Importation of Fresh Commercial Citrus Fruit: Clementine (*Citrus reticulata* Blanco var. Clementine) Mandarin (*Citrus reticulata* Blanco) and Tangerine (*Citrus reticulata* Blanco) from Chile into the United States

A Pathway Initiated Plant Pest Risk Assessment

March 2002
(Revised July 2002)
(Revised September 2002)
(Amended March 2004)

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1 INTRODUCTION

This plant pest risk assessment (PRA) was conducted in Chile by Servicio Agrícola y Ganadero (SAG), the National Plant Protection Organization (NPPO), of the Chilean Ministry of Agriculture and the Chilean Exporters Association (Asoex), through a research project with the participation of the Fruit Development Foundation (FDF). The PRA was prepared to analyze the risks posed to U.S. plant resources by the proposed importation of fresh commercial fruit of mandarin orange (*Citrus reticulata*), clementine (*Citrus reticulata* var. Clementine) and tangerine (*C. reticulata*) from Chile to United States, including the Hawaiian Islands.

On Thursday April 17, 2003 a single Medfly was captured in the Santiago Metropolitan Region, primarily in the Township of Maipu. This triggered the installation of additional traps in a 200 meter radius around the capture, and a delimiting survey was begun encompassing the equivalent of 6,400 hectares (or 64 square kilometers). On Monday April 21, 2003, a second Medfly capture was confirmed approximately 1,300 meters from the location of the first capture. Per the protocol between APHIS, PPQ and Servicio Agricola y Ganadero (SAG - Chile's national plant protection organization), once two adult flies are captured within 3 miles distance within one cycle, the trigger point for quarantine actions was reached.

As a result of this outbreak APHIS' Phytosanitary Issues Management Team requested that an addendum (**Appendix X**) be prepared to document the pest risk posed by Medfly, emergency procedures instituted by Chile and available phytosanitary treatments approved for citrus fruit from infested areas.

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

International plant protection organizations such as the North American Plant Protection Organization (NAPPO) and the International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO) provide guidance for conducting pest risk analyses. The methods used to initiate, conduct, and report this pest risk assessment are consistent with the guidelines provided by NAPPO, IPPC and FAO. The use of biological and phytosanitary terms conforms with the IPPC Glossary of Phytosanitary Terms (FAO, 2001a), the Definitions and Abbreviations (Introduction Section) in International Standards for Phytosanitary Measures, Publication No. 2: Guidelines for Pest Risk Analysis (FAO, 1996) and Definitions and Abbreviations (Introduction Section) in International Standards for Phytosanitary Measures, Publication No. 11: Guidelines for Pest Risk Analysis for Quarantine Pests (FAO, 2001b). These guidelines 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 the first two of these stages. Stage 3 is addressed in a separate risk management document entitled "Measures Suggested for Quarantine Pest Risk Management in Clementines, Mandarin Oranges and Tangerines exported from Chile to the Market of the United States, March

2002”.

Pest risk analysis encompasses risk assessment plus risk management (FAO, 2001a). Pest risk analysis is the overall process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated, and the strength of any phytosanitary measures that should be taken against that pest. Pest risk assessment determines if a pest is a quarantine pest and evaluates the risk associated with its introduction into a country (FAO, 2001a). Pest risk management involves the process of reducing the risk of introduction of a quarantine pest and leads to a decision of whether to import the commodity, and under what conditions (FAO, 2001a). In this document, the estimates of risk are expressed qualitatively (high, medium or low), and details of this risk assessment method are in the document: Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, Version 5.02 (PPQ, 2000). This document is available at:
<http://www.aphis.usda.gov/ppq/pra/commodity/cpraguide.pdf>.

Species of *Citrus* are the most important plants in the Rutaceae family and are also among the most important fruits worldwide. *Citrus* production is an important industry in both Chile and the United States. In Chile, 1,300 hectares are currently planted to mandarin oranges, clementines and tangerines. Most of these plantings are located between Region III and Region VI. Nearly 60 percent of the Chilean total production is concentrated in Region IV. Exports currently total 1,157,000 boxes and are mainly sent to European, Canadian, Far and Middle East markets. Chile hopes to export 250,000 boxes per year to the U.S. market. The proposed export season would extend from April through September.

1. Initiation

1.1. Resources at Risk

The species *Citrus reticulata* includes mandarin oranges, satsumas, clementines and tangerines (Floridata, 2000). Citrus is not native to the United States, and mandarin oranges from southern China were brought to the Americas in the 19th century (Floridata, 2000). Species of *Citrus* are commercially grown in Arizona, California, Florida, and Texas, and include grapefruit, lemons, limes, oranges, tangerines, tangelos, and temple oranges for either the fresh fruit market or for processing (NASS, 1997). The production, prices and value of production of citrus by state are summarized in Tables 1a through 1h in **Appendix I** (NASS, 1997).

1.2 Initiating Event / Proposed Action

This PRA is commodity-based, and therefore Apathway-initiated@; it was initiated in response to a request for USDA authorization to allow imports of a particular commodity presenting a potential plant pest risk. In this case, the importation of fresh mandarin orange (*Citrus reticulata*), clementine (*Citrus reticulata* var. Clementine) and tangerine (*C. reticulata*) fruits from Chile into United States is a potential pathway for the introduction of plant pests.

Chile has requested approval to export clementines, mandarins and tangerines to the continental United States and Hawaii. On at least five previous occasions, entry for other citrus commodities was denied because an appropriate treatment was not available for the grape flat mite (*Brevipalpus chilensis*) (see below). In 1991, entry of limes from Chile was approved with treatment for *B. chilensis*. That decision and those preceding it were made in the "Decision Sheet" format rather than the current PRA standard format. When the current request for clementines was made, Chile was informed that a PRA would be required. When given the option, Chile chose to conduct the PRA themselves. At least two previous drafts were received by APHIS and reviewed by various members of the Policy and Program Development (PPD) and PPQ staffs. The PRA document is accompanied by a risk management document prepared in Chile by the Fundacion para el Desarrollo Frutícola (FDF, 2002) entitled, "Measures Suggested for Quarantine Pest Risk Management in Clementines, Mandarin Oranges and Tangerines Exported from Chile to the Market of the United States of America."

1.3. Previous Regulatory Decision History

The regulatory decision record on import requests for fresh fruit of selected *Citrus* spp. from South and Central America are summarized in **Appendix II**. Between 1924 and 1997 there were approximately 30 requests. The bulk of these requests (18) were either denied or approved subject to a mandatory cold treatment for fruit flies. During this period, there were eight requests made to import fresh citrus fruit from Chile. As noted in **Table 1**, six of the eight requests were denied because of the lack of an acceptable treatment for the grape flat mite (*i.e., Brevipalpus chilensis*). To date, only lemons (1982) and limes (1994) have been approved entry from Chile subject to inspection and treatment (methyl bromide and soap wash).

Table 1. Regulatory Decision History for *Citrus* spp. From Chile

Date	Recommendation	Reason / Comment
***Citrus aurantifolia* (Lime)**		
1962	Disapproved	No acceptable treatment for *Brevipalpus chilensis*
1994	Approved	Subject to inspection and treatment for *B. chilensis*
***Citrus limon* (Lemon)**		
1971	Denied	Denied due to lack of a treatment for *B. chilensis*
1982	Approved	Subject to inspection and treatment for *B. chilensis*
***Citrus sinensis* (Orange)**		
1962	Denied	No acceptable treatment for *Brevipalpus chilensis*
Multiple *Citrus* species		
1979	Disapproved	No acceptable treatment available for *Brevipalpus chilensis*
1984	Disapproved	No acceptable treatment available for *Brevipalpus chilensis*
1993	Disapproved	No acceptable treatment available for *Brevipalpus chilensis*

1.4. Pest Interception History

The results obtained from a search of the USDA Port Information Network Pest Interception (PIN 309) Database are summarized in **Appendix III.** USDA made 133 interceptions of quarantine pests on citrus material from Chile between January, 1985 and July, 2002. The majority of interceptions were made in areas other than permit cargo shipments, primarily passenger baggage (38), ship's stores (69) and crew's quarters (13). The intercepted pests included, for example: *Xanthomonas campestris* pv. *citri* (Hasse), (= *X. axonopodis* pv. *citri* Vauterin) 1 time, *Guignardia citricarpa* Kiely 4 times, *Parlatoria ziziphi* Lucas 49 times, and *Elsinoë australis* Bitancourt.& Jenkins, 8 times. The interceptions of these pests were from passenger baggage, ship=s stores or crew=s quarters, but not from cargo fruit produced under the proposed or existing export programs. Multiple interceptions indicate that a potential pathway may exist for quarantine pests to enter the United States, but in this situation, the intercepted material cannot be directly linked to fruit produced nor are these pests reported elsewhere in the scientific literature to occur in Chile (CABI, 2001). Twelve interceptions were made in permit cargo including four interceptions of *Brevipalpus chilensis*, one interception of *Ceratitis capitata* and two interceptions of mealybugs identifiable only to the generic level.

2. Risk Assessment

2.1 Assessment of Weediness Potential

If the species considered for import poses a risk as a weed pest, then a "pest initiated" risk assessment is conducted. The results of the weediness screening for *Citrus* spp. do not prompt a pest initiated risk assessment because plants already present in the United States are not reported as weeds (**Appendix IV**).

2.2 Pests Associated with *Citrus* spp. in Chile

Appendix V lists the pests associated with *Citrus* spp. in Chile. The list identifies: (1) the presence or absence of the pests in the United States that attack citrus in Chile, (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 mandarin, clementine or tangerine fruit, and (5) pertinent citations for either the distribution or the biology of the pest. In light of pest biology and distribution, many organisms are eliminated from further consideration as sources of phytosanitary risk on mandarins, clementines or tangerines from Chile because they do not satisfy the definition of a quarantine pest.

A quarantine pest is defined as, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 2001a). Reports of harmful organisms associated with the commodity plant species indicate the organism is a pest of potential economic importance. A pest is likely to be transported on the mandarins, clementines or tangerines if the pest is present in Chile, the pest is associated with the fruit at the time of harvest, and the viable pest remains with 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, and this includes protected areas such as greenhouses. The presence of primary host species, alternate hosts, and vectors influences this determination.

Of the 75 listed citrus pests, 54 are arthropods, one is a bacterium, 13 are fungi, one is a nematode, two are mollusks, two are viroids and two are viruses. The majority of the arthropods were in two orders: Acarina (7) and Hemiptera (29). Of the total number of pests, 26 were identified as likely to follow the pathway.

2.3 Pest Categorization

The pests listed below satisfy the international standard that defines a quarantine pest: AA pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled@ (FAO, 2001a). Reports of harmful organisms associated with the commodity plant species indicate the organism is a pest of potential economic importance.

