	Coccus viridis
	Dysmicoccus neobrevipes
	Maconellicoccus hirsutus

6. Quarantine Pests Likely to Follow Pathway (*i.e.*, Quarantine Pests Selected for Further Analysis)

Only those quarantine pests that can reasonably be expected to follow the pathway, *i.e.* be included in commercial shipments of *Manilkara sapota* were analyzed in detail (see USDA, 1995 for selection criteria). Only quarantine pests listed in Table 4 were selected for further analysis and subjected to steps 7-9 below. Although the two pseudococcid insects have not been associated with sapodilla in Hawaii, they are intercepted on fruits from other tropical areas and were included for further evaluation.

Table 4: Quarantine Pest Selected for Further Analysis: Hawaiian Sapodilla fruits for consumption

Pathogens	None
Arthropods	*Bactrocera dorsalis*
	Ceratitis capitata
	Dysmicoccus neobrevipes
	Maconellicoccus hirsutus

7. Economic Importance: Consequences of Introduction

The consequences of introduction was considered for each quarantine pest selected for further analysis. For qualitative, pathway-initiated pest risk assessments, these risks are estimated by rating each pest with respect to five risk elements. A full description of these elements and rating criteria can be found in USDA (1995). Table 5 shows the risk ratings for these risk elements.

Table 5: Risk Rating: Consequences of Introduction

Pest	Climate/ Host	Host Range	Dispersal	Economic	Environ-mental	Risk Rating
Bactrocera dorsalis	high	high	high	high	high	high
Ceratitis capitata	high	high	high	high	high	high
Dysmicoccus neobrevipes	low	high	low	medium	medium	medium
Maconellicoccus hirsutus	medium	high	medium	high	high	high

8. Likelihood of Introduction

Each pest was rated with respect to introduction potential *i.e.,* entry and establishment. Two separate components were considered. First, the amount of commodity likely to be moved was estimated. More movement leads 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, five biological features concerning the pests and their interactions with the commodity were considered. The resulting risk ratings were specific to each pest. The cumulative risk rating for introduction was considered to be an indicator of the likelihood that a particular pest would be introduced. A full description of these elements and rating criteria can be found in USDA (1995). Table 6 shows the ratings for these risk elements.

Table 6: Risk Rating: Likelihood of Introduction

Pest	Quantity of commodity imported annually	Likelihood survive postharvest treatment	Likelihood survive shipment	Likelihood not detect at port of entry	Likelihood moved to suitable habitat	Likelihood find suitable host	Risk rating
Bactrocera dorsalis	low	high	high	high	high	high	high
Ceratitis capitata	low	high	high	high	high	high	high
Dysmicoccus neobrevipes	low	high	high	medium	medium	medium	medium
Maconellicoccus hirsutus	low	high	high	medium	low	low	medium

9. Conclusion: Pest Risk Potential and Phytosanitary Measures

The measure of pest risk potential combines the risk ratings for consequences and likelihood of introduction as described in USDA (1995). Table 7 shows the estimated pest risk potential for the quarantine pests selected for further analysis for the movement of *Manilkara zapota.*

Table 7: Pest Risk Potential, Quarantine Pests, *Manilkara zapota* from Hawaii

Pest	Pest risk potential
Bactrocera dorsalis	high
Ceratitis capitata	high
Dysmicoccus neobrevipes	medium
Maconellicoccus hirsutus	high

For those pests, except *Maconellicoccus hirsutus*, receiving a high PRP risk rating, we recommend specific phytosanitary measures, port-of-entry inspection is not considered sufficient to provide phytosanitary security. However, *Maconellicoccus hirsutus* has not been associated with *Manilkara sapota* in Hawaii and therefore movement of the fruit is unlikely to serve as a pathway for introduction. Although *M. hirsutus* is established in Hawaii it has had little or no impact, probably due to the introduction of a parasite about the same time. PPQ currently inspects other commodities which serve as hosts for this pests from other areas. If this pest is intercepted on Hawaiian sapodilla fruits, Operational Support staff may establish appropriate sanitary and phytosanitary measures they believe necessary to mitigate pest risk. The pest risk management phase of the PRA is not part of this document. Appropriate sanitary and phytosanitary measures to mitigate pest risk will be determined during the pest risk management phase.

PPQ has intercepted over 225 pests on *Manilkara* fruits from other tropical areas since 1985; however, virtually all external pests listed could be detected by inspection. Some of these same pests occur in Hawaii in addition to other polyphagous quarantine pests and have been intercepted as hitchhikers with other commodities. Should any of these pests be intercepted on commercial (or any other) shipments of *Manilkara sapota*, quarantine action may be taken.

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