Importation of Fresh Mango Fruit (*Mangifera indica* L.) from India into the Continental United States

A Qualitative, Pathway-Initiated Pest Risk Assessment

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Executive Summary

India requested to export fresh mango fruit (*Mangifera indica* L.) to the continental United States. This document assessed the risk that pests arriving with mango from India would pose to U.S. agriculture. We developed a list of pests associated with mango and present in India, and then further analyzed those pests that were of quarantine significance to the United States, and that were likely to follow the pathway of mango imported from India. The methodology and rating criteria used to analyze these pests are detailed in the *Guidelines for Pathway-Initiated Pest Risk Assessment, version 5.02*. Risk was estimated based on the fruit being cleaned and washed as part of standard post-harvest practices in Indian mango production. The risk assessment identified the following quarantine pests that could potentially become introduced into the United States through mango importation from India:

ARTHROPODS

Coleoptera:
Curculionidae
Sternochetus frigidus (F.)
Sternochetus mangiferae (F.)

Diptera:
Tephritidae
Bactrocera caryeae (Kapoor)
Bactrocera correcta (Bezzi)
Bactrocera cucurbitae Coquillett
Bactrocera diversa (Coquillett)
Bactrocera dorsalis Hendel
Bactrocera tau (Walker)
Bactrocera zonata (Saunders)

Hemiptera:
Coccidae
Ceroplastes rubens Maskell
Coccus viridis (Green)

Diaspididae
Aulacaspis tubercularis (Newstead)
Parlatoria crypta Mckenzie
Pseudaonidia trilobitiformis (Green)

Pathogens:
Actinodochium jenkinsii Uppal, Patel & Kamat
Cytosphaera mangiferae Died.

Hendersonia creberrima Syd., Syd. & Butler
Macrophoma mangiferae Hing. & Sharma
Phomopsis mangiferae S. Ahmad
Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al*.) Robbs *et al*.

We determined that unmitigated risk is High for *Ceroplastes rubens* and the seven fruit flies in the genus *Bactrocera*; Medium for the two mango weevils in the genus *Sternochetus*; Medium for the three armored scales, *Aulacaspis tubercularis*, *Parlatoria crypta,* and *Pseudaonidia trilobitiformis*; Medium for *Macrophoma mangiferae, Cytosphaera mangiferae*, and *Xanthomonas campestris* pv. *mangiferaeindicae*; and Low for *Actinodochium jenkinsii, Hendersonia creberrima*, and *Phomopsis mangiferae*. Although the armored scales were rated Medium based on the USDA *Guidelines*, these insects have a low likelihood of introduction and establishment that could not be addressed using the current USDA *Guidelines*. This low likelihood of establishment should be an important consideration when developing risk mitigations.

Detailed examination and recommendations for appropriate sanitary and phytosanitary measures to mitigate pest risk is undertaken as part of the pest risk management phase and is not discussed in this document.

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I. Introduction

This risk assessment was prepared by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) to examine the plant pest risks associated with importing mango fruit *Mangifera indica* L. (Anacardiaceae family) from India into the United States. Mango is grown almost throughout India up to an elevation of 4,000 ft. (NIAM, 2001). The major mango producing regions in India are Andhra Pradesh, Uttar Pradesh, Bihar, Karnataka, Tamil Nadu, West Bengal and Orissa & Maharashtra (NIAM, 2001). This risk assessment examined the pest risk of commercial quality mango, which undergoes cleaning and washing of sap from the exterior of each individual fruit as part of the standard post-harvest treatment in India (Seshadri, 2005). Post-harvest cleaning and washing of the fruit is a common and essential cultural practice in mango production, as the sap which exudes from the stem end burns the fruit skin, resulting in black lesions followed by rotting (Morton, 1987).

This risk assessment is qualitative and expresses risk in terms such as high, medium or low, instead of probabilities or frequencies. The details of the methodology and rating criteria are in: Pathway-Initiated Pest Risk Assessments: Guidelines for Qualitative Assessments, Version 5.02 (APHIS, 2000), accessible at http://www.aphis.usda.gov/ppq/pra/commodity/cpraguide.pdf.

Regional and international plant protection organizations such as the North American Plant Protection Organization (NAPPO) and the International Plant Protection Convention (IPPC) provide standards for conducting pest risk assessments (IPPC, 1996; IPPC, 2001; IPPC, 2003; IPPC, 2004; NAPPO, 2004). The methods used to initiate, conduct and report this assessment, as well as the use of biological and phytosanitary terms are consistent with these standards. These standards describe three stages of pest risk analysis: Stage 1 (initiation), Stage 2 (risk assessment) and Stage 3 (risk management). This document satisfies the requirements of IPPC Stages 1 and 2.

II. Risk Assessment

A. Initiating Event: Proposed Action

This pest risk assessment is commodity-based or "pathway-initiated" because the USDA was requested to authorize importations of fresh mango fruit from India into the United States. This is a potential pathway for the introduction of plant pests on the mango. The Plant Protection Act of 2000 (7 U.S.C. Sections 7701-7772) gives APHIS the authority to regulate plant pests/plant products; the regulations for the importation of fruits and vegetables are codified in the Code of Federal Regulations, Title 7, Part 319, Subpart 56 (7 CFR Section 319.56).

B. Assessment of Weediness Potential of Mango

The results of the weediness screening for mango did not prompt a pest-initiated risk assessment because mango is commercially cultivated in suitable climates and is not listed as a weed in any of the applicable references (Table 1).

Table 1. Assessment of the Weediness Potential of Mango.
Commodity: Mango, *Mangifera indica* L. (Anacardiaceae) Phase 1: Mango is commercially cultivated in Florida, Hawaii, Puerto Rico, the United States Virgin Islands, and the tropical regions of both Texas and California. Phase 2: Is the species listed in: No Geographical Atlas of World Weeds (Holm *et al.*, 1979) No World's Worst Weeds (Holm *et al.*, 1977) or World Weeds: Natural Histories and Distribution (Holm *et al.*, 1997) No Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982) No *Economically Important Foreign Weeds* (Reed, 1977) No Weed Science Society of America list (WSSA, 1989) No Is there any literature reference indicating weediness, *eg*, AGRICOLA, CAB, Biological Abstracts, AGRIS; search on "species name" combined with "weed". Phase 3: Mango is not listed as a weed in any of the above references and is commercially grown in suitable climates, so it does not appear to pose a risk as a weed.

C. Pest Interceptions and Decision History

Pest Interceptions

Over two thousand arthropod interceptions on mango were made since 1985 (APHIS-PPQ Interceptions, 2002).

Insect pests intercepted over 100 times:

Aulacaspis tubercularis Newstead (Diaspididae) (905)
Sternochetus mangiferae (Fabricius) (Curculionidae) (627)
Sternochetus sp. (Curculionidae) (269)
Pseudaonidia trilobitiformis (Green) (Diaspididae) (169)
Bactrocera sp. (Tephritidae) (164)

Pests intercepted from 10 to 100 times:

Tephritidae, species of (47)
Pseudococcidae, species of (40)
Lepidosaphes tapleyi Williams (Diaspididae) (23)
Parlatoria crypta Mckenzie (Diaspididae) (21)

Dacus sp. (Tephritidae) (18)

Most of the insect pests were intercepted less than 10 times and include: *Abgrallapsis* sp., *Aleurocanthus husaini*, *Aleurolobus marlatti*, Aleyrodidae sp., *Anastrepha* sp., *Aonidiella* sp., *Aulacaspis* sp., *Bactrocera dorsalis*, Carposinidae sp., *Ceratitini* sp., *Ceratitis* sp., Cicadellidae sp., Coccidae sp., *Coccus* sp., *Contarinia* sp., *Cryptophlebia* sp., *Cryptorhynchus* sp., *Curculio* sp., Curculionidae sp., Diaspididae sp., Gelechiidae sp., *Lepidosaphes similis*, *Lindingaspis fusca*, *Lindingaspis* sp., Lonchaeidae sp., *Maconellicoccus hirsutus*, Margarodidae sp., *Nipaecoccus viridis*, Nymphalidae sp., *Otiorynchus* sp., Phycitinae sp., *Planococcoides robustus*, *P. minor*, *Planococcus* sp., *Procontarinia* sp., *Pseudaonidia* sp., *Pseudaulacaspis* sp., *Pseudischnaspis* sp., Pyralidae sp., *Rastrococcus iceryoides*, *Rhagoletis cerasi*, *Sternochetus frigidus*, *Sternocoelus* sp., *Sybra* sp., *Tetraleurodes* sp., *Thrips palmi* and *Xyleborus* sp.

In contrast, there were few fungal interceptions and often noticeable disorders of mango may not be easily attributable to a single cause at ports of entry (Cappellini, 1988). APHIS-PPQ inspectors intercepted *Phomopsis* sp. and *Phaeosphaeria oryzae* once each and *Cladosporium* spp. seven times on mango in personal baggage from India. There was one interception of Ascomycotina on permit cargo. There was one interception of *Elsinoe australis* in passenger baggage, but this fungus is not otherwise known as a pathogen of mango (CMI, 1974).

Decision History for mango from India

1993 – Deny entry due to lack of approved treatment for *Sternochetus mangiferae*, *S. frigidus*, the larval borers *Hyalospilla leuconeurella* and *Tirathaba mundela*, and a complex of *Bactrocera* species: *B. correcta*, *B. cucurbitae*, *B. dorsalis*, *B. caryeae*, *B. hageni* and *B. zonata*.

1988- Deny entry due to lack of an acceptable treatment for the complex of exotic fruit flies and *Sternochetus* spp.

D. Plant Pests Associated with Mango from India

Appendix I lists the pests associated with mango and present in India. This list identifies: (1) the presence or absence of the pests in the United States, (2) the generally affected plant part or parts, (3) the quarantine status of the pest in the United States, (4) whether the pest is likely to follow the pathway to enter the United States on commercially exported mango fruit from India, and (5) pertinent citations for either the distribution or the biology of the pest. Many organisms are eliminated from further consideration as sources of phytosanitary risk on mango from India because of their biology, while others do not satisfy the definition of a quarantine pest.

A pest is likely to be transported on mango if: the pest is present in India, the pest is associated with mango at the time of harvest, and the pest remains viable on the fruit throughout the harvesting, packing and shipping procedures. Quarantine pests likely to follow the pathway may be capable of establishment, or spread within the United States if suitable ecological and climatic conditions exist, including protected areas such as greenhouses. Some of the ecological conditions include the presence of primary host species, alternate hosts, and vectors.

It is expected that mangoes will be accompanied by a very short stem attached to the top of the fruit (apprpoximately 0.3 to 0.5cm long and technically, a pedicel which is part of the infloresence). Presence of this stem cap is necessary for adequate preservation of fruit quality. Because these stem caps are relatively short and because of their close promixity to the fruit surface, it is highly unlikely that importation of mago fruit with these stems will increase the risk of importing additional pests and diseases that would not already be associated with the fruit. Consequently, for the purpose of identifying pests likely to follow the pathway on fresh mango fruit, we did not consider the short stem cap in the pest list (Appendix I).

E. Discussion of Quarantine Pests That Were Not Selected for Further Analysis

In this risk assessment, all of the quarantine pests that are likely to follow the pathway are analyzed in subsequent sections. Other quarantine pests have the potential to be detrimental to U.S. agriculture, but are not likely to follow the pathway on the commodity. These quarantine pests may be generally associated with plant parts other than the commodity, or they are not reasonably expected to remain with the commodity during harvesting and post-harvest processes. These pests may occur as biological contaminants found during inspections of these commodities, and generally are not expected to be found with commercial shipments. For these reasons, these quarantine pests are not considered to pose a risk on mango from India at this time. For example, root infecting nematodes are not expected to be directly associated with the harvested fruit. Likewise, fungi infecting leaves or stems are not expected to be transported with the fruit, except as infrequent contaminants within commercial shipments.

Organisms identified only to the genus level were not further analyzed. Any genus may contain many species that are not pests of the commodity in question, and pest risk assessments must focus on the pertinate pests for which biological information is available. Further, we assume that carefully prepared mitigation measures taken against the known pests will contol similar or closely related pests that have not been identified.

Bruchus sp. (Coleoptera: Bruchidae); *Carpophilus dimidiatus* (F.) (Coleoptera: Nitidulidae)
These beetles are unlikely to follow the pathway of commercial quality mango fruit, as they attack over-ripe fruit or are scavengers (Pruthi and Batra, 1960).

Popillia sp. (Coleoptera: Scarabaeidae)
Because of its size and mobility, this pest is not expected to stay on the commodity through standard harvest and post-harvest processing. Many scarabs feed on plant materials such as grasses, foliage, fruits, and flowers, and some are serious pests of various agricultural crops (Borrer *et al.* 1989). It is assumed that only the adults attack the fruit, as the literature does not mention scarab larvae feeding on fruit (White 1983).

Cecidomyiidae

Larvae of Cecidomyiidae (gall midges) infesting mango typically bore into leaves, causing galls to form. Larvae of several species will also infest fruit as the fruit begins to form. The infested fruits turn pale, become hollow and shapeless and drop down prematurely (Butani, 1993), and therefore do not become a pathway for gall midges to enter the United States.

Acanthocoris scabrator F. (Hemiptera: Coreidae); *Spilostethus macilentus* Stall, *Spilostethus pandurus* Scopoli (Hemiptera: Lygaeidae); *Antestiopsis cruciata* (F), *Chrysocoris particius* (F), *Coptosoma nazirae* Atkinsoni, *Halys dentata* (F.), *Nezara viridula* (L.) (Hemiptera: Pentatomidae); and *Dysdercus koenigii* F. (Hemiptera: Pyrrhocoridae)

Because the nymphs and adults of these pests only feed externally on the fruit and because of their mobility, they are not expected to stay on the commodity through harvest and standard handling and processing.

Aonidiella inornata (Hemiptera: Diaspidae)

Aonidiella inornata is considered a sporadic pest of mango in India, although in some years pest levels have risen to almost 100% infestation (Gupta & Singh, 1988). Only the females feed, and they feed primarily on the leaves and bark of the mango trees (Gupta & Singh, 1988). Lee & Wen (1977) reported that *A. inornata* attacked the stems, pedicels, and fruit of papaya as the fruit were setting, but numbers on fruit declined greatly as fruit matured. For these reasons, we consider it unlikely that *Aonidiella inornata* will follow the pathway, and also unlikely that, if it did, crawlers (the immature larvae that emerge from under the scale mother) could move to suitable hosts in the United States. Consequently, this scale species was not considered for further analysis.

Maconellicoccus hirsutus (Green), *Nipaecoccus viridis* (Newstead), *Perissopneumon ferox* Newstead, *Planococcoides robustus* Ezzat & McConnell, *Planococcus lilacinus* (Cockerell), *Rastrococcus iceryoides* (Green), and *Rastrococcus spinosus* (Robinson) (Hemiptera: Pseudococcidae)

We estimate it is unlikely for mealybugs (Pseudococcidae) to be associated with commercial export-quality mango fruit, as the fruits are individually cleaned and washed as part of the standard post-harvest treatment in India (Seshadri, 2004). Post-harvest cleaning and washing of the fruit is a common and essential cultural practice in mango production, as the sap which exudes from the stem end burns the fruit skin, resulting in black lesions followed by rotting (Morton, 1987). If any mealybugs are on the fruit at the time of harvest, they would likely be removed by this post-harvest practice. Commercial mangoes typically are composed only of the fruit and a very short (approximately 0.3 to 0.5cm) pedicel attached to the top of the fruit. The calyx is no longer present at harvest; therefore, there are no hiding places for the mealybugs on the fruits.

Achaea janata L. (Lepidoptera: Noctuidae)

Only adult moths are reported to feed on the fruit (CPC, 2004). Because of the size and mobility of the adults, this pest is not expected to stay on the commodity through harvest and standard handling and processing.

Eudocima fullonia Clerck, *Eudocima homaena* Hübner, *Eudocima materna* Linnaeus, and *Oraesia emarginata* F. (Lepidoptera: Noctuidae)

Only the adults feed on the fruit, and they only feed on the fruit externally (CPC, 2004; Atwal, 1976;

Butani, 1993). Because of the size and mobility of the adults, these pests are not expected to stay on the commodity through harvest and standard handling and processing. Furthermore, these species are reported to feed on the fruit at night (CPC, 2004; Atwal, 1976; Butani, 1993), decreasing even further the likelihood of these insects being associated with fruit at harvest and, therefore, following the pathway.

Helicoverpa armigera (Hübner) (Lepidoptera: Noctuidae)
We estimate *H. armigera* would be unlikely to follow the pathway of commercial quality mango fruit from India. When feeding on mango fruit, the larvae usually leave the major portion of their body outside the fruit (Butani, 1993); therefore, they would be unlikely to survive the standard postharvest cleaning and washing procedures. Also, since 1985, out of over 100,000 interceptions of pests and pathogens on mangoes at U.S. ports-of-entry, *H. armigera* has never been intercepted (PIN309 query September 27, 2004) (APHIS-PPQ-Interceptions, 2004).

Orgyia postica (Walker) (Lepidoptera: Lymantriidae)
The caterpillars of *Orgya postica* can cause large scale defoliation of mango trees and also feed on the stalk, skin and pulp of fruits (Fasih *et al.*, 1989). Larvae cause more severe damage to fruit than leaves, causing the fruit to drop prematurely or show obvious signs of damage on the skin and pulp (Gupta and Singh, 1986). The combined factors of external feeding, fruit drop, and conspicuous fruit damage make it unlikely that *O. postica* will follow the pathway.

Conogethes punctiferalis (Guenée), *Cryptoblabes gnidiella* (Milliere), *Ctenomeristis ebriola* Meyrick, *Deanolis albizonalis* (Hampson), *Hyalospora leuconeurella* Rangonot, *Thylacoptila paurosema* Meyrick, *Tirathaba mundella* Walker (Lepidoptera: Pyralidae)
The pyralid moths in the pest list are considered unlikely to follow the pathway because larval infestations generally cause fruit to drop before harvest, fruit injury is very noticeable and causes fruit to be unfit for sale. Additional notes follow below.

Cryptoblabes gnidiella (Milliere) (Lepidoptera: Pyralidae)
Butani (1993) mentions *C. gnidiella* only as a predator of whiteflies, not as a pest of mango. In Hawaii, this pest attacks Christmas berry, coffee, corn, green beans, and sorghum, but not mango (Mau and Kessing, 1992). *Cryptoblabes gnidiella* ranges through India, Israel, Nigeria, Egypt, Zaire, Italy (Sicily), Spain, Cyprus, Turkey, Malaysia, Indonesia, New Zealand, Hawaii and tropical and subtropical South America (Zhang, 1994), but has only been intercepted on mango entering the United States once, from Egypt (APHIS-PPQ Interceptions, 2002).

Deanolis albizonalis (Lepidoptera: Pyralidae)
As *D. albizonalis* larvae feed within the mango, the damaged area softens and collapses. A common sign of damage by *D. albizonalis* is the bursting at the fruit apex and the longitudinal cracking of the fruit as it nears maturity (Golez, 1991). Because of the destructive and obvious nature of fruit injury, it is very unlikely that any infested fruit would be packed for export.

Bactrocera incisa (Walker) (Diptera: Tephritidae)
White and Elson-Harris (1992) state that "the true *B. incisa* (Walker) is a Burmese species", that the records of *B. incisa* on mango and other plants in India were probably based on misidentifications

of *Batrocera caryeae*, and that mango is a doubtful host for *B. incisa*. Consequently, we consider this species unlikely to follow the pathway of mango fruit from India.

Sternochetus olivieri (Coleoptera: Curculionidae)
The only evidence of *S. olivieri* possibly being present India is 11 interceptions at U.S. ports-of-entry with passenger baggage (PIN309 query December 27, 2005). This is considered insufficient evidence to determine the true origin of the fruit. Consequently, we consider it not present in India and, therefore, unlikely to follow the pathway of mango fruit from India.

Retithrips syriacus and *Thrips palmi* (Thysanoptera: Thripidae)
As with the mealybugs, we estimate it is unlikely for *Retithrips syriacus* or *T. palmi* to be associated with commercial export-quality mango fruit, as the fruits are individually cleaned and washed as part of the standard post-harvest treatment in India (Seshadri, 2004). If any thrips are on the fruit at the time of harvest, they would likely be removed by this post-harvest practice. The calyx is no longer present at harvest; therefore, there are no hiding places for the thrips on the fruits.