Arthropods	*Aleurothrixus porteri* (Quaint & Backer) *Anastrepha fraterculus* (Wiedemann) *Brevipalpus chilensis* (Baker) *Ceratitis capitata* (Wiedemann) *Cosmophillum pallidulum* (Blanchard) *Dexicatres robustus* (Blanchard) *Frankliniella australis* (Morgan) *Naupactus xanthographus* (Germar) *Neosilva grupo pendula* (Bezzi) *Paraleyrodes* sp. *Proeulia auraria* (Clarke) *Proeulia chrysopteris* (Butler) *Solenopsis gayi* (Spinola) *Toxoptera citricidus* (Kirkaldy) *Tettigades chilensis* Amyot & Serville.
Mollusks	*Deroceras* sp.

2.4 Quarantine Pests Likely to Follow the Pathway

Quarantine pests found in commercial shipments of clementine, mandarin and tangerine fruit from Chile require quarantine action when they are intercepted. Three quarantine pests; *Brevipalpus chilensis*, *Proeulia auraria* and *Proeulia chrysopteris* were selected for further analysis. 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 packing 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 of plant pest introduction on imports of commercial clementines, mandarins and tangerines from Chile. For example, fungi infecting leaves or stems are not expected to be transported with the fruit except as infrequent contaminants within commercial shipments.

The biological hazard of organisms identified only to the order, family or the generic level is not assessed, often because there are many species within a taxa. Lack of species identification may indicate the limits of the current taxonomic knowledge, the life stage or the quality of the specimen submitted for identification. In this risk assessment, this applies to the following genera: *Deroceras* sp. and *Paraleyrodes* sp. (**Appendix V**). By necessity, pest risk assessments focus on the organisms for which biological information is available. The lack of biological information on any given insect, mite or pathogen of a major crop where a large volume of information generally is available suggests that this pest does not present a high pest risk, but lack of information cannot be taken as proof of this supposition. The lack of identification at the specific level does not rule out the possibility that a dangerous pest or virulent pathogen was intercepted or that it was not a quarantine pest. Development of detailed assessments for known pests that inhabit a variety of ecological niches, such as internal fruit feeders or foliage pests, allow effective mitigation measures to eliminate the known organisms as well as similar but incompletely identified organisms that inhabit the same niche. If pests identified only to higher taxa are intercepted in the future, however, a reevaluation of their risk may occur. Regardless of whether they are analyzed, should any quarantine pests be intercepted on imported fruit, phytosanitary action may be taken.

Other plant pests listed in Appendix V that were not chosen for further scrutiny may be potentially detrimental to the agricultural systems of the United States. However, there were a variety of reasons for not subjecting them to further analysis, e.g., the primary association of the pest may be with plant parts other than the commodity; the pests may not be associated with the commodity during transport or processing because of their inherent mobility, sexually immature insect stages can be transported in a shipment but are unable to establish viable populations upon entry, the pests may be associated with the commodity as biological contaminants and are not expected to be present in every shipment.

A variety of insects feed, inhabit, or are associated with citrus fruit but are not likely to follow the pathway because they are highly visible during harvest. Often they are easily removed or disturbed during the growing season, at harvest or during packing procedures by hand, or they may escape from the commodity by flying away, falling to the ground or rapidly crawling from fruit to foliage.

Two quarantine significant fruit flies; *Anastrepha fraterculus* and *Ceratitis capitata* are listed in Appendix V as likely to follow the pathway. They were not considered for further analysis as they have been considered eradicated from Chile since 1964 and 1995, respectively (CABI, 2001). U.S. import regulations restrict the entry of fruits and vegetables from quarantine significant fruit fly countries except where certain requirements are met to ensure the establishment and maintenance of eradication. Those requirements include such measures as surveys to verify eradication, regulations to prevent reinfestation, *etc.* and are outlined in Title 7 Part 319 section 56-2 of United States Code of Federal Regulations. Chile has met those requirements for these two fruit flies.

2.5 Consequences of Introduction

This portion of the analysis considers negative outcomes that may occur when the quarantine pests identified as following the pathway of clementines, mandarins and tangerines from Chile are introduced into the entire continental United States and Hawaii. The potential consequences were evaluated using the following five Risk Elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These risk elements reflect the biology, host range and climatic and geographic distribution of each pest and are supported by biological information on each of the analyzed pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) based on the criteria as stated in the Guidelines (PPQ, 2000). A cumulative risk value is then calculated by summing the ratings. For each pest, the sum of the five risk elements produces a cumulative risk rating for the consequences of introduction. This cumulative rating is considered the biological indicator of the pest's potential to cause economic and environmental impacts. The ratings are summarized in **Table 2**.

Risk Element 1: Climate / Host Interaction

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants are present and the climates are similar. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (ARS, 1990; **Appendix VI**) where the pest could establish based on its known climatic range. The primary host for these pests, C. reticulata, is grown in three Plant Hardiness Zones, while other potential hosts, both cultivated and native, may occur throughout the United States (NRCS, 2001).

Brevipalpus chilensis

Brevipalpus chilensis is distributed from the III to the X Region of Chile (González, 1989). The climate information for these regions (**Appendix VII**) indicates that the annual minimum temperatures for these regions correspond to three U.S. Plant Hardiness Zones (9-11) (USDA, 1990). Potential to establish in three "Plant Hardiness Zone", results in a **Medium (2)** rating for the "Climate/Host Interaction" risk element.

Proeulia auraria and *Proeulia chrysopteris*

Proeulia auraria is distributed from the III to the VIII Region of Chile and *Proeulia chrysopteris* is distributed from the V to the VII Region (Artigas, 1994). The climate information for these regions (**Appendix VII**) indicates that the annual minimum temperatures for these regions correspond to three U.S. Plant Hardiness Zones (9-11) (USDA, 1990). Potential to establish in three "Plant Hardiness Zone", results in a **Medium (2)** rating for the "Climate/Host interaction" risk element

Risk Element 2: Host Range

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

Brevipalpus chilensis, *Proeulia auraria* and *Proeulia chrysopteris*

These three pest species all have hosts belonging to multiple plant families (see **Appendix IX** and Tables I and II in **Appendix VIII** for a list of reported hosts for these pests). Host ranges including multiple species in multiple families leads to a Pest Risk Potential rating of **High (3)** for the "Host Range" risk element.

Risk Element 3: Dispersal Potential

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pest's economic and environmental impact may be expressed within the importing country or region and is related to the pest's reproductive potential, inherent mobility, and dispersal facilitation. Factors for rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance.

Brevipalpus chilensis

This pest is multivoltine, with four to five generations per year (see **Appendix IX;** Gonzalez, 1968). The Tenuipalpidae family, as a whole is characterized as "slow moving" (Jeppson *et al*., 1975; Doreste, 1988). Dispersal of *B. chilensis* is primarily by plant contact and mites may also be moved by human contact with infested plants (**Appendix IX**; R. Ochoa, personal communication, 2002). *B. chilensis* is rated **Medium (2)** for the Dispersal Potential risk element.

Proeulia auraria and Proeulia chrysopteris

Two to four annual generations have been reported for *P. auraria* (Alvarez and Gonzalez, 1982; Campos *et al*., 1981). Adults can disperse locally by flight and although the distance is not known definitively, it is suspected that they move as much as 10 km (CABI, 2001). Movement of infested fruits should not be dismissed as a means of spread, although it should be noted that at harvest time, most, if not all larvae, have abandoned the fruit (CABI, 2001). Because these pests have multiple generations, are capable of flight of 10 km and as well as human-assisted spread, they are rated as **High (3)** for the Dispersal Potential risk element.

Risk Element 4: Economic Impact

Introduced pests cause a variety of direct and indirect economic impacts such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included whether the pest would: affect yield or commodity quality, cause plant mortality, act as a disease vector, increase costs of production including pest control costs, lower market prices, affect market availability, increase research or extension costs, or reduce recreational land use or aesthetic value.

Brevipalpus chilensis

Brevipalpus chilensis preferably attacks *Vitis vinifera* varieties. Jeppson *et al.* (1975) describes *B. chilensis* as "…a very destructive pest of grapevines…It also attacks several different species of fruit, forest trees, ornamentals and even annual weeds." Gallasch *et al.* (1999) rated the economic impact of *B. chilensis* as "high", again on *Vitis*. At high population levels, *B. chilensis* kills buds as a result of tissue dehydration. It also causes bronzing and curling of leaves, necrosis and dehydration of the rachis and stem. New leaves are smaller in size and the new canes are shorter resulting in a reduction of yield (**Appendix IX**). In other host plants, like kiwi fruits, citrus and cherimoya there is no evidence of economic impact (**Appendix IX**; Peralta, *et al.*). Chemical controls already in use for other, similar mite species (University of California, 1991) would likely control *B. chilensis* as well.

According to the USDA export certification database (EXCERPT, 2002), Korea and South Africa both list *B. chilensis* as a pest of concern. South Africa specifically requires a declaration of freedom from *B. chilensis* for imports of California grapes. Introduction of *B. chilensis* could potentially impact these and other U.S. export markets.

Because *B. chilensis* has the potential to cause yield losses as well as the loss of foreign markets, it is rated as **Medium (2)** for the Economic Impact risk element.

Proeulia auraria and *Proeulia chrysopteris*

The genus *Proeulia* is considered an emergent pest problem of fruit trees and vineyards. *Proeulia* spp. have moved at a rather slow pace from their natural habitat into crop systems, including berries and ornamental trees (CABI, 2001). Larvae are external feeders on flowers, fruits, leaves and shoots and leaf folders (CABI, 2001). At present, the damage to flowers and young fruits on pome and stone fruits is partly controlled in Chile with some organophosphates, carbamates and/or tebufenozide but average dosages against codling moth are not sufficient to control third- to fourth-*Proeulia* larval instars (CABI, 2001). This suggests that specific controls might have to be employed if these pests were introduced resulting in increased costs to producers.

P. auraria is specifically of quarantine significance to China, Korea Republic, Taiwan and Canada. *P. chrysopteris*, as well as all other related species are of quarantine concern to a number of countries, including the USA, China, Korea Republic, Japan and Mexico (CABI, 2001).

Because *P. auraria* and *P. chrysopteris* potentially reduce the yield and value of crops through external feeding, may potentially increase production costs by triggering specific controls and of are quarantine significance to important trading partners, these pests are rated **High (3)** for the Economic Impact risk element.

Risk Element 5: Environmental Impact

The ratings for environmental impact were based on three aspects. The first aspect is whether there may be an interaction with species that are listed as Threatened or Endangered (Title 50 Part 17 Section 11-12, United States Code of Federal Regulations). The second aspect is whether the pest appears capable of disrupting native plants based on the pest's habits exhibited within its current geographic range. The third aspect is whether the pest's presence will stimulate the need for chemical or biological control programs.