Capnodium ramosum Cooke (Ascomycetes: Capnodiales)
Species of fungi in the genus *Capnodium* cause "sooty mold, a general term for the dark moldy signs of a group of closely related fungi that grow on plant and fruit surfaces" (Menge and Ploetz, 2003). These fungi do not parasitize the fruit, but grow on the honeydew excreted by various insects, *e.g.* aphids. To manage sooty mold, good control of insects which produce honeydew is needed (Ploetz, 2003). This organism is unlikely to follow the pathway with fruit, since cleaning and washing the fruit is a standard post-harvest process. "Washing the fruit in the packing house with water or a Ca-hypochlorite solution usually removes these fungi" (Menge and Ploetz, 2003).

F. Quarantine Pests Considered for Further Evaluation

Table 2. Quarantine Pests Selected for Further Analysis.	
Arthropods	**COLEOPTERA:Curculionidae** *Sternochetus frigidus* (F.) *Sternochetus mangiferae* (F.) **DIPTERA:Tephritidae** *Bactrocera caryeae* (Kapoor) *Bactrocera correcta* (Bezzi) *Bactrocera cucurbitae* Coquillett *Bactrocera diversa* (Coquillett) *Bactrocera dorsalis* (Hendel) *Bactrocera tau* (Walker) *Bactrocera zonata* (Saunders) **HEMIPTERA:** **Coccidae** *Ceroplastes rubens* Maskell *Coccus viridis* (Green) **Diaspididae** *Aulacaspis tubercularis* (Newstead) *Parlatoria crypta* Mckenzie *Pseudaonidia trilobitiformis* (Green)
Pathogens	*Actinodochium jenkinsii* Uppal, Patel & Kama *Cytosphaera mangiferae* Died. *Hendersonia creberrima* Syd., Syd. & Butler *Macrophoma mangiferae* Hing. & Sharma *Phomopsis mangiferae* S. Ahmad *Xanthomonas campestris* pv. *mangiferaeindicae* (Patel *et al*.) Robbs *et al*.

G. Analysis of Quarantine Pests Likely to Follow the Pathway

The qualitative pest risk analysis of the quarantine pests listed in Table 2 examines biological information for each risk element. The pertinent biological information is given for each pest, followed by a table summarizing the ratings for the analyzed organisms. These notes are not intended to be inclusive of all the available literature, but instead, identify the basis for the rating of “low”, “medium” or “high” as in the PPQ Guidelines v5.02 (APHIS, 2000).

The analysis of the pests is divided into two segments: Consequences of Introduction and Likelihood of Introduction. The Consequences of Introduction contains five risk elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact and Environmental Impact. The Likelihood of Introduction is divided into six sub-elements. Together, the Consequences of Introduction and the Likelihood of Introduction estimate the Baseline Pest Risk Potential, which is the overall risk in the absence of specific mitigation measures beyond standard post-harvest treatment.

The major sources of uncertainty in this risk assessment include: the lack of biological information on regional flora and fauna, inherent biological variation within a population of organisms (Morgan and Henrion, 1990), the use of a developing process (APHIS, 2000; Orr *et al*., 1993), the quality of the biological information (Gallegos and Bonano, 1993), and the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990).

Risk Elements 1-5.

This section evaluates each of the pest groups for five risk elements, (1) Climate-Host Interaction, (2) Host Range, (3) Dispersal Potential, (4) Economic Impact, and (5) Environmental Impact.

COLEOPTERA: Curculionidae: *Sternochetus frigidus* (F.), *Sternochetus mangiferae* (F.)

The mango weevils, *Sternochetus* spp, attack only mango fruit and are found in most places where mangoes are grown (CPC, 2001). In the Western Hemisphere *S. mangiferae* was identified in several islands of the Caribbean, French Guiana, and Hawaii (CPC, 2001). In India specifically, the mango weevil is found in the north-eastern regions, Andhra Pradesh, Orissa, Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat (Shukla and Tandon, 1985). *Sternochetus* spp. could presumably survive in any climate suitable for growing mango, but would not be a quarantine risk where mango is not cultivated. The mango weevils occur only in tropical regions where mango is cultivated (CPC, 2001), corresponding to USDA Plant Hardiness Zones 10 and 11; therefore, the Climate-Host Interaction is rated Medium (2). Host Range is rated Low (1) because mango is the only host of these weevils (CPC, 2001).

Sternochetus frigidus is a synonym of *Sternochetus gravis* (CPC, 2001). This insect is a major pest of mango in Tripura, India, in the state of Assam on the border with Bangladesh (De and Pande, 1990). The CIE Map 181 (1964) also placed the insect in Assam, which is largely separated from the rest of India by Bangladesh. PPQ Officers intercepted *S. frigidus* only one time in passenger baggage from India over a 17 year period (APHIS-PPQ-Interceptions, 2002), but this insect (under the synonym *S. gravis*) is a major pest of mango in Assam (De and Pande, 1990; De and Pande, 1988).

Adults are capable of surviving long, unfavorable periods. De and Pande (1988) observed *S. frigidus* adults to be poor fliers, flying only 50-90 cm, however Balock and Kozuma (1964) reported “rich flying” for *S. mangiferae*. In ports-of-entry into the United States near areas of mango cultivation, it would be possible for adults to fly to host trees. The mango weevil has become established in virtually every mango growing area of the world, except in the Canary Islands (Spain), Italy, Israel and Egypt (CPC, 2001), so Dispersal Potential is rated High (3).

Sternochetus mangiferae does not significantly reduce seed germination rates and rarely damage fruit pulp; however, they can cause exporting countries to be put under quarantine for mango export to many countries (Follett, 2002). This species may also cause early fruit drop; Follett (2002) found a nominally higher percentage of weevils in prematurely dropped fruit than on trees. Follett and Gabbard (2000) rarely found any damage to fruit pulp and challenged the idea that *S. mangiferae* is a serious pest, although (De and Pande 1988) found that when *S. frigidus* larvae fail to penetrate into seeds (10 to 15%), the adults emerge before the fruit fall, ruining the fruit pulp.

The mango weevil (*S. mangiferae*) has the potential to limit exports and have an economic impact on the mango industry because of its status as a quarantine pest (Follet, 2002). In 1997, domestic mango production in Florida was worth $1.45 million (Mossler and Nesheim, 2002). Although the presence of mango seed weevil in the United States would prevent export to several countries, the economic impact would be small, because the United States does not export mangoes. The overall economic impact of the mango seed weevil on the United States is expected to be Low (1).

Environmental Impact is rated Low (1) because mango is the only host of *Sternochetus* spp., and is not an endangered species. The weevils do not harm mango trees *per se*, but may affect seed germination in infected seeds (Follet and Gabbard, 2000).

DIPTERA: Tephritidae: *Bactrocera caryeae* (Kapoor), *Bactrocera correcta* (Bezzi), *Bactrocera cucurbitae* Coquillett, *Bactrocera diversa* (Coquillett), *Bactrocera dorsalis* Hendel, *Bactrocera tau* Walker, *Bactrocera zonata* (Saunders)

Fruit flies in the genus *Bactrocera* infest fruit of numerous hosts in tropical and semitropical areas of Southeast Asia (CPC, 2005) corresponding to USDA Plant Hardiness Zones 10 and 11, both of which are represented in the United States, so the Climate-Host Interaction risk rating is Medium (2). *Bactrocera correcta* attack the fruit of at least 31 tree genera in families as diverse as Anacardiaceae and Rosaceae (CPC 2001). The Oriental fruit fly, *B. dorsalis*, is a serious pest of a wide range of fruit crops in the northern areas of the Indian subcontinent (White and Elson-Harris, 1994), however, there has been confusion about the nomenclature of this species and many species identified as *B. dorsalis* may refer to other species in the *B. dorsalis* complex. Many of the host species occur in the United States, including *Mangifera indica* and *Citrus* spp. in Florida and California, *Carica papaya* in the southern states, and *Prunus* spp. throughout the country. The Host Range is rated High (3) for all *Bactrocera* species discussed.

In the Punjab, *B. dorsalis* adults can remain active throughout the year, but the population declines during the winter months (Mann 1996). In India, the wide host range of *B. cucurbitae* allows it to breed actively in the field from February to November and go through nine to ten generations a year (Lall and Singh 1969). These pests fly away from their host field within one hour after emergence from the pupal stage (Kazi 1976), and may disperse to nearby fields. The fruit flies are all rated High (3) for Dispersal Potential because of their high reproductive ability and their ability to disperse rapidly.

In India, *B. dorsalis* is the most destructive fruit fly of mango, followed by *B. zonatus* and *B. correctus* (Abbas *et al.* 2000). Females oviposit inside the mesocarp of mature fruits, and larvae feed on the pulp, causing the fruit to rot before ripening and finally drop (Abbas *et al.* 2000). In some years *B. cucurbitae* partially or totally destroys 50% of vegetable crops it attacks (Lall and Singh, 1969). The injury by *B. dorsalis* reduces yield and quality of mango fruits (Mann 1996).

Adult *B. dorsalis* can be controlled with methyl eugenol traps (Lakshmanan *et al.* 1973), bait sprays, pheromone mating disruption, and pesticide applications to fruit (Abbas *et al.* 2000). Larvae inside mango fruit can be killed by hot water treatment of mature fruit (Wadhi and Sharma, 1972), cold treatments (Burikam *et al.* 1992), vapor heat treatment (Heard *et al.* 1992, Heather *et al.* 1992), and gamma irradiation (Heather *et al.* 1991). The expense required to control fruit flies and the loss of export potential due to the presence of fruit flies would have a High (3) Economic Impact.

Potential hosts of *B. dorsalis* and *B. correcta* listed by USFW (2004) as Endangered are *Prunus geniculata*, and *Ziziphus celata*. Both of these plant species are present in *B. dorsalis'* and *B. correcta'*s predicted climatic range in the continental United States and are congeneric with plant species reported as hosts of these two species of *Bactrocera*. Likewise, *Prunus geniculata* is congeneric with *Prunus persica*, a reported host of *B. zonata*. Potential hosts for *B. cucurbitae* listed as Endangered by USFW (2004) and present within *B. cucurbitae*'s predicted climatic range in the continental United States are: *Cucurbita okeechobeensis* ssp. *okeechobeensis*, *Prunus geniculata*, and *Ziziphus celata*. These plant species are congeneric with plant species reported as hosts of *B. cucurbitae.* As these *Bactrocera* species represent important economic threats, their establishment in the continental United States would likely trigger the initiation of chemical and/or biological control programs. Based on this evidence, the Environmental Impact of was rated High (3) for all *Bactrocera* species

HEMIPTERA: Coccidae: *Ceroplastes rubens* Maskell

Ceroplastes rubens' distribution extends from warm temperate zones to the tropics. It is found in East and South Asia, throughout Oceania, Australia, East Africa, and the West Indies (CABI, 2005). It is estimated that it could survive in US Plant Hardiness Zones 8-11. Because one or more of its potential hosts occurs in these zones (USDA NRCS, 2003), this risk element was rated High (3).

C. rubens has been recorded on numerous wild and cultivated hosts, including *Citrus* spp. (Rutaceae), *Mangifera indica* (Anacardiaceae), *Artocarpus altilis* (Moraceae), *Cinnamomum verum* (Lauraceae), *Camellia sinensis* (Theaceae), *Litchi chinensis* (Sapindaceae), *Psidium guajava* (Myrtaceae), *Coffea* sp. (Rubiaceae), *Alpinia purpurata* (Zingiberaceae), *Myristica fragrans* (Myristicaceae), *Annona* sp. (Annonaceae), *Artemisia* sp. (Asteraceae), *Prunus* spp. (Rosaceae), *Pinus* spp. (Pinaceae), *Cocos nucifera* (Arecaceae) (CPC, 2005), and *Dimocarpus longan* (Sapindaceae) (Li-zhong, 2000; Ben-Dov et al., 2003). This risk element was rated High (3).

Females of this scale may deposit over 1000 eggs, but mean fecundity is just below 300 (CPC, 2001). There are two generations per year (CPC, 2005). As with other scales, the species exhibits limited mobility under its own power. The main means of long-distance dispersal is on infested plant materials (CPC, 2002). The dispersal potential of *C. rubens* risk element was rated High (3).

Ceroplastes rubens is a widespread pest of *Citrus*, coffee, tea, *Cinnamomum*, mango, avocado and litchi (CPC, 2001). It is considered a major pest of citrus in Australia, Hawaii, Korea, China and Japan (CPC, 2002). Economic damage is caused directly through phloem feeding and indirectly through the promotion of sooty mold growth, which lowers the market value of fresh fruit and can reduce photosynthetic efficiency, causing reduced growth (CPC, 2002). Based on this evidence, if *C. rubens* should become more widely established in the United States, there would likely be a lower yield of host crops, lower value of host crop commodities, and loss of foreign or domestic markets. Thus, its potential economic impact was rated High (3)

The extreme polyphagy of this species increases the probability of it attacking plants in the United States listed as Threatened or Endangered. It has been recorded from species of *Euphorbia*, *Gardenia*, *Ilex*, *Lindera*, and *Rhus* (CPC, 2001), which have congeners (*E. haeleeleana*, *E. telephioides*, *G. brighamii*, *G. mannii*, *I. cookii*, *I. sintenisii*, *L. melissifolia*, and *R. michauxii*) listed in 50 CFR §17.12. As this species is a pest of citrus, the wider establishment of this pest in the United States would likely result in the initiation of chemical and/or biological control programs. This risk element was rated High (3).

HEMIPTERA: Coccidae: *Coccus viridis* (Green)

This species is pantropical in distribution. It has been reported from India through Indo-China, Malaysia to the Philippines and Indonesia, throughout much of Oceania and sub-Saharan Africa south to South Africa (CABI, 2002). In the New World, it is present in Florida, and ranges from Central America to the northern part of South America and throughout the Caribbean. Its reported distribution corresponds to Plant Hardiness Zones 8-11. It is estimated that this species could become established in areas of the United States corresponding to Plant Hardiness Zones 9-11, which corresponds to its present distribution in the United States Zones 9-11 correspond to Florida, southern Texas, southern Arizona, much of California, and Hawaii (USDA, 1990). One or more hosts of *C. viridis* are present in these States (USDA NRCS, 2003). This estimate does not include Plant Hardiness Zone 8, as this zone only occurs in isolated areas of some of the countries (*e.g*., Andean regions of Bolivia and Peru, northern Mexico, isolated central area of South Africa) from which *C. viridis* is reported (BackyardGardner.com, 2003). Survival outside of these areas would be limited to greenhouse or other artificial situations. Consequently, the Climate-Host Interaction risk element was rated Medium (2) for *C. viridis*.

Coccus viridis has a broad host range (CABI, 2002). Primary hosts are *Citrus* spp. (Rutaceae), *Coffea arabica* (Rubiaceae), *Artocarpus* sp. (Moraceae), *Camellia sinensis* (Theaceae), *Manihot esculenta* (Euphorbiaceae), *Mangifera indica* (Anacardiaceae), *Psidium guajava* (Myrtaceae), and *Theobroma cacao* (Sterculiaceae) (CABI, 2002). Other hosts include *Alpinia purpurata* (Zingiberaceae), *Chrysanthemum* sp. (Asteraceae), *Manilkara zapota* (Sapotaceae), *Nerium oleander* (Apocynaceae) (CABI, 2002), and *Dimocarpus longan* (Sapindaceae) (ScaleNet, 2004). Therefore, the Host Range risk element was rated High (3) for this organism.

Coccus viridis is parthenogenetic and oviparous (Dekle 1976b). Females may deposit up to 500 eggs (CABI 2002). There may be several generations per year (Kosztarab 1997). The rate of natural dispersal is inherently low (Tandon and Veeresh 1988); however, since 1985, *C. viridis* has been intercepted 10,658 times by agricultural specialists at U.S. ports of entry (PIN309 query September 30, 2004), which is strong evidence that this species can, and has, spread quickly and widely via the transport of infested plant materials. In light of this evidence, this organism was rated High (3) for the Dispersal Potential risk element.

Although its economic impact is usually minor, it can be extremely devastating depending on location and crop (CABI 2002). *Coccus viridis* is a pest of coffee, citrus and other crops in several regions in the tropics, and it is reported as a major pest of citrus in Bolivia (Ben-Dov 1993). *Coccus* *viridis* is a major pest of coffee in Haiti (Aitken Soux 1985) and India (Narasimham 1987). In Brazil, infestations of 50 scales per plant caused significant damage to coffee seedlings, reducing leaf area and plant growth rate (Silva and Parra 1982). Of all the scale insects known on coffee in Papua New Guinea, *C. viridis* and one other scale species cause most of the yield loss (Williams 1986). In India, citrus fruit quality was significantly lower on trees following *C. viridis* infestation and the sooty mold (*Capnodium citri*) contamination that accompanied it (Haleem 1984). Based on this evidence, the wider establishment in the United States of *C. viridis* would likely lead to lower yield of host crops, lower value of host crop commodities, and loss of foreign or domestic markets. Consequently, *C. viridis* was rated High (3) for the Economic Impact risk element.

The extreme polyphagy of *C. viridis* predisposes it to attack vulnerable native plants in the United States. The potential host, *Manihot walkerae* (Euphorbiaceae), which is present in Texas, is listed as Endangered by USFWS (2004). The wider establishment of this species could have a negative impact on the citrus industry in areas, such as Arizona and Texas, and stimulate the initiation of chemical or biological control programs. The Environmental Impact risk element was, therefore, rated High (3).

HEMIPTERA: Diaspididae: *Aulacaspis tubercularis* Newstead, *Parlatoria crypta* Mckenzie, *Pseudaonidia trilobitiformis* (Green)

The mango scale, *Aulacaspis tubercularis*, is found throughout the world where mango is cultivated, including the northern part of South America, the Caribbean, the east and west coasts of Africa, and India, and Italy (CPC, 2001). The regions occupied by *A. tubercularis* correspond to USDA Plant Hardiness Zones 10 and 11 (CPC, 2001), so the Climate-Host Interaction rating is Medium (2). *Parlatoria crypta* has been reported in Africa (Comoros, Sudan) (Ben-Dov *et al.*, 2004), India (Dutta, 1996; CPC, 2003; Ben-Dov *et al.*, 2004), Afghanistan (CPC, 2003; Fowjhan and Kozar, 1994; Ben-Dov *et al.*, 2004), Pakistan (Ghani and Muzaffar, 1974; Ben-Dov *et al.*, 2004), Iran (Kozar et al, 1996; Ben-Dov *et al.*, 2004), Iraq (Ben-Dov *et al.*, 2004; CPC, 2003), and Saudi Arabia (Ben-Dov *et al.*, 2004). Based on this distribution and availability of potential hosts, it is estimated that suitable climatic conditions for this species should be available in Plant Hardiness Zones 8-11. One or more of its potential hosts occurs in these zones (USDA NRCS 2003). Therefore, this species was rated High (3) for the Climate-Host Interaction. *Pseudaonidia trilobitiformis* has been reported in Taiwan (Anonymous 1994), Mexico, Venezuela, the Caribbean (CABI 2002), East Africa, New Caledonia in the South Pacific (Fabres 1974), and Florida (Coile and Dixon 2000; USDA 1979). Suitable climatic conditions for this species should be available in the southern U.S. (Plant Hardiness Zones 9-11). One or more of its potential hosts occurs in these zones (USDA NRCS 2003). It is, therefore, rated Medium (2) for the Climate-Host risk element.

Aulacaspis tubercularis attacks hosts in at least seven plant families (Hamon, 2002), so Host Range is rated High (3). Likewise, *Parlatoria crypta* has as a very wide host range, which includes plants from multiple families (Ben-Dov *et al.*, 2004). In light of this wide host range, *P. crypta* was rated High (3) for the Host Range risk element. Hosts recorded for this species include *Mangifera indica* and *Anacardium occidentale* (Anacardiaceae), *Citrus* spp. (Rutaceae), *Anthurium andreanum* (Araceae), *Persea americana* (Lauraceae), *Zingiber officinale* (Zingiberaceae), *Theobroma cacao* (Sterculiaceae), *Coffea* spp. (Rubiaceae), *Cocos nucifera* (Arecaceae) (CABI 2002), *Passiflora* spp. (Passifloraceae) (Hill 1983), and *Dimocarpus longan* (Sapindaceae) (Anonymous 1994). *Pseudaonidia trilobitiformis* is, therefore, rated High (3) for the Host Range risk element.