Brevipalpus chilensis, *Proeulia auraria* and *Proeulia chrysopteris*

Primary hosts of *B. chilensis*, such as grapes (*Vitis*), *Citrus* and privet (*Ligustrum*), grow throughout the climatically suitable range of this pest (See **Appendix IX**; CABI, 2001; Prado, 1991; Ripa and Rodriguez, 1999). Additional primary hosts of *P. auraria* and *P. chrysopteris* (such as kiwi and fleshy-fruited plants of family Rosaceae) occur within this region. In addition, the southern tier of the United States contains at least one or more introduced or native plant species that share genera with reported hosts (NRCS, 2001; Kartesz, 1998; Wunderlin and Hansen, 2001). These plants could become hosts and incur negative impacts if infested by *B. chilensis*, *P. auraria*, and *P. chrysopteris*. *B. chilensis* and the *Proeulia* species feed on leaves, growing shoots, the inflorescence and fruits/pods; individual plants may incur reduced vigor and reproductive viability. None of the reported host species for *B. chilensis* and the *Proeulia* species appears on the list of threatened and endangered plants (USFWS, 2002). *Potential* hosts *may* include threatened and endangered plants (USFWS, 2002) that are growing within the climatically suitable range of these pests. Examples of such species are the endangered *Prunus geniculata* and the threatened *Ribes echinellum* of Florida, where pest reservoirs (commercial and backyard fruit) and ports of entry are nearby. See **Appendix VIII**, Table 1 and 2, for reported hosts of *B. chilensis*, *P. auraria*, and *P. chrysopteris* and threatened and endangered plants within host genera and families.

Potential hosts of *B. chilensis* and the *Proeulia* species may also include threatened and endangered plants (USFWS, 2002) that are growing within the climatically suitable range of these pests. Identification of these plants is part of the guidelines criteria (PPQ, 2000), and only the possibility of an extension of a host range may be inferred (Cave, 2000). Because chemical control programs used for domestic mite species (PMG, 2002) would likely control *B. chilensis*, but as noted above in the Economic Impacts discussion, *Proeulia* species may require specific control programs, *B. chilensis* is rated **Medium (2)** for the Environmental Impacts risk element and the *Proeulia* species are rated **High (3)**.

Table 2. Risk Rating for Consequences of Introduction

Pest	Risk Element 1 **Climate / Host Interaction**	Risk Element 2 **Host Range**	Risk Element 3 **Dispersal Potential**	Risk Element 4 **Economic Impact**	Risk Element 5 **Environ-mental Impact**	**Cumulative Risk Rating[1]**

Brevipalpus chilensis	Medium (2)	High (3)	Medium (2)	Medium (2)	Medium (2)	**Medium (11)**
Proeulia auraria	Medium (2)	High (3)	High (3)	High (3)	High (3)	**High (14)**
Proeulia chrysopteris	Medium (2)	High (3)	High (3)	High (3)	High (3)	**High (14)**
[1] Low = 5 to 8; Medium = 9 to 12; High = 13 to 15						

2.6 Likelihood of Introduction

We rate each pest with respect to introduction (i.e., entry and establishment) potential. We consider two separate components. First, we estimate the amount of commodity likely to be imported. More imports lead to greater risk; the result is a risk rating that applies to the commodity and country in question and is the same for all quarantine pests considered. Second, we consider five biological features (i.e., sub elements) concerning the pest and its interactions with the commodity. The resulting risk ratings are specific to each pest. Details of elements and rating criteria are provided in USDA (2000). For each pest, the sum of the sub elements produces a cumulative risk rating for likelihood of introduction. The cumulative risk rating for introduction is considered to be an indicator of the likelihood that a particular pest would be introduced. These ratings and the value for the Likelihood of Introduction are summarized in **Table 4**.

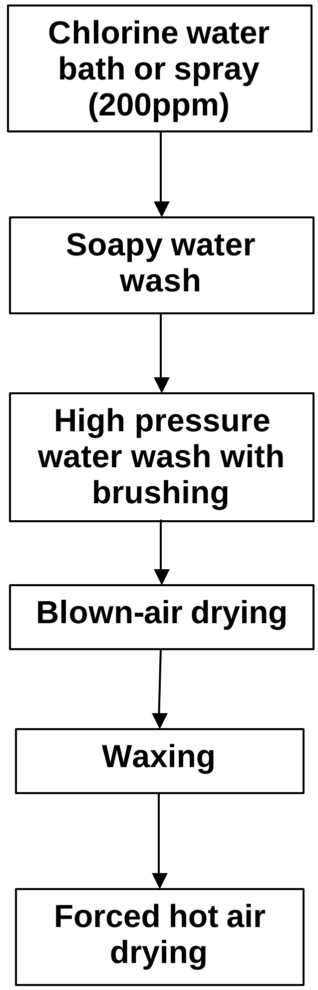
Sub Element 1: Quantity of commodity imported annually

Brevipalpus chilensis, Proeulia auraria and Proeulia chrysopteris

Chilean exporters estimate that exports of clementines, mandarins and tangerines would total 250,000 boxes a year. They also estimate that 40 percent of the boxes would be 10 to 15 kg cardboard boxes and the remaining 60 percent would be 2.3 kg wood boxes. This translates to a predicted volume of approximately 60 to 70 standard 40-foot shipping containers annually, based on a conversion factor of 20 metric tons per 40-foot shipping container (Cargo Systems, 2001). The quantity of commodity imported is estimated to fall within the range of 10 to 100 containers per year, so the Quantity Imported Annually is rated **Medium (2)** for all of the pests.

Sub Element 2: Survive postharvest treatment

Postharvest treatments include culling, washing and chemical treatments (such as waxing) that impact pest survival. This sub element evaluates the efficacy of postharvest treatments in terms of the mortality of pests exposed to the treatments. Chilean citrus harvests are, in general, selective; fruit for export is clipped, not snapped, and the pickers selectively pick fruit that meets quality standards for shape, rind blemishes, etc. (Gallasch, *et al.*, 1999). The fruit is generally placed in picking bags and then dumped carefully into 400 kg bins. Picked fruit is usually cured for 24 hours at the farm (Gallasch, *et al.*, 1999). Once it reaches the packinghouse, the following treatments are considered standard packing procedures (Castro and Astudillo, 2000; L∴pez, E. and Parra, B., 2001; Castro and Astudillo, 2001):



Brevipalpus chilensis

In the normal fruit packing process, the fruit undergoes the steps outlined above resulting in a significant reduction in the population of *Brevipalpus* mites. Three specific studies conducted by the Fundacion para el Desarrollo Frutícola (Foundation for Fruit Development) and the Universidad Católica de Valparaiso, Chile (Catholic University of Valparaiso, Chile) estimated the efficacy of these packing procedures on the mite's removal (Castro and Astudillo, 2000; Lopez and Parra, 2001; Castro and Astudillo, 2001). The efficacy results ranged from 79.9 percent to 89.7 percent. According to these studies, the normal packing process results in significant removal of *Brevipalpus* mites, however, mites hidden under the pedicel disk can survive the packing process. These studies suggested as many as 20 percent of mites survived the packing process. The potential for a 20 percent survival rate supports a rating of **High (3)** for the Survives Postharvest Treatment sub element.

Proeulia auraria and Proeulia chrysopteris

Proeulia species are external fruit feeders (**Appendix IX**; CABI, 2001) and according to CABI (2001) "Larvae are rarely found in the commodity, since they are easily disturbed and abandon the feeding source. Pupae are never found." Considering the morphology of the fruit and the rigorous packing process (as described above) it seems unlikely that the pests would either remain with the fruit or survive the packing process although *P. auraria* has, however, been found at inspection hidden at the pedicel base of apricots, a fruit which does not undergo a washing process (CABI, 2001). The conclusion that it is unlikely *Proeulia* species will survive treatment can be inferred from data in the USDA Port Information Network Pest Interception (PIN 309) Database. These data indicate that since 1994, there has been just one interception of *Proeulia* in over 5500 shipments of Chilean asparagus. During that time period, the United States imported approximately 25,000 metric tons of Chilean asparagus (Reports of Imported Regulated Articles in the PPQ 280 Database). The single interception occurred despite the fact that asparagus receives a considerably less rigorous postharvest treatment than citrus, and *Proeulia* produce external feeding scars and associated silk that are quite noticeable on infested fruits (CABI, 2001). Similar interception histories exist for raspberries and blueberries, the only other commodities in which *Proeulia* species have been intercepted. Both *Proeulia* species were rated **Low (1)** for the sub-element Survives Postharvest Treatment.

Sub Element 3: Survive shipment

This sub-element evaluates the mortality of the pest population during shipment of the commodity. Shipments of clementines, mandarins and tangerines are likely to be refrigerated and spend two to four weeks in transit to the United States (Container Shipping, 2002).

Brevipalpus chilensis

Jadue, *et al.* (1996) demonstrated that at least some *B. chilensis* individuals survive temperatures of 0 to 2°C for a period of 15 days. Data in the USDA Port Information Network Pest Interception (PIN 309) Database indicate that since 1994, there have been 155 interceptions of *B. chilensis* at U.S. ports of entry (**Table 3**). Based on this evidence, *B. chilensis* was rated **High (3)** for the Survives Shipment sub-element.

Table 3. Interceptions of *B. chilensis*, 1994-2002		
ORIGIN	**HOST**	**TOTAL**
CHILE	*Actinidia chinensis*	26
CHILE	*Actinidia* sp.	2
CHILE	*Citrus limon*	6
CHILE	*Vitis* sp.	119
JAMAICA	*Vanilla* sp.	1
UNKNOWN	At Large	1
SUM		155

Proeulia auraria and *Proeulia chrysopteris*

Mature larvae of *P. auraria* die after 2 to 3 weeks of cold storage. Conversely, the first-instar overwintering larva hidden on plant parts may withstand cold conditions (6-8°C) for over a month (CABI, 2001). Since 1985, there were only five interceptions of *Proeulia* species (USDA Port Information Network Pest Interception (PIN 309) Database). All five interceptions were made on Chilean commodities: one interception each on asparagus and blueberries and three interceptions on raspberries. The low number of interceptions of these relatively detectable (CABI, 2001) insects may suggest that they do not survive shipment. Because these pests have been intercepted, but intercepted relatively infrequently, both *Proeulia* species are rated **Medium (2)** for the Survives Shipment sub element.

Sub Element 4: Not detected at the port of entry

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

Brevipalpus chilensis

The USDA in Chile implemented a method known as "dragging by washing" for the detection of *B. chilensis* in kiwi fruit destined for the United States. This method is currently used in the Chilean kiwi export program for the certification of low prevalence orchards and the phytosanitary preclearance inspection of kiwis. The dragging method was evaluated for mandarin oranges, clementines and tangerines and shown to have 95.6 percent efficacy (FDF, 2002). However, the "dragging and washing" technique is used for export phytosanitary clearance inspections in Chile and is not routinely employed for port of entry inspections.

Childers (1994) described mites in the genus *Brevipalpus* as "…not readily detected because of their small size and sluggish behavior. They are about 260 µm in length…" Likewise, Jeppson, *et al.* (1975) described the closely related species, *B. californicus,* as "…difficult to see because they lie flat against the leaf surface and are slow to move…" On the other hand, APHIS inspectors have intercepted *B. chilensis* 155 times since 1994. This would indicate that port inspectors are reasonably able to detect this pest. Because *Brevipalpus* mites, including *B. chilensis* are small, slow moving and lie flat against plant surfaces, but port inspectors have still demonstrated a reasonable ability to detect them we rated this pest as **Medium (2)** for the Pest Not Detected at Port of Entry sub-element.

Proeulia auraria and Proeulia chrysopteris

In a standard visual inspection, these species are easy to detect because they are external feeders. "Larvae can be inspected on the crop by examining webbed flower clusters, folded leaves or fruits with attached leaves where they produce external scars and some webbing where mature larvae are hidden…external feeding scars and associated silk are quite noticeable on infested fruits and they are rejected for packing. *P. auraria* has, however, been found at inspection hidden at the pedicel base of apricots, a fruit which does not undergo a washing process" (CABI, 2001). Because the *Proeulia* species are readily detected, we rated them as **Low (1)** for the Not Detected at Port of Entry sub-element.

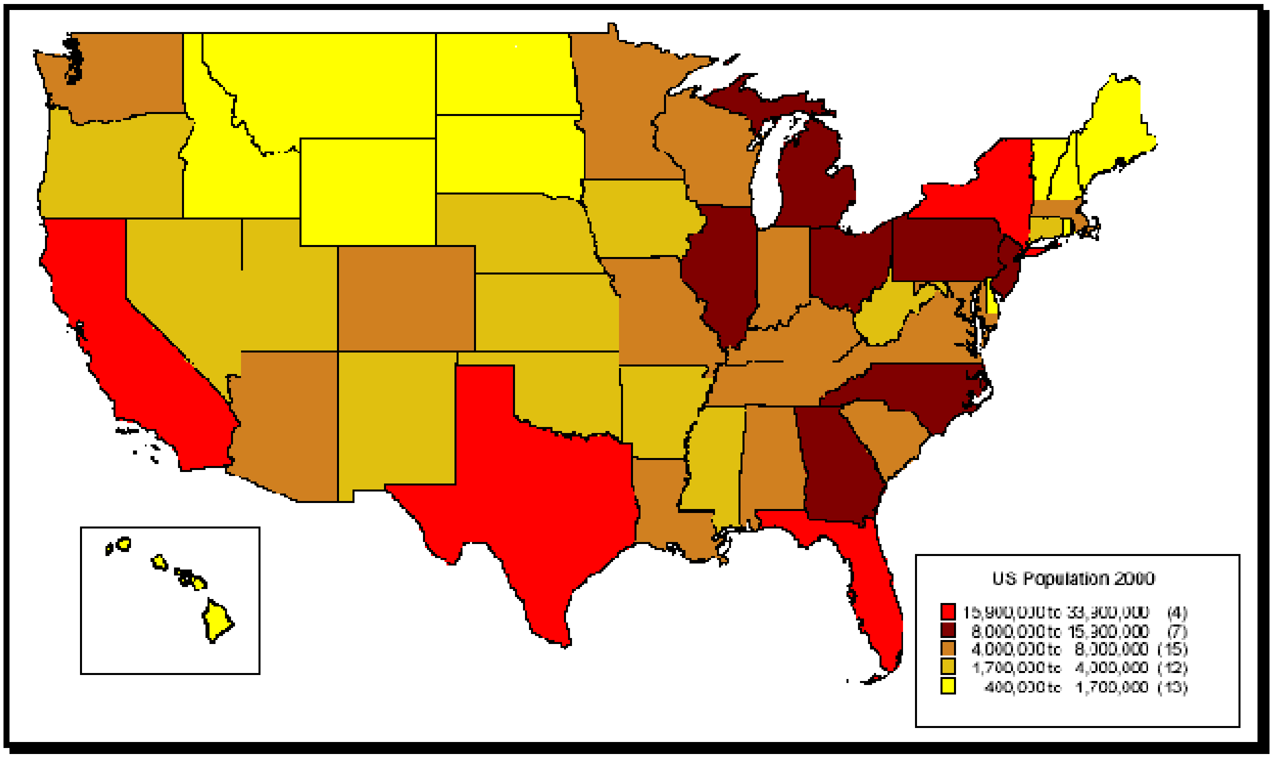
Sub Element 5: Moves to Suitable Habitat

This sub element considers the geographic location of likely markets and the chance of the commodity to move to locations suitable for the pest's survival. Fruit that arrives in the United States does not normally arrive at a single port; instead, it is distributed according to market demand. Demographics derived from United States Census data may be useful in predicting the distribution of imported citrus fruit by indicating population centers where demand may be greatest (**Figure 1**).

Brevipalpus chilensis, *Proeulia auraria* and *Proeulia chrysopteris*

Figure 1 indicates that three of the four most populous States in the United States are in the southern tier of States where the climate most closely resembles the native climates for these pests. According to United States Census data, these three States account for approximately 25 percent of the total U.S. population (U.S. Census, 2000). If we assume that Chilean citrus is distributed proportionally across the United States according to population, the rating for all three pests for the Moves to Suitable Habitat sub element is **High (3)**.

Figure 1. United States Population- 2000 (U.S. Census, 2000)



Sub Element 6: Come Into Contact with Host Material Suitable for Reproduction

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. The complete host range of the pest should be considered. According to the FAO standard for pest risk analysis (FAO, 2001b) other factors that may 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 destination points in the PRA area
- Proximity of entry, transit and destination points to suitable hosts
- Time of year at which import takes place
- Intended use of the commodity (e.g. for planting, processing and consumption)
- Risks from by-products and waste.

Brevipalpus chilensis

The reported host range of *B. chilensis*, while it is distributed over a broad range of taxa, is still relatively small. It does, however, include the genera *Convolvulus* and *Ribes* (**Appendix VIII**), both of which have common and widely distributed members (ARS, 2001). *Convolvulus arvensis*, field bindweed, is found in 49 States. As stated above in **Section 2.5**, dispersal of *B. chilensis* is primarily by plant contact though mites may also be moved by human contact with infested plants (**Appendix IX**; R. Ochoa, personal communication, 2002). Chile is requesting permission for import to all ports of the United States and the proposed shipping season extends from April to September. Suitable hosts would be available throughout the shipping season in most of the United States. The mite tends to remain on the fruit. It only moves away if the substrate dehydrates (as might occur if the fruit is peeled for eating and the peel is discarded). Such behavior has been observed when citrus fruits are artificially infested with *B. chilensis* from *Ligustrum sinensis* leaves (Castro and Astudillo, 2001).

Based on host availability, the ability of the mite to be dispersed with human assistance but its limited capability to disperse on its own, we rated *B. chilensis* **Medium (2)** for the Come into Contact with Host Materials Suitable for Reproduction sub element.

Proeulia auraria and *Proeulia chrysopteris*

The number of hosts for these pests is similar to the number of hosts for *B. chilensis*, however, their host ranges are primarily cultivated plants and none of the hosts are as widely distributed as *Convolvulus*, for example. These hosts would be available during the proposed shipping season throughout the United States. According to CABI (2001), pupation does not take place in fruits, so larvae (rather than adult moths would have to disperse) to suitable hosts for pupation. This would tend to reduce the dispersal potential of these pests and reduce their likelihood of reaching suitable hosts. As stated above for *B. chilensis*, hosts would be available during the proposed shipping season throughout the United States. Based on host availability and the limited dispersal capability of the larvae, we rated the *Proeulia* species as **Low (1)** for the Come into Contact with Host Materials Suitable for Reproduction sub element.

Table 4. Risk Rating for Likelihood of Introduction		
	Risk Element 6 **Pest Opportunity**	

Pest	Sub Element 1 **Quantity imported annually**	Sub Element 2 **Survives post harvest treatment**	Sub Element 3 **Survives shipment**	Sub Element 4 **Not detected at Port of entry**	Sub Element 5 **Moves to suitable habitat**	Sub Element 6 **Contact with host material**	**Cumulative Risk Rating**[1]
Brevipalpus chilensis	Medium (2)	High (3)	High (3)	Medium (2)	High (3)	Medium (2)	**High (15)**
Proeulia auraria	Medium (2)	Low (1)	Medium (2)	Low (1)	High (3)	Low (1)	**Medium (10)**
Proeulia chrysopteris	Medium (2)	Low (1)	Medium (2)	Low (1)	High (3)	Low (1)	**Medium (10)**
[1]Low = 6 to 9; Medium = 10 to 14; High = 15 to 18							

2.7 Pest Risk Potential / Conclusion

The sum of the values for the Consequences of Introduction and the Likelihood of Introduction produce the Baseline Pest Risk Potential (PRP) value. This cumulative total expresses the risk on the following scale: **Low** = 11 to18, **Medium** = 19 to 26 and **High** = 27 to 33. The Baseline PRP for each quarantine pest is summarized in **Table 5**.

Table 5. Pest Risk Potential			

Pest	Consequences of Introduction Cumulative Risk Rating	Likelihood of Introduction Cumulative Risk Rating	Pest Risk Potential (Total)
Brevipalpus chilensis	**Medium (11)**	**High (15)**	**Medium (26)**
Proeulia auraria	**High (14)**	**Medium (10)**	**Medium (24)**
Proeulia chrysopteris	**High (14)**	**Medium (10)**	**Medium (24)**

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

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

Medium: Specific phytosanitary measure may be necessary.

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

Identification and selection of appropriate sanitary and phytosanitary measures to mitigate risk for pests with particular Pest Risk Potential ratings is undertaken as part of the risk management phase, FAO Stage 3 (FAO, 1996, 2001b).

3. Risk Management

Pest risk management is the decision-making process of reducing the risk of introduction of a quarantine pest (FAO, 1996). The reduction of phytosanitary risk occurs through the use of mitigation measures that are designed to eliminate, reduce, or prevent the presence of pest populations in shipments of commodities primarily in the country of origin. The appropriate risk management strategy for a particular pest depends on the risk posed by that pest. APHIS risk management programs are risk based and dependent on the availability of appropriate mitigation methods. Details of APHIS risk management programs are published, primarily, in the Federal Register as quarantine notices. While the selection and evaluation of appropriate risk management measures for *B. chilensis, P. auraria* and *P. chrysopteris* on imported Chilean clementines, mandarins and tangerines are outside the scope of this document, the authors wish to draw the reader's attention to the following facts:

As noted above in **Section 2.6**, in a standard visual inspection, *P. auraria* and *P. chrysopteris* are easy to detect because they are external feeders. Consequently, U.S. import regulations currently permit importation of certain fruits from Chile (*e.g.,* apricots, nectarines, plums, plumcots and peaches) with a preclearance inspection to certify freedom from *Proeulia* species (Title 7 Code of

Federal Regulations Part 319 Section 56-2s).