In South Africa, *A. tubercularis* was first recorded on one cultivar of mango in 1947 and has since become a pest throughout all mango producing areas of South Africa (Joubert *et al.*, 2000). Only the crawler stage can move to a new host (adult males can fly but cannot establish a colony), but scale insects can move to new hosts as a result of wind, birds, and insects. Crawlers are capable of moving distances of tens of kilometers on wind currents to infect clean crops (Greathead, 1989). Because of the proven ability of *A. tubercularis* to spread through mango producing regions, Dispersal Potential is rated High (3). No information was found on the biology of *P. crypta*; however, related species exhibit multivoltinism and high fecundity. For instance, *Parlatoria ziziphi* may produce two to seven generations per year, depending on the geographical location, and fecundity varies from 8 to 34 eggs per female (CPC, 2002; Blackburn and Miller, 1984). The crawler stage of armored scales can be dispersed by natural means (several meters), on other organisms (*e.g.*, the feet of birds), or by wind (Miller 1985). As with other scale insects, long-distance dispersal of *P. crypta* can likely be accomplished by transport on infested plant material. Since 1985, the genus *Parlatoria* has been intercepted on plant materials 39,072 times (including 164 times of *P. crypta* specifically) by agricultural specialists at U.S. ports-of-entry (PIN309 query October 1, 2004). Consequently, the dispersal potential of *P. crypta* was rated High (3) for the Dispersal Potential risk element. No information is available on the biology of *Pseudaonidia trilobitiformis*, but two related species that occur in the southern U.S. exhibit multivoltinism and high fecundity. *Pseudaonidia duplex* (Cockerell) has three generations per year in Louisiana, and *P. paeoniae* (Cockerell) produce 30-50 eggs per female (Kosztarab 1996). Long-distance dispersal of *P. trilobitiformis* is likely accomplished by transport on infested plant material. Indeed, since 1985, *P. trilobitiformis* has been intercepted 11,954 times by agricultural specialists at U.S. ports of entry (PIN309 query July 9, 2003). Based on this evidence, this scale species was rated High (3) for the Dispersal Potential risk element.

Aulacaspis tubercularis attacks mango leaves, branches and fruit, where it causes superficial pink or yellow blemishes to develop, making the fruit unmarketable (Joubert *et al.*, 2000), although precise economical figures are lacking. In the absence of evidence, Economic Impact is rated Medium (2). Little information could be found on the economic impact of *P. crypta* other than it is listed as an insect pest by Miller and Davidson (1990), and it is reported to cause very serious damage (on leaves, buds, stems and the top part of trees) on olive trees in Iran (Najafinia, et al, 2002). The related species *P. ziziphi* is reported as an important citrus pest in various parts of the world: China, Egypt, Iran, Italy, Libya, Nigeria, Tunisia, Algeria, Morocco, and Southeast Asia, and is reported to cause some damage in Greece, Italy, Spain, Israel, Egypt, and South Africa (Blackburn and Miller, 1984). It has become the most important citrus pest in Upper Egypt (Coll and Abd Rabou, 1998). However, there is little information on the specific economic losses caused by this scale (CPC, 2002). This insect is mainly a problem as a contaminant on fruit, which can cause rejection in most fresh fruit markets (Blackburn and Miller, 1984). It also causes dieback of twigs, premature drop of fruit and leaves, and deformation of fruit (Blackburn and Miller, 1984). Large populations cause chlorosis and premature drop of leaves, dieback of twigs and branches, stunting and distortion of the fruit, and premature fruit drop (Blackburn and Miller, 1984). Based on the fact that there is little information available on the economic impact of *P. crypta* but that it is reported to cause serious damage to olives, that this species has a wide host range that includes some economically important hosts in the United States, and that the related species *P. ziziphi* is an important economic pest, *P. crypta* was given a Medium (2) rating for the Economic Impact risk element. *Pseudaonidia trilobitiformis* is regarded as a minor pest of avocado, cacao, citrus, coconut, coffee, mango, and passion fruit (Hill 1983). In Brazil, however, it is a pest of cashew that requires chemical control (Silva *et al.* 1977). Wider establishment of this insect in the United States could stimulate chemical and/or biological control programs and cause a loss of domestic and foreign markets for commodities, such as citrus. Based on this evidence, *P. trilobitiformis* was rated Medium (2) for the Economic Impact risk element.

Cucurbita okeechobeensis ssp. *okeechobeensis* is a potential plant host of *A. tubercularis* listed as Endangered by USFWS (2002) and reported in this scale insect's predicted climatic range in the continental United States. The genus *Cucurbita* is a reported host of this scale species (CPC, 2003). The introduction of *A. tubercularis* into the United States could stimulate chemical or biological control programs. Consequently, the Environmental Impact was rated High (3) for *A. tubercularis*. *Agave arizonica* (Agavaceae) is the only potential host for *P. crypta* present in the continental United States listed as Threatened or Endangered by USFWS (2004). This plant species is reported as present in *P. crypta*'s predicted climatic range within the United States. *Cordia bellonis* (Boraginaceae), which is reported in Puerto Rico, is another potential host listed as Endangered by USFWS (2004). Control measures against armored scales (Diaspididae) are often necessary to produce a marketable crop (Miller, 1985). In Florida, scale insects, including *P. ziziphi*, are often managed by natural as well as released parasites, predators, and pathogens; and scale populations may require treatment if biological control has been disrupted (Mossler and Nesheim, 2003). In China, the following pesticides have been used to effectively control *P. ziziphi*: omethoate, chlorpyrifos, methidathion, quinalphos, lambda-cyhalothrin, fenvalerate or cypermethrin (CPC, 2002). Based on this information, *P. crypta* was given a High (3) rating for the Environmental Impact risk element. Potential hosts, congeneric to known hosts of *P. trilobitiformis*, listed as Threatened or Endangered by USFWS (2004) and present in the continental U.S. include, among others: *Ayenia limitaris* (Sterculiaceae), *Fremontodendron californicum* ssp. *decumbens* (Sterculiaceae), *Fremontodendron mexicanum* (Sterculiaceae), and *Lindera melissifolia* (Lauraceae). These plants are present in *P. trilobitiformis*' predicted climatic range in the United States outside of Florida and are classified in plant families within this scale's host range. As no host preference tests with *P. trilobitiformis* and these plants are known, it is assumed these plants could be used as hosts. Because *P. trilobitiformis* represents a potential threat to citrus and possibly other economically important crops, wider establishment of this species in the United States could stimulate chemical or biological control programs. Based on this evidence, *P. trilobitiformis* was rated High (3) for the Environmental Impact risk element.

PATHOGENS

Actinodochium jenkinsii Uppal, Patel & Kamat

Mango black spot caused by *Actinodochium jenkinsii* Uppal, Patel & Kamat has only been recorded in India (Uppal *et al.*, 1953). Uppal *et al.* (1953) described this disease as strictly a wound parasite, with ripe fruits being more susceptible than green ones. It occurs in coastal areas of Bombay State (geographic division in 1937) (Uppal *et al.*, 1953), and because this region corresponds to USDA Plant Hardiness Zone 11, the Climate-Host Interaction rating is Low (1). The Host Range is rated Low (1) because this disease is known to attack only Alfonso and Piari varieties of mango (Uppal *et al.*, 1953). Affected fruits show only a few dusky brown to blackish brown, round, small necrotic spots. This pest is rated Medium (2) for Dispersal Potential because disease spread through an orchard could be rapid, but long range disease spread is likely to be slower, as evidenced by the fact that it does not occur outside of India. The Government of India has also indicated that this disease is of no economic significance in India (Seshadri, 2004); therefore, the Economic Impact rating is Low (1). The Environmental Impact is rated Low (1) because *A. jenkinsii* is host specific for mango (Uppal *et al.*, 1953), and mango is not an Endangered or Threatened species.

Cytosphaera mangiferae Died. 1916

Cytosphaera mangiferae is found primarily in tropical regions in Australia and Asia (Malaysia, Pakistan, India, and Papua New Guinea) (Farr *et al.*, 2006). These regions roughly correspond to the USDA Plant Hardiness Zone 11 (USDA-ARS, 1990). *Cytosphaera mangiferae* was, therefore, rated Low (1) for Climate-Host Interaction. In addition to mango, the host range of *C. mangiferae* includes agarwood (*Aquilaria agallocha* Roxb.), *Artocarpus frengenifolia*, *Macadamia integrifolia* and *Sabal palmetto* (Johnson & Hyde, 1992). Of these species, there is limited production of *Aquilaria* spp., *Artocarpus* spp. or *Macadamia* spp. in the continental United States, in Florida and California primarily (USDA-NRCS, 2003). However, the *Sabal palmetto* is a native plant throughout the Southeastern United States (USDA-NRCS, 2003). *Cytosphaera mangiferae* was, therefore, rated High (3) for Host Range, since it attacks multiple species from multiple plant families. The fungus is thought to grow endophytically leading to stem cankers and fruit infections (Johnson & Hyde, 1992). Dispersal has not been extensively studied, however discarded, infected fruit may be a source of conidia produced on the surface (Johnson & Hyde, 1992). These conidia may disperse via wind or water to infect mango nearby. *Cytosphaera mangiferae* was assigned a Medium (2) risk rating because of uncertainty in Dispersal Potential. *Cytosphaera mangiferae* causes stem-end rot (Peterson, 1986), a zonate leaf spot, twig canker, and a post-harvest fruit rot (MAF, 2003) It is more prevalent as orchards age and when anthracnose is controlled (MAF, 2003). *Cytosphaera mangiferae* was, therefore, rated Medium (2) for Economic Impact. There is one federally listed endangered species in the continental United States, in the family Anacardiaceae, *Rhus michauxii* (Georgia, North Carolina, South Carolina, and Virginia) (USFWS, 2006), however this plant does not inhabit the zones where the pathogen is estimated to become established. Based on this evidence, the Environmental Impact is rated Low (1).

Hendersonia creberrima Syd., Syd. & Butler

The fungus, *Hendersonia creberrima*, causes a ripe fruit rot of mango, with large, irregular, black spots developing all over the fruit's surface and not exclusively at the stem end (Sydow, *et al.*, 1916). It is reported only from India in mango producing areas (Farr *et al.*, 2006; Cline, 2006). Areas where it is found correspond to USDA Plant Hardiness Zones 11 or greater, so this pest is rated Low (1) for Climate-Host Interaction. The only reported host is mango, so the pathogen is rated Low (1) for Host Range. *H. creberrima* causes a storage rot of mango fruit and reproductive structures form typically when the rot is advanced, producing masses of spores from pycnidia (Sydow *et al.*, 1916). The Dispersal Potential is rated Medium (2), because spores are produced in abundance and released from pycnidia in wet tendrils or droplets likely dispersed by rain or heavy dew. *H. creberrima* causes a storage rot of harvested fruits (Sydow, *et al.*, 1916), which may impact grower revenue by reducing quality of marketed fruit, although mango production in the United States is limited (Mossler and Nesheim, 2002). For these reasons, the Economic Impact is rated Low (1). The Environmental Impact is rated Low (1) because *H. creberrima* infects only mango, although other hosts have not been studied to date. There were no known hosts congeneric with threatened or endangered species (USFWS, 2002).

Macrophoma mangiferae Hing. & Sharma

The fungus, *Macrophoma mangiferae*, causes a leaf and stem blight and postharvest rot of mango (Hingorani, *et al.*, 1960). It occurs in India and Nigeria in mango producing areas and has been intercepted from Mexico (Farr *et al.*, 2006; Okigbo & Osuinde, 2003; Hingorani, *et al.*, 1960). Areas where it is found correspond to USDA Plant Hardiness Zones 11 or greater, so this pest is rated Low (1) for Climate-Host Interaction. The primary host is mango (Hingorani, *et al.*, 1960), although it also weakly infects *Ficus carica*, *Eryobotrya japonica*, *Eugenia jambolina*, and *Vitis vinifera*, so the pathogen is rated High (3) for Host Range. *M. mangiferae* infects leaves, stems and causes a storage rot of mango fruit (Hingorani, *et al.*, 1960). The Dispersal Potential is rated Medium (2), because dispersal occurs when fruiting structures (pycnidia) form on colonized mango tissue. Spores produced in abundance are dispersed by rain or heavy dew (Hingorani, *et al.*, 1960).

This fungus causes a leaf and stem blight and storage rot of harvested fruits (Hingorani, *et al.*, 1960; Okigbo & Osuinde, 2003), which may impact grower revenue by reducing tree productivity (reduced leaf area) or quality of marketed fruit, although mango production in the United States is limited (Mossler and Nesheim, 2002). For these reasons, the Economic Impact is rated Medium (2). The Environmental Impact is rated Medium (2) because *M. mangiferae* has a somewhat limited host range, but includes some species congeneric with federal and state listed threatened or endangered species (USFWS, 2002). There are three Federally listed and five state listed *Eugenia* spp., and seven listed species of *Vitis*, although some hosts live in regions which may be prohibitively cold for the survival of *M. mangiferae* (USFWS, 2002; USDA-NRCS, 2003).

Phomopsis mangiferae S. Ahmad

The fungus, *Phomopsis mangiferae*, causes a postharvest rot of mango (Johnson *et al*., 1994). It occurs in India, Pakistan and Australia in mango producing areas (ARS, 2001; Laxinarayana and Reddy, 1975) that correspond to USDA Plant Hardiness Zone 11, so this pest is rated Low (1) for Climate-Host Interaction. The host range appears to be limited to mango (ARS, 2001; Johnson *et al*., 1994) so it is also rated Low (1) for Host Range. The disease infects mango fruit endophytically, that is, from within the plant (Johnson *et al*., 1994; Sangchote *et al.,* 1992) and infected fruit can become mummified. Infected seeds germinate to produce infected plants, perpetuating the fungus within the plant (Johnson *et al*., 1994). The Dispersal Potential is rated Low (1), because dispersal assumes that the infected seed subseqently is used in mango production. If infected fruit is consumed and seeds are discarded, infected fruit are unlikely to come into contact with susceptible mango plants.

The pest also causes a stem-end rot of harvested fruits (Johnson *et al.*, 1994), which is likely to impact grower revenue, although mango production in the United States is limited (Mossler and Nesheim, 2002). For these reasons, the Economic Impact is rated Medium (2). The Environmental Impact is rated Low (1) because *P. mangiferae* is host specific for mango (ARS, 2001), and mango is not an Endangered or Threatened species.

Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al.*) Robbs *et al*. (Proteobacteria: γ subdivision, Lysobacterales)

Mango bacterial black spot, caused by *Xanthomonas campestris* pv. *mangiferaeindicae*, is found in India, Australia, the Comoros Islands, Japan, Kenya, Malaysia, Mauritius, New Caledonia, Pakistan, the Philippines, Réunion, Taiwan, Thailand and the United Arab Emirates (Gagnevin & Pruvost, 2001). *Xanthomonas campestris* pv. *mangiferaeindicae* infects not only mango (*Mangifera indica*), but also cashew (*Anacardium occidentale*), Brazilian pepper (*Schinus terebinthefolius*), ambarella (*Spondias cytherea* or *S. dulcis*), and other members of the plant family Anacardiaceae, growing in the regions listed above (Gagnevin & Pruvost, 2001). These regions correspond to USDA Plant Hardiness Zones 10 and 11, so the Climate-Host Interaction rating is Medium (2). The Host Range is rated Medium (2) because this pathogen attacks multiple species in the family Anacardiaceae (CPC, 2005). Bacterial pathogens in the genus *Xanthomonas* penetrate their hosts through natural openings and wounds (Agrios, 1997). The bacteria overwinter on infected or healthy plant parts, on or in seeds, on infected plant debris, on contaminated containers or tools and in the soil (Agrios, 1997). Rain plays an important role in pathogen dispersal (Agrios, 1997; Pruvost *et al.*, 1990). This pest is rated Medium (2) for Dispersal Potential because disease spread through an orchard could be rapid, but long range disease spread is likely to be slower. Pruvost *et al*., (1990) described bacterial black spot of mango as one of the principle diseases in mango producing countries, so the Economic Impact rating is High (3). There is one federally listed endangered species in the continental United States, in the family Anacardiaceae, *Rhus michauxii* (Georgia, North Carolina, South Carolina, and Virginia) (USFWS, 2006), however this plant does not inhabit the zones where the pathogen is estimated to become established. Based on this evidence, the Environmental Impact is rated Low (1).

Table 3. Risk Rating for Consequences of Introduction: (Risk Elements #1-5)						
Pest	Climate/Host Interaction	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Cumulative Risk Rating[1]
ARTHROPODS						
COLEOPTERA						
Curculionidae						
Sternochetus frigidus (F.) *Sternochetus mangiferae* (F.)	2	1	3	1	1	8 (L)
DIPTERA						
Tephritidae						
Bactrocera caryeae (Kapoor) *Bactrocera correcta* (Bezzi) *Bactrocera cucurbitae* Coquillett *Bactrocera diversa* (Coquillett) *Bactrocera dorsalis* Hendel *Bactrocera tau* Walker *Bactrocera zonata* (Saunders)	2	3	3	3	3	14 (H)
HEMIPTERA						
Coccidae						
Ceroplastes rubens Maskell	3	3	3	3	3	15 (H)
Coccus viridis (Green)	2	3	3	3	3	14 (H)
Diaspididae						
Aulacaspis tubercularis Newstead	2	3	3	2	3	13 (H)
Parlatoria crypta Mckenzie	3	3	3	2	3	14 (H)
Pseudaonidia trilobitiformis (Green)	2	3	3	2	3	13 (H)
PATHOGENS						
Actinodochium jenkinsii Uppal, Patel & Kamat	1	1	2	1	1	6 (L)
Cytosphaera mangiferae Died.	1	3	2	2	1	9 (M)
Hendersonia creberrima Syd., Syd. & Butler	1	1	2	1	1	6 (L)
Macrophoma mangiferae Hing & Sharma	1	3	2	2	2	10 (M)
Phomopsis mangiferae Ahmad apud Petrak & Ahmad	1	1	1	2	1	6 (L)
Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al.*) Robbs *et al.* (Proteobacteria: γ subdivision, Lysobacterales)	2	2	2	3	1	10 (M)

[1]Low is 5-8 points, Medium is 9-12 points and High is 13-15 points

Risk Element 6: Pest Opportunity (Survival and Access to Suitable Habitat and Hosts)

Risk Element 6, sub-element 1: Quantity Imported Annually

According to the request from the government of India, the quantity of mango will be circa 100 sea containers per year. This is considered a Medium (2) quantity for the purpose of this risk assessment (APHIS, 2000).

Risk Element 6, sub-element 2: Survive Post harvest Treatment

This risk sub-element was estimated based on the fruit being cleaned and washed as part of standard post-harvest practices in Indian mango production as explained by Seshadri (2004). As internal pests, all of the fruit flies are highly likely to survive postharvest treatment and have been rated High (3) for this sub-element. As external pests, the hemipteran pests would have less of a probability of surviving post-harvest treatments than internal feeders. Consequently, the hemipteran pests are rated Medium (2) for this sub-element. All six pathogens would be highly likely to survive postharvest treatment and, therefore, are rated High (3) for this sub-element.

Risk Element 6, sub-element 3: Survive Shipment

All of the insects being analyzed in this section are highly likely to survive shipment and have been rated High (3) for this sub-element: most have been intercepted in U.S. ports by U.S. agricultural inspectors (APHIS-PPQ-Interceptions**,** 2002).

The bacteria *Xanthomonas campestris* pv. *mangiferaeindica* survive epiphytically on fruit, leaves and soil (Pruvost *et al.*, 1990; Pruvost and Luisetti, 1991); epiphytic populations are not detected on symptomless mature fruit (Pruvost and Luisetti, 1991). The number of bacterial spots occurring on mature fruits is directly related to epiphytic populations, suggesting that the resident populations are an important source of inoculum for fruit infection (Pruvost and Luisetti, 1991) so the rating was High (3).