Because *B. chilensis* may be more difficult to detect, USDA has required specific treatment(s) prior to entry for fruit hosts of this pest (*e.g*, cherimoya; Title 7 Code of Federal Regulations Part 319 Section 56-2z). In anticipation of such a requirement for clementines, mandarins and tangerines, the Chilean Servicio Agrícola y Ganadero, in cooperation with the Fundacion para el Desarrollo Frutícola, produced a risk management document entitled "Measures Suggested for Quarantine Pest Risk Management in Clementines, Mandarin Oranges and Tangerines exported from Chile to the Market of the United States, March 2002". This document describes a risk management program for *B. chilensis* proposed by Chile. The risk management document has not been revised by USDA, APHIS and is presented, along with this draft risk assessment, for public comment as part of the current Federal Register Notice of Availability.

Acknowledgements

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Appendix I. Production, prices and value of production of citrus by State (NASS, 2001)

Table 1a. Citrus Production in Florida, Average 1998/99-2000/01.

Type of Citrus	Bearing Acreage	Use of Production (in thousands of boxes)		Total (in thousands of boxes)
		Fresh	Processed	
Orange	606567	9,959	204,141	214,100
Grapefruit	112,833	18,534	30,282	48,817
K-early citrus	200	20	57	77
Lime	2,233	377	73	450
Tangelo	11,267	772	1,511	2,183
Tangerine	26,300	3,919	1,931	5,850
Temple	5,767	463	1,204	1,667
Total	765167			

Table 1b. Price and Value of Citrus Production in Florida, Average 1998/99-2000/01

Type of Citrus	Price per Box (Dollars)		Value of Production (in thousands of dollars)		
	Fresh	Processed	Fresh	Processed	Total
Orange	8.18	5.56	82,585	1,124,470	1,207,055
Grapefruit	7.51	3.34	139,029	103,917	242,946
K-early citrus	7.17	2.69	141	158	300
Lime	19.77	2.19	7,471	159	7,630
Tangelo	8.0	3.95	6,237	6,186	12,422
Tangerine	15.57	5.18	60,302	9,742	70,044
Temple	8.7	3.99	4,200	4,907	9,107
Total			299965	1249539	1549504

Table 1c. Citrus Production in California, 1998/99-2000-2001

Type of Citrus	Bearing Acreage	Use of Production (in thousands of boxes)		Total (in thousands of boxes)
		Fresh	Processed	
Orange	197,167	37,733	15,267	53,000
Grapefruit	16,200	5,946	1,054	7,000
Lemon	48,833	10,978	8,322	19,300
Tangerine	8,667	1,464	569	2,033
Total	270867			

Table 1d. Price and Value of Citrus Production in California, Average 1998/99-2000/01

Type of Citrus	Price per Box (Dollars)		Value of Production (in thousands of dollars)		
	Fresh	Processed	Fresh	Processed	Total
Orange	12.90	0.40	430,273	6,882	437,155
Grapefruit	10.59	_0.49	63,234	_589	62,646
Lemon	19.91	0.90	218,194	7,008	225,201
Tangerine	18.32	0.23	26,406	81	26,487
Total			738107	13382	751489

Table 1e. Citrus Production in Arizona, Average 1998/99-2000/01

Type of Citrus	Bearing Acreage	Use of Production (in thousands of boxes)		Total (in thousands of boxes)
		Fresh	Processed	
Orange	6,433	815	235	1,050
Grapefruit	2,700	305	179	483
Lemon	14,233	2,088	1,296	3,383
Tangerine	5,800	593	224	817
Total	29166			

Table 1f. Price and Value of Production of Citrus in Arizona, 1998/99-2000-01

Type of Citrus	Price per Box (Dollars)		Value of Production (in thousands of dollars)		
	Fresh	Processed	Fresh	Processed	Total
Orange	11.88	0.53	10,134	130	10,263
Grapefruit	7.36	_0.52	2,426	_85	2,341
Lemon	17.55	0.84	36,944	968	37,912
Tangerine	18.89	0.32	11,387	74	11,461
Total			60891	1087	61977

Table 1g. Citrus Production in Texas, Average 1998/99-2000/01

Type of Citrus	Bearing Acreage	Use of Production (in thousands of boxes)		Total (in thousands of boxes)
		Fresh	Processed	
Orange	9,100	1,223	552	1,775
Grapefruit	20,000	4,005	2,405	6,410
Total	29,100			

Table 1h. Price and Value of Production of Citrus in Texas, 1998/99-2000-01

Type of Citrus	Price per Box (Dollars)	Value of Production (in thousands of dollars)

	Fresh	Processed	Fresh	Processed	Total
Orange	6.35	2.60	7,616	1,337	8,953
Grapefruit	7.03	1.17	28,062	2,596	30,658
Total			35,678	3,933	39,611

Appendix II. Regulatory Decision History

Country	Date	Recommendation	Reason / Comment
***Citrus aurantifolia* (Lime)**			
Chile	**1962**	**Disapproved**	**No acceptable treatment for *Brevipalpus chilensis***
Chile	**1994**	**Approved**	**Subject to inspection and treatment for *B. chilensis***
***Citrus limon* (Lemon)**			
Chile	**1971**	**Denied**	**Denied due to lack of a treatment for *Brevipalpus chilensis.***
Chile	**1982**	**Approved**	**Subject to inspection and treatment for *B. chilensis***
***Citrus* x *paradisi* (Grapefruit)**			
Brazil	1924	Denied	Denied because of the presence of several different fruit flies
Panama	1928	Denied	Denied because of the presence of several different fruit flies
Peru	1928	Denied	Denied because of the presence of several different fruit flies especially *Anastrepha peruviana* (=*A. fraterculus*)
Bolivia	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha fraterculus* and *Ceratitis capitata*
Venezuela	1964	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Ecuador	1970	Approved	Entry approved through North Atlantic ports subject to cold treatment
***Citrus reticulata* (Clementine, Mandarin, Tangerine, Unshu)**			
Ecuador	1970	Approved	Entry approved through North Atlantic ports subject to cold treatment
***Citrus sinensis* (Orange)**			
Brazil	1924	Denied	Denied primarily because of the presence of several different fruit flies
Ecuador	1926	Denied	Denied primarily because of the presence of several different fruit flies

Country	Date	Recommendation	Reason / Comment
Peru	1928	Denied	Denied because of the presence of several different fruit flies especially *Anastrepha peruviana* (=*A. fraterculus*)
Uruguay	1930	Denied	Denied primarily because of the presence of several different fruit flies
Ecuador	1935	Approved	Entry approved only at New York and Boston and only for transshipping to Europe
Chile	**1962**	**Denied**	**No acceptable treatment for *Brevipalpus chilensis***
Venezuela	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Venezuela	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Bolivia	1963	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Ecuador	1964	Approved	Entry approved through the Port of New York subject to cold treatment for *Anastrepha* fruit flies
Multiple *Citrus* species			
Colombia	1963	Approved	Oranges, grapefruits, tangerines approved entry through Port of New York subject to cold treatment for *Anastrepha* fruit flies.
Peru	1969	Disapproved	No approved treatments for South American *Anastrepha* fruit flies
Venezuela	1974	Approved	Oranges, grapefruit and tangerine approved entry into Seattle or New York subject to cold treatment for fruit flies
Peru	1974	Disapproved	*Guignardia citricarpa* (citrus black spot) reported in the literature to occur in Peru
Chile	**1979**	**Disapproved**	**No acceptable treatment available for *Brevipalpus chilensis***
Chile	**1984**	**Disapproved**	**No acceptable treatment available for *Brevipalpus chilensis***
Peru	1988	Disapproved	No acceptable treatment or inspection for *Guignardia citricarpa* (citrus black spot)

Country	Date	Recommendation	Reason / Comment
Chile	**1993**	**Disapproved**	**No acceptable treatment available for *Brevipalpus chilensis***
Argentina	1997	Disapproved	No available treatment for *Elsinoë australis*, *Guignardia citricarpa* and *Xanthomonas campestris* pv. *citri*

Appendix III. Pest Interceptions: Citrus from Chile, 1985-2002

HOST	PEST	WHERE	TOTAL
Citrus sp. (Fruit)	Acutaspis sp.	Baggage	1
Citrus sp. (Leaf)	Aleurothrixus	Baggage	1
Citrus sp. (Fruit)	Anastrepha sp.	Stores	1
Citrus sp. (Leaf)	Aphididae, Species of	Baggage	1
Citrus sinensis (Fruit)	Ascochyta citri	Stores	1
Citrus limon (Fruit)	Brevipalpus chilensis	Quarters	1
Citrus limon (Fruit)	Brevipalpus chilensis	Stores	1
Citrus limon (Fruit)	Brevipalpus chilensis	Permit Cargo	4
Citrus sp. (Leaf)	Brevipalpus sp.	Baggage	1
Citrus sinensis (Fruit)	Ceratitis capitata	Baggage	1
Citrus reticulata	Ceratitis capitata	Permit Cargo	1
Citrus limon (Fruit)	Cladosporium sp.	Permit Cargo	1
Citrus sp. (Fruit)	Cladosporium sp.	Baggage	1
Citrus sinensis (Leaf)	Coccidae, Species of	Stores	1
Citrus limon (Fruit)	Coccidae, Species of	Permit Cargo	1
Citrus limon (Fruit)	Colletotrichum sp.	Stores	1
Citrus sp. (Fruit)	Diaspididae, Species of	Stores	1
Citrus sinensis (Fruit)	Diaspididae, Species of	Quarters	1
Citrus sinensis (Fruit)	Elsinoë australis	Stores	3
Citrus sinensis (Fruit)	Elsinoë australis	Stores	1
Citrus sinensis (Fruit)	Elsinoë australis	Stores	1
Citrus sinensis (Fruit)	Elsinoë australis	Baggage	1
Citrus sp. (Fruit)	Elsinoë australis	Baggage	1
Citrus sp. (Fruit)	Elsinoë australis	Stores	1
Citrus sp. (Fruit)	Elsinoë sp.	Stores	1