The stem end rot diseases (*Phompsis mangiferae* and *Actinodochium jenkinsii*) and fruit rotters (*Macrophoma mangiferae*, *Hendersonia creberrima* and *Cytosphaera mangiferae*) are highly likely to survive shipping conditions (AFFA, 2001) because most control measures are not curative and do not eradicate the pathogens (Coates *et al.*, 1997; Coates *et al.*, 1993; Johnson *et al.*, 1993; Johnson *et al.*, 1990; Johnson and Highley, 1994). Additionally, controlled atmospheric conditions may only slow stem end rot or fruit rot symptom expression (Johnson *et al.*, 1993), leading to longer latent periods. For these reasons, the rating was High (3) for *Phomopsis mangiferae*, *Actinodochium jenkinsii*, *Macrophoma mangiferae*, *Cytosphaera mangiferae* and *Hendersonia creberrima*.

Risk Element 6, sub-element 4: Not Detected at Port-of-Entry

As external feeders, the hemipteran pests have a high probability of being detected at the port-of-entry because they will be visible on the outside of the fruit, so they are rated Low (1) for Not Detected at the Port-of-Entry. The larvae of the mango weevils can only be detected by cutting open the seeds in which they feed, so they are rated High (3) for this risk element. Inspectors cutting mango failed to detect larvae of *Anastrepha supensa*, a fruit fly in the same family as *Bactrocera* spp., 71.6% of the time (Gould, 1995). These findings underscore the high likelihood of fruit flies crossing borders undetected in fruit and supports a rating of High (3) for Not Detected at Port-of-Entry for all the *Bactrocera* species.

Obvious advanced post harvest rot caused by the fungi: *Actinodochium jenkinsii, Cytosphaera mangiferae, Phomopsis mangiferae, Macrophoma mangiferae* and *Hendersonia creberrima* would likely be detected at ports of entry when there are obvious external symptoms, although they may not be clearly attributable to a single pathogen (Johnson *et al*., 1989; Lim *et al*., 1991; MAF 2003). Latent fungal infections, however, are likely to evade detection. For these reasons, *Actinodochium jenkinsii*, *Cytosphaera mangiferae*, *Phomopsis mangifera*, *Macrophoma mangiferae* and *Hendersonia creberrima* are rated Medium (2) for this risk element. Advanced symptoms of bacterial black spot, caused by *Xanthomonas campestris* pv. *mangiferaeindicae* are likely to be detected at ports of entry when there are obvious external symptoms, although symptoms may vary depending on the susceptibility of the host and on environment and may not be clearly attributable to a single pathogen (Shekhawat & Patel, 1974). The role of latent infections in mango bacterial black spot is uncertain. Limited research into mango bacterial black spot indicates that *Xanthomonas campestris* pv. *mangiferaeindicae* causes latent infections, which would also be likely to evade detection, although presence of the bacterium strictly as an epiphyte has not be conclusively ruled out (Gagnevin & Pruvost, 2001). For this reason, *Xanthomonas campestris* pv. *mangiferaeindicae* is rated Medium (2) for this risk element.

Risk Element 6, sub-element 5: Imported or Moved to an Area Suitable for Survival

The climate-host range for the majority of the pests examined here is limited to warm areas in Florida and parts of California. Mango will presumably be shipped all over the continental United States, so a portion of the pests that enter the country are likely to reach areas of host abundance should those hosts exist in the United States. Consequently, risk ratings for this sub-element were based on the climatic regions of the continental United States suitable for each pest and the hosts available in those areas. Although *Macrophoma mangiferae*, may infect hosts other than mango, which inhabit a wide range of plant hardiness zones in the United States, Indian isolates previously tested did not grow, nor did spores germinate below 7ºC (45ºF) (Hingorani, *et al.*, 1960). Based on the evidence provided above for each pest in regard to the Climate-Host Interaction risk element, *Parlatoria crypta* and *Ceroplastes rubens* are rated High, *Sternochetus frigidus*, *Sternochetus mangiferae*, *Bactrocera caryeae*, *Bactrocera correcta*, *Bactrocera cucurbitae*, *Bactrocera diversa*, *Bactrocera dorsalis, Bactrocera zonata*, *Pseudaonidia trilobitiformis*, *Coccus viridis*, and *Xanthomonas campestris* pv. *mangiferaeindicae* are rated Medium, and *Actinodochium jenkinsii*, *Cytosphaera mangiferae*, *Aulacaspis tubercularis*, *Hendersonia creberrima, Macrophoma mangiferae*, and *Phomopsis mangiferae* are rated Low (1) for the Imported or Moved To An Area Suitable for Survival sub-element.

Risk Element 6, sub-element 6: Contact with Host Material

Even if the final destination of infested commodities is suitable for pest survival, suitable hosts must be available in order for the pest to survive. This sub-element considers the likelihood that the pest species can come in contact with host material for reproduction. The complete host range of the pest was considered. According to the IPPC standard for pest risk analysis (IPPC, 2003), other factors that may be considered are:

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

The fruit flies develop quickly and, have a wide range of hosts (Fletcher, 1989a). Also, *Bactrocera* spp. have excellent dispersal capabilities, and many of them can fly 50-100km during their life (Fletcher 1989b). Therefore, it is possible that they could escape from houses, compost piles or garbage to find nearby hosts. Additionally, fruit infested with fruit flies often contain multiple larvae, making the chance that adults could mate higher. For these reasons the fruit flies are rated High (3) for this risk sub-element.

The *Sternochetus* mango weevils are capable of flight as well, although likely less so than the fruit flies, and therefore could also escape from houses, compost piles or garbage to find nearby hosts. However, as these weevils have a very narrow host range and any potential host plants have a very limited distribution in the United States, they are rated Low (1) for this risk sub-element.

Sessile hemipterans (mealybugs, scale insects, *etc*.) may disperse great distances by wind (Greathead, 1989, 1997) but do not have the capability for directed dispersal in this way. Long range dispersal strategies depend on large numbers of insects being dispersed so that some may find suitable hosts. Insects arriving with fruit represent such small populations that dispersal by air to a host would be very unlikely. Furthermore, successful establishment of these insects in a new environment can occur only when mobile forms (*i.e.,* crawlers) are present on the imported fruit and these fruit are placed in close proximity to a susceptible host. As these circumstances are highly unlikely to co-occur (Miller, 1985), scale insects have a low probability of establishment. For these reasons, the hemipteran pests are rated Low (1) for this risk sub-element.

For the pathogens, only discarded fruit or unused portions of fruit (peel, seed, etc.) are likely to be sources of inoculum. Bacteria or spores must then be dispersed from discarded fruit into mango orchards at a time when susceptible tissue is available (Johnson *et al.*, 1993; Johnson *et al.*, 1989; Kishun and Chand, 1989; Pruvost *et al.*, 1990; Pruvost and Luisetti, 1991). The likelihood of discarded fruit being in close proximity to cultivated mango is small. For these reasons, four of the pathogens are rated Low (1). *Macrophoma mangiferae* and *Cytosphaera mangiferae* may infect a broader range of hosts, yet temperatures required for survival may limit their ranges, so they are rated Medium (2).

Table 4. Risk Rating for Likelihood of Introduction: Risk Element #6.							
Pest	Quantity imported annually	Survive postharvest treatment	Survive shipment	Not detected at port of entry	Moved to suitable habitat	Contact with host material	Cumulative Risk Rating[1]
ARTHROPODS							
COLEOPTERA							
Curculionidae							
Sternochetus frigidus (F.) *Sternochetus mangiferae* (F.)	2	3	3	3	2	1	14 (M)
DIPTERA							
Tephritidae							
Bactrocera caryeae (Kapoor) *Bactrocera correcta* (Bezzi) *Bactrocera cucurbitae* Coquillett *Bactrocera diversa* (Coquillett) *Bactrocera dorsalis* Hendel *Bactrocera tau* Walker *Bactrocera zonata* (Saunders)	2	3	3	3	2	3	16 (H)
HEMIPTERA							
Coccidae							
Ceroplastes rubens Maskell	2	2	3	1	3	1	12 (M)
Coccus viridis (Green)	2	2	3	1	2	1	11 (M)
Diaspididae							
Aulacaspis tubercularis Newstead	2	2	3	1	1	1	10 (M)
Parlatoria crypta Mckenzie	2	2	3	1	3	1	12 (M)
Pseudaonidia trilobitiformis (Green)	2	2	3	1	2	1	11 (M)
PATHOGENS							
Actinodochium jenkinsii Uppal, Patel & Kamat	2	3	3	2	1	1	12 (M)
Cytosphaera mangiferae Died.	2	3	3	2	1	2	13 (M)
Hendersonia creberrima Syd., Syd. & Butler	2	3	3	2	1	1	12 (M)
Macrophoma mangiferae Hing & Sharma	2	3	3	2	1	2	13 (M)
Phomopsis mangiferae Ahmad apud Petrak & Ahmad	2	3	3	2	1	1	12 (M)
Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al.*) Robbs *et al*. (Proteobacteria: γ subdivision, Lysobacterales)	2	3	3	2	2	1	13 (M)

[1]Low is 6-9 points, Medium is 10-14 points, and High is 15-18 points

Baseline Risk Potential

A combination of the Consequences of Introduction with the Likelihood of Introduction provide an estimate of the baseline risks associated with each of the pests analyzed here. Table 5 provides a summary of our findings.

Table 5. Pest Risk Potential

Pest	Conseqences of Introduction Cumulative Risk Rating	Likelihood of Introduction Cumulative Risk Rating	Pest Risk Potential[1]
ARTHROPODS			
COLEOPTERA			
Curculionidae			
Sternochetus frigidus (F.) *Sternochetus mangiferae* (F.)	L (8)	H (14)	M (22)
DIPTERA			
Tephritidae			
Bactrocera caryeae (Kapoor) *Bactrocera correcta* (Bezzi) *Bactrocera cucurbitae* Coquillett *Bactrocera diversa* (Coquillett) *Bactrocera dorsalis* Hendel *Bactrocera tau* Walker *Bactrocera zonata* (Saunders)	H (14)	H (16)	H (30)
HEMIPTERA			
Coccidae			
Ceroplastes rubens Maskell	H (15)	M (12)	H (27)
Coccus viridis (Green)	H (14)	M (11)	M (25)
Diaspididae			
Aulacaspis tubercularis Newstead	H (13)	M (10)	M (24)*
Parlatoria crypta Mckenzie	H (14)	M (12)	M (26)*
Pseudaonidia trilobitiformis (Green)	H (13)	M (11)	M (23)*
PATHOGENS			
Actinodochium jenkinsii Uppal, Patel & Kamat	L (6)	M (12)	L (18)
Cytosphaera mangiferae Died.	M (9)	M (13)	M (22)
Hendersonia creberrima Syd., Syd. & Butler	L (6)	M (12)	L (18)
Macrophoma mangiferae Hing & Sharma	M (10)	M (13)	M (23)
Phomopsis mangiferae Ahmad apud Petrak & Ahmad	L (6)	M (12)	L (18)
Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al.*) Robbs *et al*. (Proteobacteria: γ subdivision, Lysobacterales)	M (10)	M (13)	M (23)

[1]Low is 11-18 points, Medium is 19-26 points and High is 27-33 points
*Please see comments in section III (Conclusions) regarding armored scales (Diaspididae).

III Conclusions

Pest Risk Potentials are the summations of the Consequences of Introduction and Likelihood of Introduction values (Table 5). The following scale was used to interpret this total: Low was 11-18 points, Medium was 19-26 points and High was 27-33 points. Risk was estimated for commercial quality mangoes, which are cleaned and washed as part of standard post-harvest practices in Indian mango production.

Pests with a Low Pest Risk Potential do not typically require mitigation measures, other than port-of-arrival inspection. A value within the Medium range indicates that specific phytosanitary measures may be necessary. A rating in the High range indicates that specific phytosanitary measures, supplemental to port-of-arrival inspection, are strongly recommended.

Ceroplastes rubens and all of the *Bactrocera* species were rated High. The mango weevils, *Sternochetus mangiferae* and *S. frigidus, Coccus viridis,* the three armored scales insects (Diaspididae), and three of the pathogens, *Macrophoma mangiferae*, C*ytosphaera mangiferae* and *Xanthomonas campestris* pv. *mangiferaeindicae*, were rated Medium, while the three other pathogens, *Actinodochium jenkinsii*, *Hendersonia creberrima*, and *Phomopsis mangiferae*, were rated Low.

Although the armored scales (*Aulacaspis tubercularis, Pseudaonidia trilobitofirmis,* and *Parlatoria crypta*) were rated Medium, these insects have a low likelihood of introduction and establishment that could not be addressed using the current USDA *Guidelines* (APHIS, 2000). Even if the armored scales are able to follow the pathway of mango fruit from India, these scales would be highly unlikely to become established in the United States. This low likelihood of establishment should be an important consideration when developing risk mitigations. This estimate of low risk is based on the following evidence:

- Scale insects (Coccoidea), including armored scales, may disperse great distances by wind (Greathead, 1990, 1997; Gullan and Kosztarab, 1997). However, they do not have the capability for directed dispersal in this way; so long range dispersal would likely depend on large numbers of insects being dispersed so that some may find suitable hosts. Insects arriving with commercial quality fruit represent such small populations that dispersal by air to a host would be very unlikely.
- It is mainly the newly emerged first instar nymphs ("crawlers") of scale insects that can be dispersed long distances by wind (Gullan and Kosztarab, 1997). Plus, for armored scales, "only crawlers and perhaps gravid females could contribute to dispersal of the species and to the colonization of new host plants" (Greathead, 1990). The crawler stage has to be the primary stage enabling dispersal, as this is the only mobile stage besides the males, and males cannot start new infestations by themselves (Greathead, 1990). Therefore, spread of armored scales from infested plant materials for consumption can only occur if crawlers or adult females with eggs are present (Burger and Ulenberg, 1990), and spread from the gravid females would likely only occur if crawlers hatched from the females' eggs.

- A USDA Agricultural Research Service expert working group assessed the risk of armored scales on fruit for consumption (Miller *et al.*, 1985). These authors concluded that, for several reasons, the probability of armored scales becoming established in a new region by way of commercially shipped fruit for consumption is relatively remote. For one, these authors state that fruits are not the preferred feeding sites for most armored scales; therefore, these insects would be less likely to survive on fruits compared to leaves or twigs. Secondly, the sessile nature of armored scales and their inability to disperse long distances under their own powers severely limit their ability of coming into contact with potential hosts. Furthermore, in order for armored scales on imported commercial fruit to become established in a new area, many conditions must co-occur, which is highly unlikely. These conditions include, among others: 1) survival through harvest and post-harvest handling and transport, 2) survival of the rigors of the marketplace, as well as consumer storage, handling, and consumption, 3) presence of susceptible host near infested fruit discarded by the consumer, 4) presence of crawlers on the discarded fruit (or the fruit stays viable long enough for crawlers to develop from a gravid female), and 5) successful colonization of the new host by the crawlers (Miller, 1985).

Detailed examination and choice of appropriate sanitary and phytosanitary measures to mitigate pest risk is undertaken as part of the pest risk management phase and is not discussed in this document. Appropriate sanitary and phytosanitary measures to mitigate pest risk will be determined during the pest risk management phase.

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NIS. 2004a. Personal communication (Email, June 14, 2004) from USDA-APHIS-PPQ National Identification Services to Marina Zlotina, USDA-APHIS-PPQ-CPHST Plant Epidemiology and Risk Analysis Laboratory confirming that *Thrips palmi* (Thysanoptera: Thripidae) is actionable by USDA and is under official control or being considered for official control.

NIS. 2004b. Personal communication (Email, February 3, 2004) from USDA-APHIS-PPQ National Identification Services to Marina Zlotina, USDA-APHIS-PPQ-CPHST Plant Epidemiology and Risk Analysis Laboratory confirming that *Aulacaspis tubercularis* Newstead (Diaspididae) is actionable by USDA and are under official control or being considered for official control.

NIS. 2004c. Email (Feb. 24, 2004) from National Identification Services to Leah Millar, Entomologist, USDA-APHIS-PPQ, confirming that *Aleurodicus dispersus* is actionable at US ports-of-entry.

NIS. 2004d. Personal communication (Email, February 25, 2004) from USDA-APHIS-PPQ National Identification Services to Marina Zlotina, USDA-APHIS-PPQ-CPHST Plant Epidemiology and Risk Analysis Laboratory confirming that *Aleurocanthus woglumi* (Hemiptera: Aleyrodidae) is actionable by USDA and is under official control or being considered for official control.

NIS. 2006a. Personal communication (Email, February 23, 2006) from USDA-APHIS-PPQ National Identification Services to Ken Lakin, USDA-APHIS-PPQ-CPHST Plant Epidemiology and Risk Analysis Laboratory confirming that *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) is actionable by USDA "pending APHIS evaluation of implementing official control with input from the National Plant Board."

NIS. 2006b. Phone call (March 24, 2006) from Paul Courneya, USDA-APHIS-PPQ National Identification Services, to Ken Lakin, Senior Risk Analyst, USDA-APHIS-PPQ, confirming that *Sinoxylon crassum dekhanense* Lesne (Coleoptera: Bostrichidae), *Sinoxylon crassum* Lesne (Coleoptera: Bostrichidae), and *Xylothrips flavipes* Illiger (Coleoptera: Bostrichidae) are nonreportable for the continental United States and only reportable for Hawaii, Puerto Rico, and the Virgin Islands .

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Appendix I: List of Pests Associated with Mango and Present in India

Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
ACARI					
Eriophyidae					
Aceria mangiferae Sayed	IN, US	branch	N	N	Atwal, 1976; CPC, 2001; Baker *et al.*, 1996
Cisaberoptus kenyae Keifer	IN	leaf	Y	N	CPC, 2001; Jeppson *et al.*, 1975
Metaculus mangiferae (Attiah)	IN	branch, leaf, inf.	Y	N	Butani, 1993; Jeppson *et al.*, 1975
Neocalacarus mangiferae Channa & Basavanna	IN	leaf	Y	N	Butani, 1993; Jeppson *et al.*, 1975
Tegonotus mangiferae (Kieiffer)	IN	inf.	Y	N	Butani, 1993; CPC, 2001
Tarsonemidae					
Polyphagotarsonemus latus (Banks)	IN, US	whole plant, leaf, fruit	N	Y	CPC, 2001; CIE Map 191, 1986
Brevipalpus californicus (Banks)	IN, US	stem, leaf, fruit	N	Y	Butani, 1993; CPC, 2001
Raoiella macfarlanei Pritchard & Baker	IN	leaf	Y	N	Butani, 1993
Tetranychidae					
Oligonychus coffeae (Nietner)	IN, US	leaf	N	N	CPC, 2001; Jeppson *et al.*, 1975
Oligonychus mangiferus (Rahman & Sapra)	IN	stem, leaf	Y	N	Butani, 1993; Jeppson *et al.*, 1975
Tetranychus neocaledonicus Andre	IN, US	leaf	N	N	Butani, 1993; CPC, 2001; Pillai *et al.*, 1993; Singh & Singh, 1999; Bolland *et al.*, 1998
INSECTA					
COLEOPTERA					
Alticidae					
Phyllotreta sp.	IN	root	Y	N	Butani, 1993
Bostrichidae					
Dinoderus distinctus Lesne	IN	stem	Y[1]	N	Butani, 1993
Heterobostrychus aequalis Waterhouse	IN, US	stem	N	N	Butani, 1993; CPC, 2001; Pruthi and Batra, 1960
Heterobostrychus hamatipennis Lesne	IN	stem	Y[1]	N	Butani, 1993

Appendix I: List of Pests Associated with Mango and Present in India

Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Heterobostrychus pileatus Lesne	IN	stem	Y[1]	N	Butani, 1993
Lyctoxylon convixtor Lesne	IN	stem	Y	N	Butani, 1993
Micrapate simplicipennis Lesne	IN	stem	Y[1]	N	Butani, 1993
Minthea rugicollis Walker	IN, US	stem	N	N	Butani, 1993; Anonymous, 1968
Parabostrychus elongata Lesne	IN	stem	Y	N	Butani, 1993; Pruthi and Batra, 1960
Schistoceros anobiodes Waterhouse	IN	stem	Y	N	Butani, 1993
Sinoxylon anale Lesne	IN	stem	Y[1]	N	Butani, 1993; CPC, 2001
Sinoxylon conigerum Gerstacher	IN, US	stem, leaf	N	N	Butani, 1993; CPC, 2001
Sinoxylon crassum dekhanense Lesne	IN	stem	Y[1]	N	Butani, 1993
Sinoxylon crassum Lesne	IN	stem	Y[1]	N	Butani, 1993
Sinoxylon indicum Lesne	IN	stem	Y[1]	N	Butani, 1993
Sinoxylon oleare Lesne	IN	stem	Y	N	Butani, 1993
Sinoxylon pygmaeum Lesne	IN	stem	Y	N	Butani, 1993
Sinoxylon sudanicum Lesne	IN	stem	Y	N	Butani, 1993
Trogoxylon spinifrons Lesne	IN	stem	Y	N	Butani, 1993
Xylodectes ornatus (Lesne)	IN	stem	Y	N	Butani, 1993
Xylopsocus capucinus F.	IN	stem	Y	N	Butani, 1993
Xylothrips flavipes Illiger	IN	stem	Y[1]	N	Butani, 1993
Bruchidae					
Bruchus sp.	IN	fruit	Y	N (see section E)	Pruthi and Batra, 1960
Belionota prasina Thunberg	IN	stem	Y	N	Butani, 1993
Cerambycidae					
Acanthophorus serraticornis (Olivier)	IN	stem, root	Y	N	Butani, 1993
Aeolesthes holosericea (F.)	IN	stem	Y	N	Butani, 1993
Anoplophora versteegi (Ritseema)	IN	stem	Y	N	Butani, 1993
Batocera numitor (Newman)	IN	stem	Y	N	Butani, 1993
Batocera roylei (Hope)	IN	stem	Y	N	Butani, 1993; Singh, 1993
Batocera rubus (L)	IN	stem	Y	N	Butani, 1993; Singh, 1993
Batocera rufomaculata (de	IN	stem	Y	N	Atwal, 1976; Butani, 1993; Singh, 1993
Batocera titana Thomson	IN	stem	Y	N	Butani, 1993; Singh, 1993
Epepeotes ficicola Fisher	IN	stem	Y	N	Butani, 1993

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Epepeotes luscos F.	IN	stem	Y	N	Butani, 1993
Glenea multiguttata Guerin-Meneville	IN	stem	Y	N	Butani, 1993
Macrotoma crenata F.	IN	stem	Y	N	Butani, 1993
Olenecamptus bilobus F.	IN	stem	Y	N	Butani, 1993; CPC, 2001
Oncideres repandator Faust	IN	leaf	Y	N	Butani, 1993
Pharsatia proxima Gahan	IN	stem	Y	N	Butani, 1993
Plocaederus ferrugineus (L.)	IN	stem	Y[1]	N	Butani, 1993
Plocaederus obesus Gahan	IN	stem	Y[1]	N	Butani, 1993
Plocaederus pedestris White	IN	stem	Y[1]	N	Butani, 1993
Rhytidodera bowringi White	IN	stem	Y	N	Butani, 1993
Rhytidodera simulans White	IN	stem	Y	N	Butani, 1993
Sthenias grisator F.	IN	stem	Y	N	Butani, 1978
Stromatium barbatum (F)	IN	stem	Y	N	Butani, 1993; CIE Map 469, 1985
Xylotrechus smei La Porte & Gory	IN	stem	Y	N	Butani, 1993
Chrysomelidae					
Aetheomorpha suturata Jacoby	IN	leaf	Y	N	Butani, 1993
Altica coerulea Olivier	IN	leaf	Y	N	Borror *et al.*, 1989; Butani, 1993
Aspidolopha melanophthalma	IN	stem, leaf	Y	N	Zaman & Maiti, 1994
Aulacophora foveicollis (Lucas)	IN	leaf	Y	N	Butani, 1993
Clitea picta Baly	IN	leaf	Y	N	Butani, 1993
Corticarnia gibbosa Herbst	IN	leaf	Y	N	Borror *et al.*, 1989; Butani, 1993
Costalimaita ferruginea (Klug)	IN	leaf	Y	N	Butani, 1993
Cryptocephalus insubidus Suffrain	IN	leaf	Y	N	Butani, 1993; Ramamurthy, 1982
Cryptocephalus suillus Suffrain	IN	leaf	Y	N	Butani, 1993; Ramamurthy, 1982
Diapromorpha _elanopus Lacordaire	IN	leaf	Y	N	Borror *et al.*, 1989; Butani, 1993
Diapromorpha pallens	IN	stem, leaf	Y	N	Zaman & Maiti, 1994
Gynadrophthalma sp.	IN	leaf	Y	N	Borror *et al.*, 1989; Butani, 1993
Luperomorpha weisi Jacoby	IN	leaf	Y	N	Borror *et al.*, 1989; Butani, 1993
Monolepta signata (Olivier)	IN	leaf	Y	N	Butani, 1993
Pagria sp.	IN	leaf	Y	N	Borror *et al.*, 1989; Butani, 1993
Scelodonta striglcollis Matschulsky	IN	leaf	Y	N	Butani, 1993; Pruthi and Batra, 1960

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Coccinellidae					
Micraspis cardoni Weise	IN	none	Y	N	Butani, 1993; CPC, 2001
Curculionidae					
Alcidodes frenatus (Faust)	IN	leaf	Y	N	Butani, 1993; Singh, 1993
Amblyrrhinus poricollis Boheman	IN	leaf	Y	N	Butani, 1993
Apoderus tranquebaricus (F)	IN	leaf	Y	N	Atwal, 1976; Butani, 1993; Singh, 1993
Astychus lateralis (F.) =*Lepropus lateralis* (F)	IN	stem, leaf	Y	N	Zaman & Maiti, 1994
Atmetonychus perigrinus Oliver	IN	leaf	Y	N	Butani, 1993
Camptorrhinus mangiferae Marshall	IN	leaf	Y	N	Butani, 1993
Crinorrhinus crassirostris Faust	IN	leaf	Y	N	Patel *et al*., 1997
Deporaus marginatus (Pascoe)	IN	stem, leaf	Y	N	CPC, 2001
Desmidophorus hebes (F.)	IN	leaf	Y	N	Butani, 1993
Hypomeces squamosus Fabricius	IN	leaf	Y	N	CPC, 2001
Myllocerus discolor Boheman	IN	leaf	Y	N	Butani, 1993; Singh, 1993
Myllocerus lactivirens Boheman	IN	leaf	Y	N	Butani, 1993; Singh, 1993
Myllocerus sabulosus Marshall	IN	leaf	Y	N	Butani, 1993
Myllocerus undecimpustulatus Faust	IN	leaf	Y	N	Butani, 1993
Peltotrachelus cognatus Marshall	IN	leaf	Y	N	Butani, 1993; Siddappaji and Lingappa, 1977
Peltotrachelus pubes (Faust)	IN	leaf	Y	N	Butani, 1993; Siddappaji and Lingappa, 1977
Platymycterus sjostedi Marshall	IN	leaf	Y	N	Butani, 1993
Rectosternum poriolle (Faust)	IN	leaf	Y	N	Butani, 1993
Rhynchaenus mangiferae Marshall	IN	leaf	Y	N	Butani, 1993; Singh, 1993
Sternochetus frigidus (F.) =*Sternochetus gravis* (F.)	IN	fruit	Y	Y	APHIS-PPQ Intercep., 2002; CIE Map 181, 1964; CPC, 2001; De and Pande, 1990

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Sternochetus mangiferae (F.) =*Cryptorhynchus mangiferae* (F.)	IN, US (HI)	fruit	Y	Y	APHIS-PPQ Intercep., 2002; Butani, 1993; CPC, 2001; CIE Map 180, 1995; Singh, 1993; Srivastava, 1997
Sternochetus olivieri Faust	IN	fruit	Y	N (see section E)	APHIS-PPQ Intercep., 2002
Lyctidae					
Lyctus africanus Lesne	IN	stem	Y[1]	N	Butani, 1993; Pruthi and Batra, 1960
Lyctus malayanus Lesne	IN	stem	Y	N	Butani, 1993
Nitidulidae					
Carpophilus dimidiatus (F.)	IN, US	leaf, fruit	N	N (see section E)	Butani, 1993; CPC, 2001; Pruthi and Batra, 1960; CPC, 2005
Platypodidae					
Crossotarsus saundersi Chapius	IN	stem	Y	N	Borror *et al.*, 1989; Butani, 1993
Platypus solidus Walker	IN	stem	Y	N	Butani, 1993
Scarabaeidae					
Adoretus bicaudatus Arrow	IN	leaf	Y	N	Butani, 1993
Adoretus lasiophygus Burmeister	IN	leaf	Y	N	Butani, 1993
Anomala dussumieri (Blanchard)	IN	leaf	Y	N	Butani, 1993
Anomala varicolor Gyllenhal	IN	leaf	Y	N	Butani, 1993
Holotrichia consanguinea Blanchard	IN	leaf, root	Y	N	Butani, 1993; Mahal *et al*, 1991
Holotrichia reynaudi Blanchard =*Holtrichia insularis* Brenske	IN	leaf	Y	N	Butani, 1993
Holotrichia serrata (F.)	IN	leaf, root	Y	N	CPC, 2001; Husain *et al.*,1987
Popillia sp.	IN	leaf, fruit	Y	N (see section E)	Borror *et al.*, 1989; Butani, 1993
Scolytidae					
Hypocryphalus eupholyphagus Beeson	IN	stem, sh	Y	N	Butani, 1993
Hypocryphalus mangiferae Stebbing	IN	stem, sh	Y	N	Butani, 1993; CPC, 2001
Xyleborus affinis Eichhoff	IN, US	stem	N	N	Beaver, 1976; Butani, 1993; CPC, 2001; Mathew, 1982

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Xyleborus andrewesi Blandford	IN	stem	Y	N	Beaver, 1976; Butani, 1993; CPC, 2001; Mathew, 1982
Xyleborus kraatzi Eichhoff	IN	stem	Y	N	Beaver, 1976; Pruthi and Batra, 1960; Mathew, 1982
Xyleborus perforans (Wollaston)	IN, US (HI)	stem	Y	N	Beaver, 1976; CPC, 2001; CIE Map 320, 1973; Mathew, 1982
Xyleborus semigranosus Blandford	IN	stem	Y	N	Beaver, 1976; Butani, 1993; Mathew, 1982; Pruthi and Batra, 1960
Xylosandrus compactus (Eichhoff)	IN, US	stem	N	N	CPC, 2001; Mangold *et al.*,1977; Young and Sauls, 1981; CPC, 2005
Silvanidae					
Oryzaephilus mercator (Fauval)	IN, US	seed (stored product)	N	N	Dudu *et al.*, 1996; CPC, 2005
DIPTERA					
Cecidomyiidae					
Allassomyia tenuispatha (Kieffer)	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; Singh, 1993; Srivastava, 1997
Amradiplosis allahabadensis Grover	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; Singh, 1993
Amradiplosis amaemyia Rao	IN	leaf, fruit, inf.	Y	N (see section E)	Singh, 1993
Amradiplosis brunneigallicola Rao	IN	leaf	Y	N (see section E)	Singh, 1993
Amradiplosis tenuispatha (Kieffer)	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993
Amradiplosis viridigallicola (Rao)	IN	leaf	Y	N (see section E)	Singh, 1993
Contarinia moringae (Mani)	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Dasineura amaramanjarae Grover	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; Grover, 1987; Singh, 1993
Dasineura citri Rao & Grover	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; Grover & Vasantika, 1985
Dasineura mangiferae Felt	IN, US (HI)	inf.	Y	N (see section E)	Butani, 1993; Grover & Vasantika, 1985
Erosomyia mangiferae Felt =*Erosomyia indica* Grover & Prasad, *Procontarinia* Felt	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; Grover, 1987; Singh, 1993; Srivastava, 1997
Lasioptera mangiflorae (Grover)	IN	inf.	Y	N (see section E)	Butani, 1993
Oligotrophus mangiferae Kieffer	IN	leaf, fruit, inf.	Y	N (see section E)	Singh, 1993; Srivastava, 1997
Procontarinia mangifoliae (Grover) =*Munierielle mangifoliae* Grover	IN	leaf	Y	N (see section E)	Butani, 1993; Gangwar, 1982; Srivastava, 1997
Procontarinia matteiana Kieffer & Cecconi	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; CPC, 2001; Singh, 1993; Srivastava, 1997
Procystiphora indica Grover & Prasad	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; CPC, 2001; Singh, 1993
Procystiphora mangiferae (Felt)	IN	leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; Singh, 1993
Rhabdophaga mangiferae Mani	IN	stem, leaf, inf.	Y	N (see section E)	Butani, 1993; Singh, 1993
Tephritidae					
Bactrocera caryeae (Kapoor)	IN	fruit	Y	Y	DMQPE, 1998
Bactrocera correcta (Bezzi) =*Dacus correctus* (Bezzi), *Chaetodacus correctus* Bezzi	IN, US (HI)	fruit	Y	Y	Butani, 1993; CPC, 2001; Singh, 1993
Bactrocera cucurbitae Coquillett =*Dacus cucurbitae* Coquillett	IN, US (HI)	fruit	Y	Y	Butani, 1993; CPC, 2001; CIE Map 550, 1994; DMQPE, 1998

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Bactrocera diversa (Coquillett)	IN	fruit	Y	Y	Butani, 1993; Singh, 1993; Srivastava, 1997
Bactrocera dorsalis Hendel =*Dacus dorsalis* Hendel Strumeta dorsalis (Hendel)	IN, US (HI)	fruit	Y	Y	APHIS-PPQ Intercep., 2002; Atwal, 1976; Butani, 1993; CPC, 2001; CIE Map 109, 1994; DMQPE, 1998; Singh, 1993
Bactrocera incisa (Walker) (synonym: *Dacus incisus* Walker)	IN	fruit	Y	N (see section E)	Butani, 1993; Thompson, 1998; Thompson, 2005a and 2005b
Bactrocera tau Walker =*Dacus tau* (Walker)	IN	fruit	Y	Y	Butani, 1993; CPC, 2001; White and Elson-Harris, 1992; Srivastava, 1997
Bactrocera zonata (Saunders) =*Dacus zonatus* (Saunders), *Chaetodacus zonatus* (Saunders)	IN	fruit	Y	Y	Butani, 1993; CPC, 2001; Singh, 1993; DMQPE, 1998
HEMIPTERA					
Aleyrodidae					
Aleurocanthus mangiferae Quaintance & Baker	IN	leaf	Y	N	Butani, 1993; Laroussilhe, 1980
Aleurocanthus woglumi Ashby	IN, US (FL,TX, HI)	stem, leaf	[Y][2]	N	Butani, 1993; CPC, 2001; CIE Map 91, 1990; Young and Sauls, 1981; CPC, 2005
Aleurodicus dispersus Russell	IN, US (FL)	leaf	[Y][2]	N	Bennett & Noyes, 1989; CPC, 2001; CIE Map 476, 1993
Aleurothrixus floccosus Maskell	IN, US	stem, leaf, fruit, inf.	N	Y	CPC, 2001
Aphididae					
Aphis epillabina Kulkarny	IN	stem, leaf, inf.	Y	N	Butani, 1993
Aphis gossypii Glover	IN, US	whole plant	N	Y	Butani, 1993; Srivastava, 1997; CIE Map 18, 1968
Greenidea mangiferae Takahashi	IN	leaf, inf.	Y	N	Butani, 1993
Macrosiphum euphorbiae (Thomas)	IN, US	stem, leaf, inf.	N	N	Butani, 1993; Srivastava, 1997; CIE Map 44, 1984

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Toxoptera aurantii Boyer de Fonscolombe)	IN, US	w	N	Y	Butani, 1993; CPC, 2001; CIE Map 131, 1961; Srivastava, 1997
Toxoptera odinae (van der Goot)	IN	stem, leaf,	Y	N	Butani, 1993; CPC, 2001; Srivastava, 1997
Cicadellidae					
Amrasca splendens Ghauri	IN	leaf, inf.	Y	N	CPC, 2001; Sohi and Sohi, 1990
Amritodus atkinsoni (Lethierry)	IN	sh, leaf, inf.	Y	N	Atwal, 1976; CPC, 2001; Singh, 1993; Srivastava, 1997
Amritodus brevistylus Viraktamath	IN	leaf	Y	N	Kudagamage *et al*., 2001
Busoniominus manjunathi Viraktamath	IN	leaf, inf.	Y	N	Sohi and Sohi, 1990
Idioscopus anasuyae Viraktamath	IN	leaf, inf.	Y	N	Sohi and Sohi, 1990, Srivastava, 1997
Idioscopus clypealis (Lethiery)	IN	sh, inf.,	Y	N	Atwal, 1976; Butani, 1993; CPC, 2001; Singh, 1993;
Idioscopus decoratus Virktamath	IN	leaf, inf.	Y	N	Sohi and Sohi, 1990; Srivastava, 1997
Idioscopus jayshriae Virktamath	IN	leaf, inf.	Y	N	Sohi and Sohi, 1990; Srivastava, 1997
Idioscopus nagpurensis Pruthi	IN	leaf, inf.	Y	N	Butani, 1993; CPC, 2001; Srivastava, 1997
Idioscopus niveosparsus (Lethiery)	IN	leaf, inf.	Y	N	Butani, 1993; CPC, 2001
Idioscopus spectabilis Virktamath	IN	leaf	Y	N	Sohi and Sohi, 1990
Coccidae					
Ceroplastes actiniformis Green	IN	leaf	Y	N	Ben-Dov *et al*., 2001; Butani, 1993; CPC, 2001; Srivastava, 1997
Ceroplastes ceriferus (Anderson)	IN, US	leaf, stem	N	N	Ben-Dov *et al*., 2001; CPC, 2001; Srivastava, 1997
Ceroplastes floridensis Comstock	IN, US	leaf	N	N	Ben-Dov *et al*., 2001; Butani, 1993; CPC 2001; Peña, 1993

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Ceroplastes pseudoceriferus Green	IN	leaf, stem	Y	N	Ben-Dov *et al*., 2001; Butani, 1993; Srivastava, 1997
Ceroplastes rubens Maskell	IN, US (FL)	fruit	[Y][2]	Y	Butani, 1993; Ben-Dov *et al*., 2001; CPC, 2001; CPC, 2005; Srivastava, 1997
Ceroplastes rusci (L.)	IN, US (FL)	stem, leaf	Y	N	CIE Map 3, 1993; CPC, 2001; Hamon & Mason, 1997; Srivastava, 1997
Coccus almoraensis Avasthi & Shafee	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Borror *et al*., 1989
Coccus bicruciatus (Green)	IN	stem, leaf	Y	N	Borror *et al*., 1989; Butani, 1993
Coccus colemani Kannan	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Butani, 1993
Coccus discrepans (Green)	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Butani, 1993
Coccus formicarii (Green)	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Butani, 1993
Coccus hesperidum L.	IN, US	stem, leaf	N	N	Butani, 1993; CPC, 2001; Ben-Dov *et al*., 2001; Srivastava, 1997; Ben-Dov *et al*., 2006
Coccus kosztarabi Avasthi & Shafee	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Medina Gaud *et al*., 1997
Coccus latioperculatum Green	IN	leaf	Y	N	Ben-Dov *et al*., 2001; Srivastava, 1997
Coccus longulus (Douglas)	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; Srivastava, 1997
Coccus piperis (Green)= *Lecanium peperis* (Green)	IN	leaf	Y	N	Suresh & Mohanasundaram, 1996
Coccus viridis (Green)	IN, US (FL)	stem, leaf, fruit	[Y][2]	Y	Ben-Dov *et al*., 2001; Butani, 1993; CPC, 2001; CPC, 2005; CIE Map 305, 1972; Swirski *et al*., 1997
Eucalymnatus tessellatus (Signoret)	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; Butani, 1993