HOST	**PEST**	**WHERE**	**TOTAL**
Citrus sp. (Leaf)	Geometridae, Species of	Baggage	1
Citrus reticulata (Fruit)	Guignardia citricarpa	Stores	1
Citrus sp.	Guignardia citricarpa	Baggage	1
Citrus sp. (Fruit)	Guignardia citricarpa	Baggage	1
Citrus limon (Fruit)	Guignardia citricarpa	Stores	1
Citrus aurantiifolia (Fruit)	Parlatoria cinerea	Quarters	1
Citrus limon (Fruit)	Parlatoria cinerea	Stores	2
Citrus sinensis (Fruit)	Parlatoria cinerea	Baggage	3
Citrus sp. (Fruit)	Parlatoria cinerea	Quarters	1
Citrus sp. (Fruit)	Parlatoria cinerea	Baggage	3
Citrus sinensis (Fruit)	Parlatoria cinerea	Stores	7
Citrus sinensis (Fruit)	Parlatoria cinerea	Stores	1
Citrus sp. (Fruit)	Parlatoria cinerea	Stores	9
Citrus aurantiifolia (Fruit)	Parlatoria ziziphi	Baggage	1
Citrus sinensis (Fruit)	Parlatoria ziziphi	Baggage	2
Citrus sp. (Fruit)	Parlatoria ziziphi	Stores	3
Citrus sp. (Fruit)	Parlatoria ziziphi	Baggage	14
Citrus limon	Parlatoria ziziphi	Stores	1
Citrus sinensis (Fruit)	Parlatoria ziziphi	Stores	1
Citrus sinensis (Fruit)	Parlatoria ziziphi	Stores	2
Citrus sp. (Fruit)	Parlatoria ziziphi	Quarters	7
Citrus limon (Fruit)	Parlatoria ziziphi	Baggage	1
Citrus sp. (Fruit)	Parlatoria ziziphi	Stores	16
Citrus reticulata (Fruit)	Parlatoria ziziphi	Stores	1
Citrus limon (Fruit)	Phlaeothripidae, Species of	Permit Cargo	1
Citrus sinensis (Fruit)	Pseudococcidae, Species of	Quarters	1
Citrus sp. (Fruit)	Pseudococcidae, Species of	Stores	1
Citrus sinensis (Fruit)	Pseudococcidae, Species of	Miscel-laneous	1

HOST	PEST	WHERE	TOTAL
Citrus sp. (Leaf)	Pseudococcidae, Species of	Baggage	1
Citrus sp.	Pseudococcus sp.	Baggage	1
Citrus limon (Fruit)	Pseudococcus sp.	Permit Cargo	1
Citrus sp. (Fruit)	Pseudorobillarda sp.	Baggage	1
Citrus limon (Fruit)	Stemphylium sp.	Stores	1
Citrus reticulata (Fruit)	Pseudaonidia trilobitiformis	Stores	1
Citrus limon (Fruit)	Tarsonemus sp.	Quarters	1
Citrus limon (Fruit)	Tarsonemus sp.	Stores	2
Citrus limon (Fruit)	Tarsonemus sp.	Permit Cargo	3
Citrus sinensis (Fruit)	Tarsonemus sp.	Stores	3
Citrus latifolia (Fruit)	Tarsonemus sp.	Stores	1
Citrus sinensis (Fruit)	Tortricidae, Species of	Stores	1
Citrus sp. (Dried Fruit)	X. campestris pv. citri	Stores	1
Sum			**133**

Appendix IV. Assessment of Weediness Potential

Commodity: *Citrus reticulata* Blanco

Phase 1: Many species of *Citrus* are cultivated in the United States.

Phase 2: Is the genus listed as a weed in:

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

Phase 3: *Citrus reticulata* is prevalent in the United States and the answer to all of the questions in Phase 2 is "no", therefore the pest risk assessment proceeds.

Appendix V. Pests Associated with *Citrus* spp. In Chile

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Arthropods					
Aleurothrixus floccosus (Maskell) Hemiptera: Aleyrodidae **Woolly whitefly**	CL, US	S, L, TW	No	No	Artigas, 1994; Metcalf & Metcalf, 1993; Mound & Halsey, 1978; Ripa & Rodriguez, 1999; Prado 1991
(★) *Aleurothrixus porteri* Quaint. & Baker Hemiptera: Aleyrodidae **Citrus whitefly**	CL	S, L, TW	Yes	No	Mound & Halsey, 1978; Prado 1991; Badilla, 2001
Anastrepha fraterculus (Wiedemann) Diptera Tephritidae **South American fruit fly**	CL[a b]	F	Yes	Yes	Berg, 1979; Norrbom *et al.*, 1998; Olalquiaga & Lobos, 1993; White & Elson-Harris, 1992
Aonidiella aurantii (Maskell) Hemiptera: Diaspididae **California red scale**	CL, US	F, L, S	No	Yes	Artigas, 1994; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999
Aonidiella citrina (Coquillet) Hemiptera: Diaspididae **Yellow scale**	CL, US	F, L, S	No	Yes	Artigas, 1994; González, 1989; Metcalf & Metcalf, 1993; Prado, 1991
(★) *Aphis craccivora* Koch Syn.: *Aphis laburni* Koch Hemiptera: Aphididae **Cowpea aphid**	CL, US	L, S, Sh	No	No	Blackman & Eastop, 1984; Prado, 1991**;** González, 1989
(★) *Aphis gossypii* Glover Hemiptera: Aphididae **Melon aphid**	CL, US	FL, L, Sh, TW	No	No	Blackman & Eastop, 1984; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Aphis spiraecola Patch. Hemiptera: Aphididae **Spirea aphid**	CL, US	L, S, Sh	No	No	Metcalf & Metcalf, 1993; Prado, 1991; Ripa & Rodriguez, 1999
Aspidiotus nerii Bouché Hemiptera: Diaspididae **White ivy scale**	CL, US	F, L, S, TW	No	Yes	Artigas, 1994, González, 1989; Metcalf & Metcalf, 1993; Nakahara, 1982; Prado, 1991; Ripa & Rodriguez, 1999
(★) *Aulacorthum solani* (Kaltenbach) Hemiptera: Aphididae **Foxglove aphid**	CL, US	L, Sh	No	No	Blackman & Eastop, 1984; Prado, 1991
Brevipalpus chilensis Baker Acarina: Tenuipalpidae **Grape flat mite.**	CL	F, L, S	Yes	Yes	González, 1968, 1975,1980,1989; Prado, 1991, Ripa & Rodriguez, 1999
(★) *Brevipalpus obovatus* Donnadieu Syn.: *Tenuipalpus pseudocuneatus* Blanchard Acarina: Tenuipalpidae **Privet mite**	CL, US	F, L, S	No	Yes	Childers, 1994; Jeppson *et al,* 1975; González, 1989; Prado, 1991
Ceratitis capitata (Wiedemann) Diptera:Tephritidae **Mediterranean fruit fly**	CL[c] US[d]	F	Yes	Yes	Berg, 1979; Olalquiaga & Lobos, 1993; Norrbom *et al,* 1998; Prado, 1991, White & Elson-Harris, 1992
Ceroplastes cirripediformis Comstock Hemiptera: Coccidae **Wax scale**	CL, US	L, S	No	No	González, 1989; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Chrysomphalus dictyospermi (Morgan) Hemiptera: Diaspididae **Florida red scale**	CL, US	L, S	No	No	Artigas, 1994; Nakahara, 1982; González, 1989; Prado, 1991
Coccus hesperidum Linnaeus Hemiptera: Coccidae **Brown soft scale**	CL, US	L, S	No	No	Artigas, 1994; Ebeling, 1959; González, 1989; Hamon & Williams, 1984; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999
(★) *Cosmophillum pallidulum* Blanchard Orthoptera: Tettigonidae **Citrus katydid**	CL	FE, L	Yes	No	González 1989; Prado 1991; Ripa & Rodriguez, 1999
(★) *Dexicrates robustus* (Blanchard) Syn.: *Bostrichus robustus* (Blanchard) Coleoptera: Bostrichidae **Tree wood borer**	CL	DT	Yes	No	González, 1989**;** Prado, 1991
(★) *Dialeurodes citri* (Ashmead) Hemiptera: Aleyrodidae **Citrus whitefly**	CL, US	L, S	No	No	Prado, 1991; González, 1989; IPM, 1991
(★) *Eriophyes sheldoni* Ewing Syn.: *Aceria sheldoni* (Ewing) Acarina: Eriophyidae **Citrus bud mite**	CL, US	L, FL, Sh	No	No	González, 1989; IPM; 1991; Prado, 1991; Ripa & Rodriguez, 1999
(★) *Ectomyelois ceratoniae (Zeller)* *Syn.: Spectrobates ceratoniae (Zeller)* *Lepidoptera: Pyralidae* **Carob-bean moth**	CL, US	F	No	No	González and Cepeda, 1999, Navarro *et al*, 1986

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
(★) *Frankliniella australis* Morgan Syn. *Frankliniella cestrum* Moulton *Frankliniella argentinae* Moulton Thysanoptera: Thripidae **Flower thrips**	CL	FL	Yes	No	Prado, 1991; Santacroce, 1993. Nakahara, 1997
(★) *Frankliniella occidentalis* (Pergande) Thysanoptera: Thripidae **Western flower thrips**	CL, US	F, FL, L	No	Yes	González, 1999; IPM, 1991
(★) *Hemiberlesia palmae* (Cock.) Hemiptera: Diaspididae **Palm scale**	CL[h], US	L, S	No	No	McKenzie, 1956; Prado, 1991
(★) *Hemiberlesia rapax* (Comstock) Hemiptera: Diaspididae **Greedy scale**	CL, US	F, L	No	No	McKenzie, 1956; Prado, 1991
Icerya purchasi Maskell Hemiptera: Margarodidae **Cottony cushion scale**	CL, US	L, S	No	No	Artigas, 1994; Gill, 1993; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999
Lepidosaphes beckii (Newmann) *Aspidiotus citricola* Packard; *Mytilococcus beckii* (New.) Hemiptera: Diaspidae **Citrus purple scale**	CL, US	L, F, TW	No	Yes	Gonzalez, 1989; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999
Linepithema humile (Mayr) Hymenoptera: Formicidae **Argentine ant**	CL, US		No	No	IPM, 1991; Ripa & Rodriguez, 1999