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Kilifia acuminata (Signoret)	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; CPC, 2001
Lecanium formicarii Green	IN	leaf	Y	N	Atwal, 1976
Maacoccus bicruciatus (Green) = *Lecanium bicruciatus* Green	IN	stem, sh, leaf	Y	N	Ben-Dov *et al*., 2001; Johnson & Lyon, 1991
Milviscutulus mangiferae (Green) = *Lecanium mangiferae* Green, *Protopulvianria mangiferae* Green	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; Johnson & Lyon, 1991; Wysoki *et al*., 1997
Neoplatylecanium adersi (Newstead) = *Lecanium adersi* Newstead	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Johnson & Lyon, 1991
Parasaissetia nigra (Nietner)	IN, US	stem, leaf	N	N	CPC, 2001; Abraham *et al*., 1970
Parthenolecanium persicae persicae (F.) = *Parthenolecanium persicae* spinosum	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; Johnson & Lyon, 1991
Prococcus acutissimus (Green)	IN, US	leaf	N	N	Ben-Dov *et al*., 2001; Srivastava, 1997
Pulvinaria avasthii Yousuf & Shafee	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Hamon & Williams, 1984
Pulvinaria cellulosa Green	IN	stem, leaf	Y	N	Butani, 1993; Srivastava, 1997
Pulvinaria iceryi (Signoret)	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Hamon & Williams, 1984
Pulvinaria ixorae Green	IN	stem, leaf	Y	N	Butani, 1993; Hamon & Williams, 1984
Pulvinaria pergandei Comstock	IN	stem, leaf	Y	N	Butani, 1993; Hamon & Williams, 1984
Pulvinaria polygonata (Cockerell) =*Chloropulvinaria polygonata*	IN	leaf, stem	Y	N	Butani, 1993; CPC, 2001; Srivastava, 1997
Pulvinaria psidii Maskell	IN, US	leaf, stem, fruit	N	Y	Atwal, 1976; CPC, 2001; Ben-Dov *et al*., 2001
Saisettia oleae Bernard	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; CPC, 2001

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Saissetia coffeae (Walker)	IN, US	stem, leaf, fruit	N	Y	Butani, 1993; Ben-Dov *et al*., 2001; Johnson & Lyon, 1991
Saissetia miranda (Cockerell & Parrott)	IN, US	stem, leaf	N	N	Ben-Dov *et al*., 2001; Johnson & Lyon, 1991
Saissetia privigna Lotto	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; Johnson & Lyon, 1991
Vinsonia stellifera (Westwood)	IN	leaf, stem	Y	N	APHIS-PPQ Intercep., 2002; Ben-Dov *et al*., 2001; Butani, 1993; CPC, 2001; Dekle, 1969; Hamon & Williams, 1984
Coreidae					
Acanthocoris scabrator F.	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; CPC, 2001;
Leptocorisa acuta (Thunberg)	IN	leaf, se	Y	N	Butani, 1993; CPC, 2001;
Diaspididae					
Aonidiella aurantii (Maskell)	IN, US	whole plant	N	Y	CPC, 2001
Aonidiella citrina (Coquillett)	IN, US	whole plant	N	Y	Butani, 1993; CPC, 2001
Aonidiella inornata McKenzie	IN	whole plant	Y	N	Gupta and Singh, 1988; Johnson & Lyon, 1991; Lee & Wen, 1977
Aonidiella orientalis Signoret	IN, US	leaf, stem, fruit	N	Y	CPC, 2001; Johnson & Lyon, 1991
Aonidiella sp.	IN	whole plant	Y	Y	APHIS-PPQ Intercep., 2002; Johnson & Lyon, 1991
Aspidiotus destructor Signoret	IN, US	leaf, stem, shoot	N	Y	Butani, 1993; CPC, 2001; Srivastava, 1997
Aspidiotus nerii Bouche	IN, CA	whole plant, leaf	N	Y	Butani, 1993; Hill, 1983; CPC, 2001
Aulacaspis martini Williams	IN	leaf	Y	N	Suresh & Mohanasundaram, 1996

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Aulacaspis rosae (Bouche)	IN; US	leaf	N	N	Butani, 1993; Srivastava, 1997; Ben-Dov *et al.*, 2006
Aulacaspis tubercularis Newstead	IN, US (FL)	leaf, fruit	[Y][2]	Y	APHIS-PPQ Intercep., 2002; Butani, 1993; CPC, 2001; Cunningham, 1991; Peña, 1993
Aulacaspis vitis =Phenacaspis vitis, *Chionaspis vitis*	IN	leaf	Y	N	Ozaki *et al.*, 1999; Suresh & Mohanasundaram, 1996
Chrysomphalus aonidum (L.)	IN, US	stem, leaf, fruit	N	Y	Butani, 1993; CPC, 2001
Chrysomphalus dictyospermi (Morgan)	IN, US	stem, leaf, fruit	N	Y	Butani, 1993; Hill, 1983; CPC, 2001; Young and Sauls, 1981
Chrysomphalus pinnulifer (Maskell)	IN	stem	Y	N	Borror *et al.*, 1989
Hemiberlesia lataniae (Signoret)	IN, US	stem, leaf, fruit	N	Y	CPC, 2001; Peña, 1993; CPC, 2005
Hemiberlesia rapax (Comstock)	IN, US	bark, leaf, fruit	N	Y	Butani, 1993; CPC, 2001
Insulaspis pallkidula Williams	IN	stem	Y	N	Borror *et al.*, 1989; Butani, 1993
Ischnaspis longirostris (Signoret)	IN, US	leaf	N	N	Butani, 1993; Peña, 1993
Lepidosaphes beckii (Newman)	IN, US,	whole plant	N	Y	CPC, 2001
Lepidosaphes gloverii (Packard)	IN, US	stem, leaf, fruit	N	Y	Butani, 1993; CPC, 2001
Lepidosaphes shikohabadensis Dutta	IN	stem	Y	N	Borror *et al.*, 1989
Leptosapes tapleyi Williams	IN	stem, leaf	Y	N	Butani, 1993
Leucaspis indica Marlatt	IN	stem	Y	N	Borror *et al.*, 1989; Butani, 1993
Lindingaspis floridana Ferris	IN, US	leaf	N	N	Butani, 1993; Johnson & Lyon, 1991
Lindingaspis greeni (Brain & Kellly)	IN	stem	Y	N	Borror *et al.*, 1989; Butani, 1993
Lindingaspis rossi (Maskell)	IN; US	leaf	N	N	Butani, 1993; Johnson & Lyon, 1991; Ben-Dov *et al.*, 2006

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Parlatoria camelliae Comstock	IN, US	stem, leaf	N	N	Butani, 1993; NCSU, 2000
Parlatoria cinerea Hadden	IN	stem	Y	N	Butani, 1993; Suresh & Mohanasundaram, 1996
Parlatoria crypta Mckenzie	IN	stem, leaf, fruit	Y	Y	APHIS-PPQ Intercep., 2002; Butani, 1993; Suresh & Mohanasundaram, 1996
Parlatoria oleae (Colvee)	IN, US	whole plant	N	Y	Butani, 1993; CPC, 2001
Parlatoria pergandii Comstock	IN, US	whole plant	N	Y	Butani, 1993; CPC, 2001
Phenocaspis vitis (Green)	IN	stem	Y	N	Borror *et al*., 1989; Butani, 1993
Pinnaspis aspidistrae (Signoret)	IN; US	stem, leaf, fruit	N	Y	Butani, 1993; Johnson & Lyon, 1991; Ben-Dov *et al*., 2006
Pinnaspis strachani (Cooley)	IN, US	stem, leaf, fruit	N	Y	CPC, 2001; Young and Sauls, 1981; Ben-Dov *et al*., 2006
Pseudaonidia trilobitiformis (Green)	IN, US (FL)	Leaf, fruit	[Y][2]	Y	APHIS-PPQ-Interceptions, 2004; CPC, 2001; Butani, 1993; Peña, 1993
Pseudaulacaspis barberi (Green)	IN	stem	Y	N	Borror *et al*., 1989; Butani, 1993
Pseudaulacaspis cockerelli (Cooley) =*Phenacaspis cockerelli* (Cooley)	IN, US	whole plant	N	Y	CPC, 2001; Hamon, 1970; Young and Sauls, 1981
Pseudaulacaspis pentagona (Targioni-Tozzetti)	IN, US	whole plant	N	Y	CPC, 2001
Radionaspis indica (Marlatt)	IN, US	trunk, branches, buds	N	N	Butani, 1993; Peña, 1993
Semilaspidus mangiferae Takahashi	IN	stem	Y	N	Borror *et al*., 1989; Butani, 1993
Flatidae					
Salurnis marginellus (Guerin)	IN	inf.	Y	N	Dalvi *et al*., 1992
Fulgoridae					
Ricania marginalis Westwood	IN	inf.	Y	N	Dalvi *et al*., 1992
Kerridae					

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Kerria lacca Kerr	IN	stem	Y	N	CPC, 2001; Borror *et al*., 1989
Paratachardina theae Green	IN	stem	Y	N	Ben-Dov *et al*., 2001; Borror *et al*., 1989
Lecanodiaspididae					
Psoraleococcus sp. multipori	IN	stem	Y	N	Beeghly, 1999; Bhumannavar & Jacob, 1989
Lophopidae					
Pyrilla perpusilla Walker	IN	bk	Y	N	Dubey *et al*, 1981; CPC, 2001
Lygaeidae					
Spilostethus macilentus Stall	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993
Spilostethus pandurus Scopoli	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993
Margarodidae					
Drosicha contrahens (Walker)	IN	stem, shoot, leaf	Y	N	Butani, 1993
Drosicha dalbergiae (Green)	IN	stem, shoot, leaf	Y	N	Butani, 1993
Drosicha mangiferae Green	IN	stem, shoot, leaf	Y	N	Singh, 1993; Srivastava, 1997
Drosicha stebbingi (Green)	IN	stem, shoot, leaf	Y	N	Butani, 1993; CPC, 2001; Singh, 1993
Icerya aegyptiaca (Douglas)	IN	stem, shoot, leaf	Y	N	CPC, 2001
Icerya minor Green	IN	stem, shoot, leaf	Y	N	Butani, 1993
Icerya pulcher (Leonardi)	IN	stem, shoot, leaf	Y	N	Butani, 1993
Icerya purchasi Maskell	IN, US	stem, shoot, leaf	N	N	Butani, 1993; CPC, 2001
Icerya seychellarum (Westwood)	IN	stem, shoot, leaf	Y	N	Butani, 1993; CPC, 2001
Labioproctus poleii (Green)	IN	stem	Y	N	Butani, 1993; Suresh & Mohanasundaram, 1996
Membracidae					
Leptocentrus obliquis Walker	IN	stem, leaf	Y	N	Butani, 1993; Beeghly, 1999
Otinotus oneratus Walker	IN	stem, leaf	Y	N	Butani, 1993
Oxyrhachis serratus (Ahmad & Abrar)	IN	stem, leaf	Y	N	CPC, 2001

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Oxyrhachis tarandus (F.)	IN	stem, leaf	Y	N	Beeghly, 1999; Butani, 1993
Tricentrus bicolor Distant	IN	stem, leaf	Y	N	Butani, 1993
Pentatomidae					
Antestiopsis cruciata (F) =*Antestictsis cruciata* (Fabricius)	IN	stem, leaf, fruit, inf.	Y	N (see section E)	CPC, 2001; Butani, 1993
Bagrada hilaris (Burmeister) =*Bagrada cruciferarum* Kirkaldy	IN	stem, leaf,	Y	N	Butani, 1993; CPC, 2001
Cantheconidea furcellata (Wolff)	IN	none	Y	N	Butani, 1993; Srivastava, 1997, Senraya, 1991
Chrysocoris particius (F)	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993
Coptosoma nazirae Atkinsoni	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993
Halys dentata (F.)	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; CPC, 2001
Nezara viridula (L.)	IN, US	stem, leaf, fruit, inf.	N	N (see section E)	Butani, 1993; CPC, 2001
Pseudococcidae					
Dysmicoccus brevipes (Cockerell)	IN, US	whole plant	N	N[6]	CPC, 2001
Ferrisia virgata (Cockerell)	IN, US	shoot, stem, leaf, fruit	N	N[6]	CPC, 2001
Geococcus coffeae Green	IN, US (HI)	root	Y	N	Ben-Dov *et al*., 2001; CIE Map 285, 1971
Maconellicoccus hirsutus (Green)	IN, US (CA, HI)	whole plant	[Y][2]	N (see section E)	APHIS-PPQ Intercep., 2002; CPC, 2001
Nipaecoccus nipae (Maskell)	IN, US (CA, LA, FL)	stem, leaf, fruit	N	N[6]	Ben-Dov *et al*., 2001; CPC, 2001
Nipaecoccus viridis (Newstead)	IN, US (HI)	whole plant	Y	N (see section E)	APHIS-PPQ Intercep., 2002; Ben-Dov *et al*., 2001; Butani, 1993; CPC, 2001; CIE Map 446, 1983; CPC, 2005
Perissopneumon ferox Newstead	IN	stem, leaf, fruit	Y	N (see section E)	Butani, 1993; CPC, 2001; Srivastava, 1997
Planococcoides robustus Ezzat & McConnell	IN	whole plant	Y	N (see section E)	APHIS-PPQ Intercep., 2002; Ben-Dov *et al*., 2001
Planococcus citri (Risso)	IN, US	whole plant	N	N[6]	Ben-Dov *et al*., 2001; CPC, 2001

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Planococcus ficus (Signoret)	IN; US	whole plant	N	N[6]	Ben-Dov *et al*., 2001; CPC, 2001; Ben-Dov *et al.*, 2006
Planococcus lilacinus (Cockerell)	IN, US (HI)	whole plant	Y	N (see section E)	Ben-Dov *et al*., 2001; CPC, 2001; Suresh & Mohanasundaram, 1996
Pseudococcus longispinus (Targioni-Tozzetti)	IN, US	stem, leaf, fruit,	N	N[6]	CPC, 2001
Rastrococcus iceryoides (Green)	IN	stem, leaf, fruit, inf.	Y	N (see section E)	APHIS-PPQ Intercep., 2002; Ben-Dov *et al*., 2001; CPC, 2001; Srivastava, 1997
Rastrococcus invadens Williams	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; CPC, 2001; APHIS-PPQ Intercep., 2002
Rastrococcus mangiferae (Green)	IN	stem, leaf	Y	N	Ben-Dov *et al*., 2001; APHIS-PPQ Intercep., 2002
Rastrococcus spinosus (Robinson)	IN	whole plant	Y	N (see section E)	Ben-Dov *et al*., 2001; CPC, 2001
Psyllidae					
Apsylla cistellata Buckton	IN	shoot, leaf	Y	N	Butani, 1993; CPC, 2001; Singh, 1993; Srivastava, 1997
Arytania obscura Crawford	IN	stem, leaf	Y	N	Butani, 1993
Leuronota minuta (Crawford)	IN	stem, leaf	Y	N	Butani, 1993
Microceropsylla brevicornis Crawford	IN	leaf	Y	N	Butani, 1993; Lee & Wen, 1980
Microceropsylla maculata Mathur	IN	leaf	Y	N	Butani, 1993; Lee & Wen, 1980
Microceropsylla nigra (Crawford) =*Pauropsylla nigra* Crawford	IN	leaf	Y	N	Butani, 1993; Dalvi *et al*., 1992; Lee & Wen, 1980
Pauropsylla brevicornis Crawford	IN	stem, shoot, leaf	Y	N	Srivastava, 1997
Trioza jambolanae Crawford	IN	leaf	Y	N	Butani, 1993
Pyrrhocoridae					
Dysdercus koenigii F.	IN	stem, leaf, fruit, inf.	Y	N (see section E)	Butani, 1993; CPC, 2001; CIE Map 3, 1985
HYMENOPTERA					
Formicidae					

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Anoplolepis longipes Jerdon	IN	leaf	Y[1]	N	CPC, 2001; Srivastava, 1997
Azteea schimperi (Elm)	IN	leaf	Y	N	Srivastava, 1997
Dorylus orientalis (Westwood)	IN	leaf	Y	N	Butani, 1993; CPC, 2001; Srivastava, 1997
Oecophylla longinoda (Latreille)	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997
Oecophylla smaragdina (F.)	IN	leaf	Y	N	Atwal, 1976; Butani, 1993; Hill, 1983; Singh, 1960; Srivastava, 1997
ISOPTERA					
Kalotermitidae					
Microtermes edentatus Wasmann	IN	stem, root	Y	N	Butani, 1993
Microtermes obesi Holmagren	IN	stem, root	Y	N	Butani, 1993; CPC, 2001;
Neotermes boesi Snyder	IN	stem, root	Y	N	Butani, 1993
Neotermes magaoculatus Roonwal & Sen-Sarma	IN	stem, root	Y	N	Butani, 1993
Neotermes mangiferae Roonwal & Sen-Sarma	IN	stem, root	Y	N	Butani, 1993
Rhinotermitidae					
Coptotermes gestroi Wasmann	IN	stem, root	Y	N	Butani, 1993
Coptotermes heimei (Wasmann)	IN	stem, root	Y	N	Butani, 1993; CPC, 2001;
Heterotermes indicola (Wasmann)	IN	stem, root	Y	N	Butani, 1993; CPC, 2001;
Termitidae					
Odontotermes assmuthi Holmgren	IN	stem, root	Y	N	Butani, 1993; CPC, 2001;
Odontotermes feae Wasmann	IN	stem, root	Y	N	Butani, 1993; CPC, 2001;
Odontotermes horni (Wasmann)	IN	stem, root	Y	N	Butani, 1993; Veeresh *et al.*, 1989;
Odontotermes wallonensis (Wasmann)	IN	stem, root	Y	N	Butani, 1993; CPC, 2001
Stylotermes fletcheri (Holmgren)	IN	stem, root	Y	N	Butani, 1993
Trinervitermes biformis (Wasmann)	IN	stem, root	Y	N	Butani, 1993
Trinervitermes rubidus (Hagen)	IN	stem, root	Y	N	Butani, 1993
LEPIDOPTERA					
Arctiidae					

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Amsacta lactinea (Cramer)	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Pericallia ricini F.	IN	leaf	Y	N	CPC, 2001; Srivastava, 1997; Zhang, 1994
Spilarctia obliqua Walker =*Spilosoma obliqua* Walker	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Cosmopterigidae					
Pyroderces simplex Walsingham =*Anatrachyntis simplex* Walsingham	IN	inf.	Y	N	Butani, 1993; CPC, 2001; Zhang, 1994
Gelechiidae					
Anarsia lineatella Zeller	IN, US	shoot, leaf	N	N	Butani, 1993; CPC, 2001; Srivastava, 1997; Zhang, 1994
Anarsia melanoplecta Meyrick	IN	shoot, leaf, inf.	Y	N	Butani, 1993; Srivastava, 1997
Hypatima haligramma Meyrick =*Chelaria haligramma* Meyrick	IN	leaf	Y	N	Sundara Babu, 1983; Butani, 1993; Raju, 1983
Hypatima spathota Meyrick =*Chelaria spathota* Meyrick	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Geometridae					
Buzura suppressaria GuenΘe	IN	leaf	Y	N	CPC, 2001; Srivastava, 1997; Zhang, 1994
Hyposidra talaca Walker =*Hyposidra successaria* Walker	IN	leaf, inf.	Y	N	Butani, 1993; CPC, 2001
Thalassodes dissita (Walker)	IN	leaf	Y	N	Butani, 1993; CPC, 2001; Srivastava, 1997; Zhang, 1994
Thalassodes quadraria Guenee	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Thalassodes veraria Guenee	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997
Gracillariidae					
Acrocercops cathedraea Meyrick	IN	stem, leaf	Y	N	Butani, 1993
Acrocercops isonoma Meyrick	IN	stem, leaf	Y	N	Butani, 1993
Acrocercops pentalocha Meyrick	IN	stem, leaf	Y	N	Butani, 1993; Srivastava, 1997

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Acrocercops syngramma Meyrick	IN	stem, leaf	Y	N	Butani, 1993; CPC, 2001; Pruthi and Batra, 1960; Srivastava, 1997; Zhang, 1994
Acrocercops zygonoma Fletcher	IN	stem, leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994;
Heliodinidae					
Stathmopoda auriferella Walker	IN	stem	Y	N	Nonveiller, 1969; Zhang, 1994
Limacodidae					
Chalcoscelides castaneipars Moore	IN	leaf[3]	Y	N	Zhang, 1994; CPC, 2005
Cheromettia laleana Moore =*Belippa laleana* Moore	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Parasa lepida Cramer =*Latoia lepida* (Cramer)	IN	leaf	Y	N	CPC, 2001; Srivastava, 1997; Zhang, 1994
Phocoderma velutina Kollar	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Lycaenidae					
Deudorix isocrates (F.) =*Virachola isocrates* (F.)	IN	fruit	Y	N (see section E)	Butani, 1993; Srivastava, 1997; Zhang, 1994
Rapala manea Hewitson	IN	leaf	Y	N	Johnson *et al.*,1980; Zhang, 1994;
Rapala melampus (Stoll)	IN	leaf	Y	N	Srivastava, 1997
Rathinda amor F.	IN	leaf	Y	N	Zhang, 1994
Lymantriidae					
Dasychira mendosa (Hübner)	IN	leaf	Y	N	Koshiya & Bharodia,1976; Mehra & Sah, 1976; Zhang, 1994;
Euproctis flava Bremer	IN	leaf	Y	N	Butani, 1993; Pruthi and Batra, 1960; Zhang, 1994
Euproctis fraterna Moore	IN	leaf	Y	N	Butani, 1993; Pruthi and Batra, 1960; Zhang, 1994
Euproctis lunata Walker	IN	leaf	Y	N	Butani, 1993; Pruthi and Batra, 1960; Zhang, 1994