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
(★) *Macrosiphum euphorbiae* (Thomas) Syn.: *Macrosiphum solanifolii* (Ashmead) Hemiptera: Aphididae **Potato aphid**	CL, US	L, Sh	No	No	Blackman & Eastop, 1984; Prado, 1991
(★) Naupactus xanthographus (Germar) Coleoptera: Curculionidae **Grape weevil**	CL	L, S, R	Yes	No	González, 1989; Prado, 1991; Ripa & Rodriguez, 1999; Santacroce, 1993
1.1. **(★)** *Neosilba grupo pendula* (Bezzi) *Lonchaea pendula* (Bezzi) Diptera: Lonchaeidae **Blue lance fly**	CL[h]	F	Yes	No	Artigas, 1994; González, 1989; Prado, 1991
1.1. **(★)** *Nezara viridula* (Linnaeus) Syn.: *Nezara prasinus* (Linnaeus) Hemiptera: Pentatomidae **Green stinkbug**	CL, US	F, S, Sh	No	Yes	González, 1989; Metcalf & Metcalf, 1993; Prado, 1991
Panonychus citri (McGregor) Acarina: Tetranychidae **Citrus red mite**	CL, US	S, L	No	No	González, 1989; IPM, 1991; Prado, 1991
(★) *Pantomorus cervinus* (Boheman) Coleoptera: Curculionidae **Fruit tree weevil**	CL, US	L, S, R	No	No	Artigas, 1994; Elgueta, 1993; González, 1989; IPM, 1991; Prado 1991; Ripa & Rodriguez 1999
(★) *Paraleyrodes* sp. Hemiptera : Aleyrodidae **Filamentosus whitefly**	CL	L	Yes	No	Artigas, 1994; Prado, 1991; Ripa & Rodriguez, 1999

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
1.1. (★) *Phyllocoptruta* oleivorus (Ashmead); Syn.: *Typhodromus oleivorus* Ashmead Acarina: Eriophydidae **Citrus rust mite**	CL[e], US	F, L, S	No	No	Metcalf & Metcalf, 1993; Prado, 1991
(★) *Phyllocnistis citrella* Stainton Lepidoptera: Gracillariidae **Citrus leafminer**	CL[h], US	L, S	No	No	Knapp *et al*, 1995; Ripa & Rodriguez, 1999
Planococcus citri (Risso) Hemiptera: Pseudococcidae **Citrus mealybug**	CL, US	L, F, TW, S	No	Yes	Artigas, 1994; McKenzie, 1967; Prado, 1991; Ripa & Rodriguez, 1999; Stoetzel and Miller, 1991
(★) *Polyphagotarsonemus latus* (Banks) Acarina: Tarsonemidae **Broad mite**	CL, US	F, L, TW	No	Yes	IPM, 1991; Ripa & Rodriguez, 1999
(★) *Proeulia auraria* (Clarke) Lepidoptera:Tortricidae **Fruit leaf folder**	CL	F, L, Sh	Yes	Yes	González, 1989; Prado, 1991; Ripa & Rodriguez, 1999
(★) *Proeulia chrysopteris* (Butler) Lepidoptera: Tortricidae **Fruit leaf folder**	CL	L, F	Yes	Yes	González, 1989; Prado, 1991; Ripa & Rodriguez, 1999
(★) *Protopulvinaria pyriformis* (Cockerell) Hemiptera: Coccidae **Pyriform scale**	CL, US	L	No	No	Ben – Dov, 1993; Ripa & Rodriguez, 1999
Pseudococcus calceolariae (Maskell) Syn.: *P. gahani* Green; *P. fragilis* Brain Hemiptera: Pseudococcidae **Citrophilus mealybug**	CL, US	L, F, TW	No	Yes	Artigas, 1994; De Lotto, 1958; Essing, 1942; González, 1989; IPM, 1991; McKenzie, 1964; Prado, 1991; Ripa & Rodriguez, 1999

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Pseudococcus longispinus (Targioni & Tozzeti) Hemiptera: Pseudococcidae **Long-tailed mealybug**	CL, US	L, F, TW	No	Yes	Artigas, 1994; González, 1989; IPM, 1991; Kosztarab, 1996; Prado, 1991; Ripa & Rodriguez. 1999
Pseudococcus viburni (Maskell) Syn.: *Pseudococcus. affinis* Maskell Hemiptera: Pseudococcidae **Obscure mealybug**	CL, US	L, F, TW	No	Yes	Ben - Dov, 1994; Gimpel and Miller 1996; Ripa & Rodriguez, 1999
(★) *Saissetia coffeae* (Walker) Hemiptera: Coccidae **Hemispherical scale**	CL, US	L, S	No	No	Ben – Dov, 1993, González, 1989; Hamon & Williams, 1984; Prado 1991; Ripa & Rodriguez, 1999

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Saissetia oleae (Oliver) Hemiptera: Coccidae **Olive black scale**	CL, US	L, S	No	No	Ben – Dov, 1993; González, 1989; Hamon & Williams, 1984; IPM, 1991; Prado 1991, Ripa & Rodriguez, 1999
(★) *Selenaspidus articulatus (Morgan)* Hemiptera: Diaspididae **Rufous scale**	CL[f], US	F, L, S	No	No	Artigas, 1994; CABI, 2000
Solenopsis gayi (Spinola) Hymenoptera: Formicidae **Red ant**	CL	FL, TW, R, T	Yes	No	Ripa & Rodriguez, 1999
Tetranychus urticae Koch Syn.: Tetranychus telarius L. Acarina: Tetranychidae **Two-spotted mite**	CL, US	L, S	No	No	IPM, 1991; Jeppson et al, 1975; Metcalf & Metcalf, 1993; Ripa & Rodriguez, 1999
(★)*Tettigades chilensis Amyot & Serville.* Hemiptera: Cicadidae	CL	Br	Yes	No	Prado, 1991
Toxoptera aurantii (Boy. de Fons.) Hemiptera: Aphididae **Black citrus aphid**	CL, US	L, S	No	No	González, 1989; IPM, 1991; Prado, 1991; Ripa & Rodriguez, 1999
Toxoptera citricidus (Kirkaldy) Hemiptera: Aphididae **Brown citrus aphid**	CL[f], US (FL)	L, S	Yes	No	Artigas, 1994; Blackman & Eastop, 1984; APS, 1988; Carver, 1978; Prado, 1991
Thrips tabaci (Lindeman) Thysanoptera: Thripidae **Onion thrips**	CL, US	FL, L	No	No	Prado, 1991; Metcalf & Metcalf, 1993
Bacteria					
Pseudomonas syringae pv. *syringae* van Hall	CL, US	F, FL, T	No	Yes	Besoain, 1999; C.M.I, 1988; Montealegre & Herrera, 1999
Viruses					
Citrus tristeza virus Closteroviridae:	CL, US	Wp (Not seed) [g]	No	No	Besoaín *et al,* 2000; Frison & Taher, 1991.

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Closterovirus **Tristeza**					Herra *et al,* 1995; IPM, 1991; Latorre, 1992; Wallace, 1968; Weathers *et al,* 1972
Citrus psorosis virus Ophiovirus **Citrus psorosis**	CL, US	Wp (Not seed) [g]	No	No	Besoaín *et al,* 2000; Frison & Taher, 1991; IPM, 1991; Latorre, 1992; Wutscher, 1977
Viroids					
Citrus exocortis viroid, Pospiviroidae : Pospiviroid	CL, US	Wp (Not Seed) [g]	No	No	Besoaín *et al,* 2000; Frison & Taher 1991; IPM, 1991; Latorre, 1992; Wallace, 1968; Wutscher, 1977
Citrus viroid IIb Syn. *: Citrus cachexia viroid* **Cachexia**	CL, US	Wp (Not seed) [g]	No	No	Besoaín *et al,* 2000; Frison & Taher, 1991; Valenzuela *et al,* 2000; Wutscher, 1977
Fungi					
Alternaria alternata (Fr.) Keissler. **Black rot**	CL, US	L, F, R	No	Yes	APS, 1988; Besoain, 1999; IPM, 1991; Latorre, 1992
Alternaria citri Ellis & Pierci **Alternaria brown spot**	CL, US	L, F, R	No	Yes	APS, 1988; Besoain, 1999; IPM, 1991; Latorre, 1992
Botrytis cinerea Pers. ex Fr. *(teleomorph: Botryotinia fuckeliana (*of Bary) Whetzel*)* (=*Sclerotinia fuckeliana* (de Bary) Fuckel) **Gray mold**	CL, US	FL, L, F, TW	No	Yes	APS, 1988; Besoain, 1999; IPM, 1991; Latorre, 1992; Sanchez, 1997
Colletotrichum gloeosporioides (Penz.) Sacc. *(teleomorph: Glomerella*	CL, US	F, L	No	Yes	APS, 1988; IPM, 1991; Latorre, 1992

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
cingulata (Stoneman) Spauld.& Schrenk) **Anthracnose tear stain**					
Diaporthe citri F. A. Wolf Anamorph: *Phomopsis citri* Fawc. **Stem end rot**	CL, US	L, F	No	Yes	CABI, 2001; Sanchez, 1997; Arpaia & Kader 1999; APS, 1988
Diplodia natalensis P.Evans (Syn. *Botryodiploidia theobromae* Pat., (teleomorph: *Physalospora rhodina* Berck.& Curt.) Cooke) **Fruit stem rot**	CL, US	F, T, R, TW	No	Yes	APS, 1988; Sanchez, 1997
Fusarium solani (Mart.) Sacc. (Teleomorph, *Nectria haematococca* Berck.& Br) **Dry root rot**	CL, US	R, S, B	No	No	APS, 1988; Besoain, 1999
Penicillium digitatum Sacc. **Green mold**	CL, US	F	No	Yes	Sanchez, 1997; Arpaia & Kader 1999; APS, 1988
Penicillium italicum Wehemer **Blue mold**	CL, US	F	No	Yes	Sanchez, 1997; Arpaia & Kader 1999; APS, 1988
Phytophthora citrophthora (R.E.Sm. & E.H. Sm.) Leonian **Brown rot, gummosis**	CL, US	L, F, T, R	No	Yes	Latorre, 1992; IPM, 1991; Besoain, 1999
Phytophthora nicotianae (Dastur) Var. Parasitica **Brown rot, gummosis**	CL, US	L, F, T, R	No	Yes	Latorre, 1992
Septoria citri Pass **Septoria spot**	CL, US	F	No	Yes	APS, 1988; Latorre, 1992; IPM, 1991
Sclerotinia sclerotiorum (Lib.) de Bary *(=Whetzelinia sclerotiorum* (Lib.) Korf & Dumont **Sclerotinia twig blight**	CL, US	F	No	No	APS, 1988; Latorre, 1992; IPM, 1991
Nematodes					

Pests	Geographic Distribution [1]	Plant Part Affected [2]	Quarantine Pest	Follows Pathway	References
Tylenchulus semipenetrans Cobb **Citrus nematode**	CL, US	R	No	No	Latorre, 1992; IPM, 1991; Abayllay 1995; Magunacelaya & Dagnino, 1999
Mollusk					
Helix aspersa (Muller) Order: Stylommatophora Family: Helicidae **Brown garden snail**	CL, US	L, F	No	Yes	Ripa & Rodriguez, 1999; IPM, 1991
Deroceras sp. Order: Stylommatophora Family: Limacidae	CL	L, F	Yes	Yes	Ripa & Rodriguez, 1999

Footnotes:

1. **Geographic Distribution:** CL = Chile, FL = Florida, TX = Texas, US = United States.