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Euproctis scintillans Walker	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Euproctis xanthosticha (Hampson)	IN	leaf	Y	N	Butani, 1993
Lymantria ampla (Walker)	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Lymantria beatrix Stoll.	IN	leaf	Y	N	Srivastava, 1997
Lymantria marginata Walker	IN	leaf	Y	N	Singh, 1993; Srivastava, 1997; Zhang, 1994
Lymantria mathura Moore	IN	stem, inf.	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Orgyia postica Walker	IN	leaf, fruit	Y	N (see section E)	CPC, 2001; Gupta and Singh, 1986; Srivastava, 1997; Wu, 1977; Zhang, 1994
Perina nuda F.	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Metarbelidae					
Indarbela dea Swinhoe=*Arbela dea* Swinhoe	IN	stem	Y	N	Srivastava, 1997; Zhang, 1994
Indarbela quadrinotata Walker	IN	stem	Y	N	Srivastava, 1997; Zhang, 1994
Indarbela tetraonis (Moore)	IN	stem	Y	N	Srivastava, 1997; Zhang, 1994
Indarbela theivora (Hampson)	IN	stem	Y	N	Srivastava, 1997; Zhang, 1994
Noctuidae					
Achaea janata L.	IN, US (HI)	leaf, fruit	Y	N (see section E)	Butani, 1993; Zhang, 1994; CPC, 2004
Chlumetia alternana Moore	IN	shoot, leaf, inf.	Y	N	Butani, 1993; Srivastava, 1997
Chlumetia transversa Walker =*Sholumetia transversa* Walker	IN	shoot	Y	N	Singh, 1993; Srivastava, 1997; Zhang, 1994
Eublemma abrupta (Walker)	IN	inf.	Y	N	Butani, 1993
Eublemma angulifera Moore	IN	inf.	Y	N	Butani, 1993; Zhang, 1994
Eublemma brachygonia Hampson	IN	inf.	Y	N	Butani, 1993; Zhang, 1994
Eublemma silicula Swinhoe	IN	inf.	Y	N	Butani, 1993

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Eublemma versicolor (Walker)	IN	inf.	Y	N	Butani, 1993
Eudocima fullonia Clerck	IN, US (HI)	fruit, leaves	Y	N (see section E)	CPC, 2001; Zhang, 1994
Eudocima homaena Hübner =*Ophideres ancilla* Cramer	IN	fruit, leaves	Y	N (see section E)	Atwal, 1976; Zhang, 1994
Eudocima materna Linnaeus =*Ophideres materna* Linnaeus	IN	leaves, fruit	Y	N (see section E)	Zhang, 1994; Atwal, 1976
Helicoverpa armigera (Hübner) =*Heliothis armigera* Hübner	IN	fruit, leaves, flowers	Y	N (see section E)	Butani, 1993; CIE Map 15, 1993; Zhang, 1994; CPC, 2005
Oraesia emarginata F. =*Calpe emarginata* (F.)	IN	fruit	Y	N (see section E)	Butani, 1993; Zhang, 1994
Penicillaria jocosatrix Guenee =*Bombotelia jocosatrix* (Guenée)	IN, US (HI)	shoot, leaf, inf.	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Selepa celtis Moore	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Stauropus alternus (Walker) =*Neostauropus alternans* Walker	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Nymphalidae					
Euthalia aconthea Cramer =*Euthalia garuda* (Moore)	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Pyralidae					
Cadra cautella Walker =*Cadra defecta* Walker	IN, US	fruit pods	N	N	CPC, 2001; Zhang, 1994
Conogethes punctiferalis (Guenée) =*Dichocrocis punctiferalis* Guenée	IN	inf., fruit	Y	N (see section E)	Butani, 1993; Zhang, 1994
Cryptoblabes gnidiella (Milliere)	IN, US	fruit	Y	N (see section E)	Butani, 1993; CPC, 2001; Hashem *et al.*,1997; Kishore & Jotwani, 1982; Silva & Mexia, 1999; Srivastava & Singh, 1973; Swirski *et al.*,1980; Yehuda *et al.*,1992; Zhang, 1994
Ctenomeristis ebriola Meyrick	IN	fruit	Y	N (see section E)	Butani, 1993

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Deanolis albizonalis (Hampson) =*Noorda albizonalis* Hampson	IN	fruit	Y	N (see section E)	AQIS, 1987; Butani, 1993; CPC, 2001; Zaheruddeen & Sujatha, 1993; Zhang, 1994
Hyalospila leuconeurella Rangonot	IN	fruit	Y	N (see section E)	Butani, 1993; Zhang, 1994
Hypsopygia mauritialis Boisduval	IN, US (HI)	inf.	Y	N	Zhang, 1994
Lamida moncusalis (Walker)	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Lamida sordidalis Hampson	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Macalla carbonifera Meyrick =*Lamida carbonifera* Meyrick	IN	leaf	Y	N	Srivastava, 1997
Maruca vitrata Fabricius =*Maruca testulalis* (Geyer)	IN, US	inf.	Y	N	Butani, 1993
Orthaga euadrusalis Walker	IN	leaf	Y	N	Butani, 1993; Singh, 1993; Srivastava, 1997; Zhang, 1994
Orthaga exvinacea Hampson	IN	leaf, inf.	Y	N	Butani, 1993; Singh, 1993; Srivastava, 1997; Zhang, 1994
Orthaga mangiferae Misra	IN	leaf	Y	N	Butani, 1993; Singh, 1993; Srivastava, 1997; Zhang, 1994
Scirpophaga excerptalis Walker	IN	leaf, stem	Y	N	CPC, 2001; Zhang, 1994
Thylacoptila paurosema Meyrick =*Nephopteryx paurosema* Meyrick	IN	fruit	Y	N (see section E)	Butani, 1993; Zhang, 1994
Tirathaba mundella Walker	IN	fruit	Y	N (see section E)	Bhumannavar & Jacob, 1990; Nair and Rawther, 1969; Zhang, 1994
Saturniidae					
Attacus atlas L.	IN	leaf	Y	N	CPC, 2001; Zhang, 1994

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Cricula trifenestrata Helfer	IN	stem, leaf	Y	N	Ahmed & Alam, 1993; Butani, 1993; CPC, 2001; Zhang, 1994
Sphingidae					
Acherontia styx (Westwood)	IN	leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Agrius convolvuli (L.)	IN	leaf	Y	N	Butani, 1993; Zhang, 1994
Tineidae					
Hypophrictis plana Meyrick	IN	stem	Y	N	Zhang, 1994
Tortricidae					
Dudua aprobola (Meyrick)	IN	stem, leaf	Y	N	Butani, 1993; Srivastava, 1997; Zhang, 1994
Enarmonia anticipans Walker	IN	inf.	Y	N	Butani, 1993
Gatesclarkeana erotias (Meyrick)	IN	stem, leaf	Y	N	Butani, 1993; Srivastava, 1997;Zhang, 1994
Homona coffearia Nietner	IN	leaf	Y	N	CPC, 2001; Zhang, 1994;
Homona permutata Meyrick	IN	leaf	Y	N	Srivastava, 1997
Strepsicrates rhothia Meyrick =*Spilonata rhotia* Meyrick	IN	leaf, shoot	Y	N	Butani, 1993; Zhang, 1994
ORTHOPTERA					
Acrididae					
Aularches miliaris L.	IN	leaf	Y	N	Butani, 1993; CPC, 2001
Gryllidae					
Gryllus viator Kirby	IN	leaf	Y	N	Butani, 1993
Platygryllus melanocephalus (Serville)	IN	leaf	Y	N	Butani, 1993
Tarbnskielllus portentosus Lichtenstein	IN	leaf	Y	N	Butani, 1993; CPC, 2001
THYSANOPTERA					
Thripidae					

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Megalurothrips distalis (Karny)	IN	inf., leaf	Y	N	CPC, 2003
Retithrips syriacus (Mayet)	IN, US (FL)	infl, leaf, fruit	[Y]²	N (see section E)	CPC, 2005; Hamon & Edwards, 1994
Thrips palmi Karny	IN, US (FL, HI)	fruit, leaf	[Y]²	N (see section E)	CPC, 2005
Scirtothrips dorsalis	IN, US (FL, HI)	inf., leaf	[Y]²	N	CPC, 2003; Entomology Section, 2004; Thomas, 2000
PARASITIC PLANTS					
Cephaleuros mycoidea Karst. (Chlorophyceae)	IN, US (HI)	leaf, stem	Y	N	Raabe *et al*., 1981; Reddy, 1975; Vala *et al*., 1989
Cephaleuros virescens Kunze (Chlorophyceae)	IN, US	Leaf	N	N	Alfieri *et al*., 1994
Dendrophthoe falcata (L.f.) Etting. (Loranthaceae)	IN	leaf, stem	Y	N	Vala *et al*., 1989
Bacteria					
Bacillus subtilis (Ehrenberg) Cohn (Firmicutes: Bacillus/Clostridium group)	IN, US	Fruit	N	Y	Bradbury, 1986; CPC, 2001; Beeghly, 1999
Pectobacterium carotovorum subsp. *carotovorum* Hauben *et al.* = *Erwinia carotovora* subsp. *carotovora* (Jones) Bergey *et al*. = *E. carotovora* (Jones) Holland = *E. herbicola* Dye (Proteobacteria: γ subdivision, Enterobacteriaceae)	IN, US	Fruit	N	Y	APS, 2001; Bradbury 1986; CPC, 2001; Kranz *et al*., 1977; Beeghly, 1999; Weber, 1973
Pseudomonas syringae pv. *syringae* van Hall (Proteobacteria: γ subdivision, Pseudomonas group)	IN, US	flower, leaf buds, leaf, stem	N	Y[4]	CPC, 2001; Ploetz, 2003; Cazorla, *et al.*, 1998
Pseudomonas syringae van Hall (Proteobacteria: γ subdivision, Pseudomonas group)	IN, US	fruit, leaf, stem	N	Y	CPC, 2001; Kranz *et al*., 1977
Rhizobium radiobacter (Beijerinck and van Delden) Young = *Agrobacterium tumefaciens* (Smith & Town.) Conn (Proteobacteria: α subdivision, Rhizobiaceae group)	IN, US	root, stem	N	N	Alfieri *et al*., 1994; APS, 2001; Bradbury, 1986; CPC, 2001

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Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al.*) Robbs *et al.* = *Pseudomonas mangiferae-indicae* Patel, Kulkarni and Moriz (Proteobacteria: γ subdivision, Lysobacterales)	IN	fruit, leaf, stem	Y	Y	APS, 2001; Bradbury 1986; CPC, 2001; Beeghly, 1999; Reddy, 1975; Shekhawat and Patel, 1975; Weber, 1973; Vala *et al.*, 1989
Fungi					
Actinodochium jenkinsii Uppal, Patel & Kamat (Mitosporic Fungi)	IN	fruit	Y	Y	Reddy, 1975; Rao, 1966; Uppal, *et al.*, 1953
Alternaria alternata (Fr.: Fr.) Keissl. = *A. tenuis* Nees (Mitosporic Fungi)	IN, US	fruit, infl., leaf, stem	N	Y	Alfieri *et al.*, 1994; CPC, 2001; Beeghly, 1999; Om-Prakash *et al.*, 1985; Ploetz *et al.*, 1994
Alternaria tenuissima (Nees ex Fries) Wiltshire (Mitosporic Fungi)	IN, US	leaf	N	N	ARS, 2001; Beeghly, 1999; Weber, 1973
Aspergillus fumigatus Fresen. (Mitosporic Fungi)	IN, US	fruit	N	Y	ARS, 2001; Farr *et al.*, 1989; Reddy, 1975
Aspergillus nidulans (Eidam) Wint. (Mitosporic Fungi)	IN, US	fruit	N	Y	Farr *et al.*, 1989; Reddy, 1975; Farr, *et al.*, 2006
Aspergillus niger van Tiegh (Mitosporic Fungi)	IN, US	fruit, infl.	N	Y	ARS, 2001; CPC, 2001; Farr *et al.*, 1989; French, 1989; Onions, 1966; Rao, 1966; Reddy, 1975
Aspergillus stellifer Samson & Gams = *A. variecolor* (Mitosporic Fungi)	IN, US	fruit	N	Y	Farr *et al.*, 1989; Reddy, 1975
Aspergillus sp. (Mitosporic Fungi)	IN	fruit	Y	Y	Vala *et al.*, 1989
Aspergillus terreus Thom & Church (Mitosporic Fungi)	IN, US	fruit, leaf, stem	N	Y	ARS, 2001; Farr *et al.*, 1989; Patel *et al.*, 1985

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Asterolibertia mangiferae Hansf. & Thirum (Ascomycota: *inc. sed.*)	IN	leaf	Y	N	ARS, 2001; Rangaswami *et al.*, 1970; Reddy, 1975
Astromeila sp. (Ascomycota: *inc. Sed.*)	IN	leaf, stem	Y	N	Vala *et al.*, 1989
Aureobasidium pullulans (de Bary) Arnaud (Mitosporic Fungi)	IN, US	leaf	N	N	ARS, 2001; Farr *et al.*, 1989; Reddy, 1975; Sarbhoy *et al.*, 1975
Bipolaris australiensis (Ellis) Tsuda & Ueyama = *Drechslera australiensis* (Bugnicourt) Subramanian & Jain ex Ellis = *Helminthosporium australiensis* = *H. australiense*, teleomorph = *Cochliobolus australiensis* (Ascomycota: Dothideales)	IN, US (HI)	leaf, seed	N	N	ARS, 2001; CPC, 2001; Farr *et al.*, 1989; Sivanesan, 1987
Botryosphaeria butae Tilak & Kale = *B. buteae* (Ascomycota: Dothideales)	IN	stem	Y	N	ARS, 2001; Sarbhoy *et al.*, 1975; Talde, 1970
Botryosphaeria ribis Gross. & Duggar, anamorph = *Fusicoccum* sp. (Ascomycota: Dothideales)	IN, US	fruit, leaf stem	N	Y	Alfieri *et al.*, 1994; CPC, 2001; Farr *et al.*, 1989; USDA, 1960
Capnodium mangiferae Cooke & Broome (Ascomycota: Dothideales)	IN, US	fruit, infl., leaf, seed	N	Y	Kranz *et al.*, 1977; Beeghly, 1999; USDA, 1960; Vitchitrananda, 1983; Weber, 1973
Capnodium ramosum Cooke (Ascomycota: Dothideales)	IN	fruit, infl., leaf, seed	Y	N (see section E)	APS, 2001; ARS, 2001; Beeghly, 1999; Mukherjee, 1953; Rangaswami *et al.*, 1970; Rao, 1966; Reddy, 1975; Vala *et al.*, 1989; Menge & Ploetz, 2003; Ploetz, 2003

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Ceratocystis fimbriata Ellis & Halsted, anamorph = *Chalara* sp. (Ascomycota: Microascales)	IN, US	leaf, stem	N	N	ARS, 2001; CMI Map No. 91, 1983; CPC, 2001; Farr *et al*., 1989; Kranz *et al*., 1977
Ceratocystis paradoxa (Dade) Moreau, anamorph = *Chalara paradoxa* Sacc. (Ascomycota: Microascales)	IN, US	fruit, leaf	N	Y	ARS, 2001; CPC, 2001
Cercospora mangiferae-indicae Munjal, Lall & Chona (Mitosporic Fungi)	IN	leaf	Y	N	Arora and Rao, 1998; ARS, 2001; Beeghly, 1999; Munja, 1962; Rangaswami *et al*., 1970; Reddy, 1975
Cladosporium cladosporioides (Fresen.) De Vries (Ascomycota: Dothideales)	IN, US	fruit, leaf	N	Y	ARS, 2001; Holliday, 1980; Beeghly, 1999
Cladosporium herbarum (Pers.:Fr.) Link (Ascomycota: Dothideales)	IN, US	fruit	N	Y	Farr *et al*., 1989; Rao, 1966
Ciliochlorella mangiferae Syd. (Mitosporic Fungi)	IN, US (HI)	leaf	Y	N	Goos and Uecker, 1992; Rangaswami *et al*., 1970
Coccomyces vilis Syd. & Butl. (Ascomycota: Rhytismatales)	IN	leaf	Y	N	ARS, 2001; Cannon and Minter, 1984; Reddy, 1975; Sherwood, 1980; Stevenson, 1926; Watson, 1971
Cochliobolus lunatus Nelson & Haasis (Ascomycota: Dothideales)	IN, US	leaf, seedlings	N	N	ARS, 2001; Farr *et al*., 1989; Reddy, 1975; Sivanesan, 1987
Colletotrichum capsici (Syd.) Butler & Bisby (Ascomycota: Phyllachorales)	IN, US	fruit, leaf	N	Y	Mordue, 1971; Reddy, 1975; USDA, 1960
Colletotrichum mangiferae Kelkar & Rao (Ascomycota: Phyllachorales)	IN	leaf	Y	N	ARS, 2001; Mathur, 1979

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Corticium rolfsii Curzi (Basidiomycota: Stereales)	IN, US	seedling	N	N	CPC, 2001; Peregrine & Ahmad, 1982
Curvularia lunata var. *aeria* Ellis (Mitosporic Fungi)	IN, US	leaf	N	N	ARS, 2001; Farr *et al.*, 1989; Sarbhoy *et al.*, 1975; Sivanesan, 1987
Cytospora mangiferae-indicae Vasant, Rao & Narendra (Mitosporic Fungi)	IN	leaf	Y	N	Mathur, 1979
Cytosphaera mangiferae Died. [=*Aplosporella mangiferae* (Died.) Petr. & Syd., *Haplosporella mangiferae* (Died.) Petr. & Syd.] (Ascomycetes: Incertae sedis)	IN	Leaf, stem, fruit	Y	Y	Johnson & Hyde, 1992
Diaporthe medusaea Nits. (Ascomycota: Dothideales)	IN, US	fruit, leaf, stem	N	Y	Kranz *et al*., 1977
Discosia hiptages Tilak (Ascomycetes: Incertae sedis)	IN	leaf	Y	N	ARS, 2001; Sarbhoy *et al.*, 1975; Shreemali, 1971; Nag Raj, 1993; Subramanian & Chandra-Reddy, 1974
Dothiorella sp. (Mitosporic Fungi)	IN, US (FL)	fruit, stem	Y	Y	Alfieri *et al.*, 1994; Vala *et al.*, 1989
Dothiorella mangiferae P. Syd. & Butler = *Nattrassia mangiferae* Sutton & Dyko = *Hendersonula toruloidea* Nattrass (Mitosporic Fungi)	IN, US	stem, fruit	N	Y	ARS, 2001; Ploetz *et al.*, 1996; Reddy, 1975; Farr et al., no date
Dothiorella dominicana Petr. & Cif. = *Fusicoccum aesculi* Corda, teleomorph = *Botryosphaeria dothidea* Ces. & De Not. (Mitosporic Fungi)	IN, US	fruit, infl.	N	Y	ARS, 2001; Ploetz *et al.*, 1996; Prasad and Sinha, 1979
Elsinoe mangiferae Bitancourt & Jenkins, anamorph = *Sphaceloma mangiferae* (Ascomycota: Dothideales)	IN, US	fruit, infl., leaf, stem	N	Y	CPC, 2001; Farr *et al.*, 1989; Horst, 1990; Kranz *et al.*, 1977; Singh, 1960; USDA, 1960; Weber, 1973

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Erythricum salmonicolor (Berk. & Br.) Burdsall = *Botryobasidium slmonicolor* Venkatarayan = *Corticium salmonicolor* Berk. & Br. (Basidiomycota: Stereales)	IN, US	fruit, stems	N	Y	CMI, 1976; CMI, 1995; Farr *et al*., 1989; Kranz *et al*., 1977; Beeghly, 1999; Kwee and Chong, 1985; Weber, 1973
Fusarium decemcellulare (Brick), teleomorph = *Nectria regidiuscula* Berk. & Broome (Mitosporic Fungi)	IN, US	stem	N	N	Beeghly, 1999; Ploetz *et al*., 1996; Prasad and Sinha, 1979
Fusarium moniliforme Sheld., teleomorph = *Gibberella fujikuroi* (Sawada) Ito & Kimura (Mitosporic Fungi)	IN, US	seedling	N	N	ARS, 2001; Reddy, 1975
Fusarium pallidoroseum (Cooke) Sacc. = *F. semitectum* Berk. & Rav. (Mitosporic Fungi)	IN, US	fruit, leaf	N	Y	Booth & Sutton, 1984; Booth, 1978; CPC, 2001; Farr *et al*., 1989; Beeghly, 1999; Singh and Devi, 1990
Fusarium subglutinans (Wollenweb. & Reinking) Nelson, Toussoun & Marasas = *F. moniliforme* var. *subglutinans* (Mitosporic Fungi)	IN, US	infl., leaf, stem	N	N	Akhtar *et al*., 1999; ARS, 2001; Farr *et al*., 1989; Beeghly, 1999
Fusarium solani (Mart.) Sacc., teleomorph = *Nectria haematococca* Berk & Broome (Mitosporic Fungi)	IN, US	root, seedling	N	N	ARS, 2001; Booth and Waterston, 1964; Kore and Patil, 1985; Beeghly, 1999; Reddy, 1975; Sarbhoy *et al*., 1975; Williams and Liu, 1976
Fusarium sp. (Mitosporic Fungi)	IN	fruit	Y	Y	Rao, 1966
Ganoderma applanatum (Pers.) Pat. = *Fomes applanatus* Gill. (Basidiomycota: Ganodermatales)	IN, US	stem	N	N	ARS, 2001; Beeghly, 1999; Reddy, 1975; Singh, 1960; Steyaert, 1975
Geotrichum candidum Link (Ascomycota: Saccharomycetales)	IN, US	fruit	N	Y	ARS, 2001; Farr *et al*., 1989; Beeghly, 1999

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Gilbertella persicaria (Eddy) Hesseltine Zygomycota: Mucorales)	IN, US	fruit	N	Y	Farr *et al.*, 1989; Prasad and Sinha, 1979; Sarbhoy, 1966
Gibberella zeae (Schwein.) Petch, anamorph = *Fusarium graminearum* Schwabe (Ascomycota: Hypocreales)	IN, US	infl., leaf, root, seed	N	N	CPC, 2001
Gloeosporium sp. (Mitosporic fungi)	IN	fruit	Y	Y	Vala *et al.*, 1989
Glomerella cingulata (Stoneman) Spaulding & Schrenk, anamorph = *Colletotrichum gloeosporioides* Penz. = *Gloeosporium mangiferae* Henn. = *Gloeosporium raciborskii* Henn. (Ascomycota: Phyllachorales)	IN, US	fruit, infl., leaf, stem	N	Y	APS, 2001; CPC, 2001; Farr *et al.*, 1989; Horst, 1990; Kranz *et al.*, 1977; Beeghly, 1999; Kwee and Chong, 1985; Palm, 2003; Singh, 1960; Spalding, 1982; USDA, 1960; Vala *et al.*, 1989; Von Arx, 1970; Weber, 1973
Haplosporella beaumontiana = *Aplosporella* sp. (Mitosporic Fungi)	IN	leaf, stem	Y	N	ARS, 2001; Om *et al.*, 1985
Hendersonia creberrima Syd., P. Syd. & E.J.Butler (Ascomycetes: Pleosporales)	IN	fruit	Y[5]	Y	ARS, 2001; Reddy, 1975; Farr *et al.*, 2005 & 2006; Index Fungorum, 2006; Slippers *et al.*, 2005; Sutton & Dyko, 1989
Hendersonia sp. (Mitosporic Fungi)	IN	leaf, stem	Y	N	Vala *et al.*, 1989
Hexagonia discopoda Pat. & Har. (Basidiomycota: Poriales)	IN	stem	Y	N	ARS, 2001; Beeghly, 1999; Reddy, 1975
Hypoxylon hypomiltum Mont. (Ascomycota: Xylariales)	IN, US	stem	N	N	ARS, 2001; Sarbhoy *et al.*, 1975
Lambertella aurantiaca Tewari & Pant. Ascomycota: Leotiales)	IN	leaf	Y	N	ARS, 2001; Sarbhoy *et al.*, 1975

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Lasiodiplodia theobromae (Pat.) Griffon & Maubl. = *Botryodiplodia theobromae* Pat., = *Diplodianatalensis* Pole-Evans, teleomorph = *Physalospora rhodina* (Berkeley & Curtis) Cooke (Mitosporic Fungi)	IN, US	fruit, leaf, stem	N	Y	ARS, 2001; CMI, 1976; CPC, 2001; French, 1989; Kranz *et al.*, 1977; Beeghly, 1999; Rao, 1966; Reddy, 1975
Laxitextum bicolor (Pers.:Fr.) Lentz (Basidiomycota: Hericiales)	IN, US	stem	N	N	Farr *et al.*, 1989
Leptoxyphium fumago (Woron.) Srivastava = *Caldariomyces fumago* Woron. (Ascomycota: Dothideales)	IN	leaf, stem	Y	N	ARS, 2001; Beeghly, 1999; Om and Prakesh, 1991; Singh and Rawat, 1990
Lophodermium mangiferae Koorders (Ascomycota: Rhytismatales)	IN	leaf	Y	N	CMI, 1984; Vala *et al.*, 1989
Macrophoma mangiferae Hingorani & Sharma [= *Sphaeropsis*] (Ascomycetes: Dothidiales)	IN	fruit, leaf, stem	Y	Y	ARS, 2001; Hingorani *et al.*, 1960; Beeghly, 1999; Prasad and Sinha, 1980; Reddy, 1975; Farr *et al.*, 2006; Index Fungorum, 2006; Okigbo & Osuinde, 2003
Macrophomina phaseolina (Tassi) Goid. = *Rhizoctonia bataticola* (Taub.) Brition-Jones (Mitosporic Fungi)	IN, US	none	N	Y	APS, 2001; CPC, 2001; Holliday, 1980; Holiday and Punithalingam, 1970; Beeghly, 1999; Mathur, 1979; Weber, 1973
Marasmius crinis-equi = M. *crinisequi* Muller ex Kalchbrenner = *M. equicrinis* Muller ex Berk. = *M. equicrinis* Muell. (Basidiomycota: Agaricales)	IN	infl., fruiting stage, leaf	Y	N	CPC, 2001; Turner, 1971

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Meliola mangiferae Earle (Ascomycota: Meliolales)	IN	leaf	Y	N	APS, 2001; ARS, 2001; Kwee and Chong, 1985; Kranz *et al*., 1977; Beeghly, 1999; Rangaswami *et al*., 1970; Rodriguez and Minter, 1998; Singh, 1960; Stevenson, 1926; USDA, 1960; Weber, 1973
Microxyphium columnatum (Mitosporic Fungi)	IN	leaf, stem	Y	N	ARS, 2001; Beeghly, 1999; Om and Prakesh, 1991
Mycosphaerella tassiana (de Not.) Hohnson (Ascomycota: Dothideales)	IN, US	leaf, stem	N	N	ARS, 2001; CPC, 2001; Farr *et al*., 1989
Nattrassia mangiferae Sutton & Dyko = *Dothiorella mangiferae* Syd. *et al*. = *Hendersonula toruloidea* Nattrass (Mitosporic Fungi)	IN, US	leaf, stem	N	N	ARS, 2001; CMI, 1970; Reddy, 1975
Nectria rigidiuscula Berk. & Br. (Ascomycota: Hypocreales)	IN, US	fruit, leaf	N	Y	CPC, 2001
Nodulisporium indicum Reddy & Bilgram (Ascomycota: Xylariales)	IN	leaf	Y	N	CPC, 2001
Oidium mangiferae Berth. (Ascomycota: Erysiphales)	IN, US	fruit, infl., leaf	N	Y	Alfieri *et al*., 1994; Burnett, 1975; Chadha, 1989; CPC, 2001; French, 1989; Kranz *et al*., 1977; Beeghly, 1999; Reddy, 1975; Vala *et al*., 1989; Weber, 1973
Pellicularia koleroga Cooke = *Corticium koleroga* (Cooke) Hohnel = *Koleroga noxia* Donk (Mitosporic Fungi)	IN, US	leaf	N	N	ARS, 2001; CMI, 1988; CPC, 2001; Farr *et al*., 1989; Kranz *et al*., 1977

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Penicillium aurantiogriseum Dierckx = *P. cyclopium* Westling (Mitosporic Fungi)	IN, US	fruit	N	Y	ARS, 2001; IMI, 1992; Farr *et al*., 1989; Beeghly, 1999
Penicillium fellutanum Biourge (Mitosporic Fungi)	IN, US	fruit	N	Y	ARS, 2001; Farr *et al*., 1989; Reddy, 1975
Penicillium crustosum (Thom) (Mitosporic Fungi)	IN, US	fruit	N	Y	ARS, 2001; Farr *et al*., 1989; Beeghly, 1999
Penicillium sp. (Mitosporic Fungi)	IN	fruit	Y	Y	Rao, 1966
Pestalotiopsis glandicola (Castagne) Steyaert (Ascomycota: Xylariales)	IN, US	fruit, leaf	N	Y	ARS, 2001; Farr *et al*., 1989; Beeghly, 1999; Ullasa and Rawal, 1989
Pestalotiopsis mangiferae Steyaert = *Pestalotia mangiferae* Henning = *P. funerea* var. *mangiferae* Sacc. (Ascomycota: Xylariales)	IN, US	fruit, leaf	N	Y	Alfieri *et al*., 1994; APS, 2001; CPC, 2001; Farr *et al*., 1989; Guba, 1961; Beeghly, 1999; Kwee and Chong, 1985; Mordue, 1980; Nag-Raj, 1993; USDA, 1950; Weber, 1973
Pestalotiopsis theae (Saw.) Stey. (Ascomycota: Xylariales)	IN, US	leaf	N	N	ARS, 2001; Kranz *et al*., 1977
Pestalotiopsis versicolor Steyaert = *Pestalotia versicolor* Speg. (Ascomycota: Xylariales)	IN, US	infl.	N	N	ARS, 2001; Farr *et al*., 1989; Kwee and Chong, 1985; Beeghly, 1999
Pestalotiopsis virgatula Steyart = *Pestalotia virgatula* Kleb. (Ascomycota: Xylariales)	IN	leaf	Y	N	ARS, 2001; Reddy, 1975
Phellinus gilvus Pat. = *Polyporus givus* (Schwein.) Fr. (Basidiomycota: Hymenochaetaceae)	IN, US	stems	N	N	Farr *et al*., 1989; Beeghly, 1999; USDA, 1960

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Phellinus conchatus Quel. = *Fomes conchatus* (Pers.:Fr.) Gill. (Basidiomycota: Hymenochaetaceae)	IN, US	stem	N	N	Farr *et al.*, 1989; Beeghly, 1999; Reddy, 1975; Singh, 1960
Phoma glomerata (Corda) Wollenb. & Hochapfel (Ascomycota: Dothideales)	IN, US	leaf	N	N	Farr *et al.*, 1989; Beeghly, 1999
Phoma sorghina (Sacc.) Boerema *et al.* = *P. insidiosa* Tassi (Ascomycota: Dothideales)	IN, US	leaf, stem	N	N	ARS, 2001; Punithalingam, and Holliday, 1972; Farr *et al.*, 1989; Beeghly, 1999; Om *et al.*, 1985
Phoma sp. (Ascomycota: Dothideales)	IN	fruit	Y	Y	Rao, 1966; Vala *et al.*, 1989
Phomopsis mangiferae Ahmad (Ascomycota: Diaporthales)	IN	fruit, infl., leaf, stem	Y	Y	ARS, 2001; CMI, 1993; IMI, 1995; Johnson *et al.*, 1993; Beeghly, 1999; Laxminarayana and Reddy, 1975; Mathur, 1979
Phyllosticta anacrdiacearum van der Aa = *Phyllostitinia mangiferae* Batista & Vital, teleomorph = *Guignardia mangiferae* Roy (Ascomycota: Dothideales)	IN, US	leaf	N	N	Alfieri *et al.*, 1994; ARS, 2001; Farr *et al.*, 1989; Prasad and Sinha, 1979; Roy, 1967; Watson, 1971
Phyllosticta mortoni Fairman (Ascomycota: Dothideales)	IN, US	fruit	N	Y	Alfieri *et al.*, 1994; ARS, 2001; Horst, 1990; Beeghly, 1999; USDA, 1960; Weber, 1973
Phytophthora arecae Coleman (Oomycota: Pythiales)	IN, US	leaf, root	N	N	ARS, 2001; Ploetz and Mitchell, 1989; Rangaswami *et al.*, 1970
Phytophthora nicotianae var. *parasitica* (Dastur) Waterhouse (Oomycota: Pythiales)	IN, US	fruit	N	Y	Farr *et al.*, 1989; NIAM, 2001

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Phytophthora palmivora Butler = *P. heveae* Thomps. (Oomycota: Pythiales)	IN, US	none	N	N	CPC, 2001; Farr *et al*., 1989; Matheron and Matejka, 1990; Reddy, 1975
Plenotrichella sp. (Mitosporic Fungi)	IN	leaf, stem	Y	N	Om *et al*., 1985
Polystictus leoninus Sacc. (Basidiomycota: Hymenochaetales)	IN	branch	Y	N	ARS, 2001; Reddy, 1975
Polystictus persoonii Sacc. (Basidiomycota: Hymenochaetales)	IN	stem	Y	N	Beeghly, 1999; Reddy, 1975; Ryvarden, 1992
Pseudocercospora mangiferae (Mitosporic Fungi)	IN	leaf	Y	N	Deighton, 1976; Beeghly, 1999
Pyrenochaeta sp. (Ascomycota: Dothideales)	IN	leaf	Y	N	Vala *et al*., 1989
Pythium splendens Braun (Oomycota: Pythiales)	IN, US	fruit, leaf	N	Y	Alfieri *et al*., 1994; CPC, 2001; CMI, 1966
Rhinocladium corticola Sacc. = *Peziotrichum corticola* Sacc. = *P. corticolum* Subramaniam = *R. corticolum* Massee (Mitosporic Fungi)	IN	leaf, stem	Y	N	APS, 2001; Beeghly, 1999; Narashimhudu *et al*., 1987; Rawal, 1997; Reddy, 1975; Vala *et al*., 1989
Rhizopus arrhizus Fischer = *R. oryzae* Went and Geerlings (Zygomycota: Mucorales)	IN, US	fruit	N	Y	CPC, 2001; Farr *et al*., 1989; Beeghly, 1999; Reddy, 1975
Robillarda sessilis Sacc. = *Pestalotia sessilis* Sacc. = *Rosellinia* sp. (Mitosporic fungi)	IN	leaf, stem	Y	N	ARS, 2001; Gassich, 1995; Giri *et al*., 1996; Om *et al*., 1985
Rosellinia necatrix Prill. (Ascomycota: Xylariales)	IN, US	fruit, infl., leaf, stem	N	Y	CPC, 2001
Schizophyllum alneum (Basidiomycota: Schizophyllales)	IN, US	stem	N	N	ARS, 2001; Beeghly, 1999; Reddy, 1975
Schizophyllum commune Fr. = *S. radiatum* (Sw.) Fr. (Basidiomycota: Schizophyllales)	IN, US	none	N	N	ARS, 2001; Farr *et al*., 1989; Reddy, 1975

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Sclerotium rolfsii Sacc. (Mitosporic Fungi)	IN, US	seedling	N	N	Farr *et al.*, 1989; Beeghly, 1999; Prakash and Singh, 1976
Sclerotium rolfsii var. *delphinii* Boerema & Hamers = *Sclerotium delphinii* Welch (Mitosporic Fungi)	IN, US	seedling	N	N	Farr *et al.*, 1989; Beeghly, 1999; Singh, 1960
Stagonospora sp. (Mitosporic Fungi)	IN	leaf	Y	N	Beeghly, 1999; Singa and Singh, 1991
Stigmina mangiferae Ellis = *Cercospora mangiferae* Koord. (Ascomycota: Dothideales)	IN, US (FL, HI)	leaf	Y	N	ARS, 2001; CMI, 1992; Watson, 1999
Synchytrium macrosporum Karling (Chytridiomycota: Chytridiales)	IN, US	leaf, stem	N	N	Farr *et al.*, 1989; Beeghly, 1999; Walker, 1983
Thanatephorus cucumeris (Frank) Donk, anamorph = *Rhizoctonia solani* Kuhn (Basidiomycota: Ceratobasidiales)	IN, US	fruit, root	N	Y	Alfieri *et al.*, 1994; ARS, 2001; Farr *et al.*, 1989; Beeghly, 1999; Mordue, 1974
Tripospermum myrii (Lind.) Hughes (Ascomycota: Dothideales)	IN, US	fruit, infl., leaf, stem	N	Y	ARS, 2001; Farr *et al.*, 1989; Beeghly, 1999; Om and Prakesh, 1991
Nematodes					
Criconemella sp. (Tylenchida: Criconematidae)	IN	root	Y	N	CPC, 2001
Helicotylenchus dihystera (Cobb.) (Tylenchida: Tylenchidae)	IN, US	root	N	N	CPC, 2001
Helicotylenchus multicinctus Cobb. (Tylenchida: Tylenchidae)	IN, US	root	N	N	CPC, 2001
Hemicriconemoides mangiferae Siddiqi (Tylenchida: Criconematidae)	IN, US	root	N	N	CPC, 2001
Hoplolaimus indicus Sher. (Tylenchida: Hoplolaimidae)	IN	root	Y	N	CPC, 2001
Hoplolaimus seinhorsti Luc. (Tylenchida : Hoplolaimidae)	IN	root	Y	N	CPC, 2001

Appendix I: List of Pests Associated with Mango and Present in India

Pest	Geographic Distribution[7]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Meloidogyne incognita (Kofoid & White) (Tylenchida: Heteroderidae)	IN, US	root	N	N	CPC, 2001
Pratylenchus brachyurus (Godfrey) (Tylenchida: Pratylenchidae)	IN, US	root	N	N	CPC, 2001
Pratylenchus loosi Loof. (Tylenchida: Pratylenchidae)	IN	root	Y	N	CPC, 2001
Pratylenchus penetrans (Cobb) Filipjev & Stekhoven (Tylenchida: Pratylenchidae)	IN, US	root	N	N	CPC, 2001
Xiphinema americanum Cobb. (Dorylaimida: Longidoridae)	IN, US	root	N	N	CPC, 2001

[1]Nonreportable for the continental United States (APHIS-PPQ-Interceptions, 2006; NIS, 2006)

[2]Brackets ("[ ]") indicate that this is a quarantine significant species with limited distribution in the United States (APHIS-PPQ-Interceptions, 2006a, b; NIS, 2003, 2004a, b, c, d)

[3]Based on biology at the family level.

[4]Although the bacterium does not cause lesions on the fruit, this species colonizes host surfaces readily, so fruit would be likely to carry the bacterium (Cazorla *et al*., 1998).

[5]*Hendersonia creberrima* is only reported from India on mango fruit (Sydow *et al.*, 1916) and is not the same as the soft brown rot reported from South Africa (Sutton & Dyko, 1989; Farr *et al.*, 2005; Brodrick & Van der Westhuizen, 1978). The genus *Hendersonia* needs to be revised; placement of this species requires examination (Cline, 2006). It is not synonymous with the following species reported from mango: *Fusicoccum dimidiatum* (Penz.) D.F. Farr 2005, *Botryosphaeria dothidea* (Moug.:Fr.) Ces. & De Not. 1863, *Fusicoccum aesculi* Corda 1829, *Dothiorella dominicana* Petr. & Cif. 1930, nor *Cytosphaera mangiferae* Died. 1916 (Cline, 2006).

[6]The standard postharvest practice of washing mangoes to remove the latex that exudes from the cut stem (Morton, 1987; Seshadri, 2005) is expected to remove this pest from the pathway.

[7]IN = India; US = United States; CA = California; FL = Florida; HI = Hawaii; MS = Mississippi; TX = Texas (Individual U.S. states are listed only if the pest species is considered a quarantine pest for the United States).