2. **Plant Parts Affected**

B	=	Bark	L	=	Leaf
Br	=	Branch	R	=	Root
DT	=	Died Trunk	S	=	Stem
F	=	Fruit	Sh	=	Shoot
FE	=	Early Stage	T	=	Trunk
Fl	=	Flower	TW	=	Twigs
			Wp	=	Whole Plant

Additional explanatory notes:

a) *Anastrepha fraterculus*: Presently not distributed in Chile. The first identification was made in 1930 in the town of Arica, I Region, Northern Chile. This species never spread to other regions in Chile. Its definitive eradication in the last affected localities of the I Region (Miñe -Miñe and Cutimaya) was in 1964 .

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

c) *Ceratitis capitata* eradicated in Chile since 1995.

d) An outbreak of *Ceratitis capitata* occurred in certain counties of Florida in 1997 where it is currently subject to an official eradication program.

e) *Phyllocoptruta oleivorus*: Only on Easter Island, not in Continental Chile.

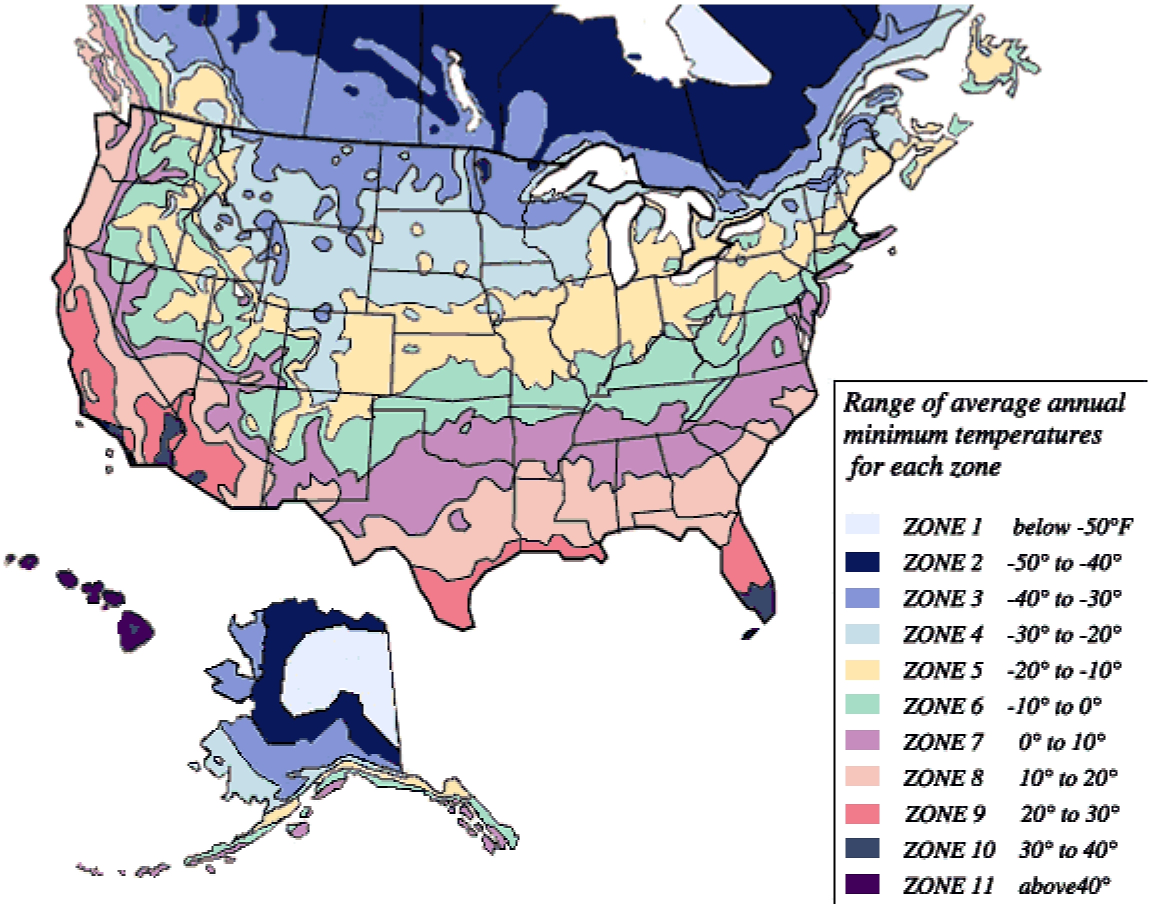
f) Erroneous identification, not detected in Chile (Artigas, 1994; Servicio Agrícola y Ganadero, Registros de Vigilancia y Laboratorios).

g) Transmission only by grafting.

h) Exclusively in Chile's Region I.

(★) Not reported for mandarin oranges, clementines or tangerines.

Appendix VI. USDA Plant Hardiness Zones



Appendix VII. Climatological Data

Chart 1. Average Minimum Monthly Temperatures in several Chilean towns (North to South)

Town	Region	Month												Annual Average	
		E	F	M	A	M	J	J	A	S	O	N	D	° C	° F
Arica Lat. 18 ° 28' S y Long. 70° 02' W	**I**	17.8	18.2	16.9	15.4	14.5	13.8	13.1	13.2	14.0	14.5	15.3	16.4	**15.26**	**59.47**
Iquique Lat. 29 ° 54' S y Long. 71° 15' W	**II**	16.8	16.6	15.6	14.3	13.7	13.1	12.5	12.6	13.2	13.8	14.8	15.8	**14.40**	**57.92**
Copiapó Lat. 27 ° 21' S y Long. 70° 21' W	**III**	15.5	15.7	13.8	11.8	8.7	7.0	6.5	8.0	9.2	11.9	13.0	13.6	**11.23**	**52.21**
La Serena Lat. 29 ° 54' S y Long. 71° 15' W	**IV**	13.5	12.8	11.8	9.9	8.8	7.7	7.0	7.3	8.1	9.1	10.7	11.3	**9.83**	**49.70**
Ovalle Lat. 30 ° 03' S y Long. 71° 01' W	**IV**	13.2	13.1	11.2	9.2	7.7	6.6	6.3	6.8	7.8	8.7	10.0	11.7	**9.36**	**48.85**
La Ligua Lat. 32 ° 27' S y Long. 71° 16 ' W	**V**	11.0	9.5	8.5	7.5	5.0	4.6	4.5	6.0	6.5	7.0	7.0	8.0	**7.09**	**44.77**
Quillota Lat. 32 ° 43' S y Long. 71° 16 ' W	**V**	11.5	11.2	9.8	8.1	7.4	5.8	5.5	5.8	6.9	8.2	9.1	10.7	**8.33**	**47.00**
Santiago Lat. 33° 34' S y Long. 70 ° 38 ' W	**RM**	10.3	9.5	8.3	5.7	4.8	3.0	2.8	3.1	4.2	6.0	7.8	9.7	**6.27**	**43.28**

Rengo Lat. 34° 24' S y Long. 70° 52 ' W	**VI**	11.4	10.1	7.7	4.9	5.7	4.1	2.9	3.9	4.2	6.6	8.4	10.4	**6.69**	**44.05**
Talca Lat. 35° 26' S y Long. 71° 40 ' W	**VII**	12.6	11.8	9.8	7.1	5.6	4.2	3.8	4.0	5.3	7.4	9.5	11.3	**7.70**	**45.86**
Chillan Lat. 36° 34' S y Long. 72° 06' W	**VIII**	12.6	11.5	9.6	7.3	6.6	4.8	3.5	4.1	5.1	6.7	8.7	10.7	**7.60**	**45.68**
Angol Lat. 37° 47' S y Long. 72° 42' W	**IX**	10.9	10.6	9.0	6.7	5.3	4.3	4.4	4.0	5.0	6.9	8.1	8.7	**6.99**	**44.59**
Remehue Lat. 40° 35' S y Long. 73° 09' W	**X**	8.6	7.7	7.0	5.6	5.9	3.2	3.8	3.6	3.6	4.9	6.0	7.7	**5.63**	**42.14**
Puerto Aysen Lat. 45° 24' S y Long. 72° 42' W	**XI**	9.9	9.4	7.8	6.1	4.1	2.4	2.5	2.1	3.8	5.5	7.0	8.3	**5.74**	**42.34**
Punta Arenas Lat. 53° 10' S y Long. 70° 54' W	**XII**	7.1	6.7	5.4	3.8	1.9	0.3	-0.3	0.5	1.6	3.4	4.5	6.1	**3.42**	**38.15**

Source: Novoa et al., 1989 Mapa Agroclimático de Chile, Instituto de Investigaciones Agropecuarias

Chart 2: Absolute Minimum Monthly Temperatures in Chilean Towns

Town	Region	Month												Annual Minimum	
		E	F	M	A	M	J	J	A	S	O	N	D	° C	° F

Arica Lat. 18 ° 28' S y Long. 70° 02' W	**I**	11.0	12.0	11.5	10.2	8.3	8.5	**5.2**	6.5	8.0	9.0	10.5	11.0	**5.2**	**41.36**
Iquique Lat. 29 ° 54' S y Long. 71° 15' W	**II**	13.0	12.0	9.0	8.4	9.0	9.6	8.1	**8.0**	9.0	10.0	11.2	11.5	**8.0**	**46.40**
Caldera Lat. 27 ° 03' S y Long. 70° 51' W	**III**	11.4	11.4	10.0	4.8	6.0	4.0	**2.8**	3.0	4.0	6.3	6.5	9.0	**2.8**	**37.04**
Ovalle Lat. 30 ° 03' S y Long. 71° 01' W	**IV**	9.4	9.3	7.5	6.1	3.7	2.0	**1.5**	1.8	2.9	4.0	6.4	8.3	**1.5**	**34.70**
Quillota Lat. 32 ° 43' S y Long. 71° 16 ' W	**V**	8.4	7.8	5.3	3.6	2.7	0.9	0.4	**0.1**	2.4	3.3	5.2	6.7	**0.1**	**32.18**
Santiago Lat. 33° 34' S y Long. 70 ° 38 ' W	**RM**	7.1	6.2	3.8	1.5	0.0	-1.8	**-2.5**	-2.1	-0.8	0.6	3.6	5.4	**-2.5**	**27.50**
Rengo Lat. 34° 24' S y Long. 70° 52 ' W	**VI**	10.2	6.7	5.6	0.6	-1.0	-3.0	**-3.2**	-0.6	-1.1	1.6	2.2	6.7	**-3.2**	**26.24**
Talca Lat. 35° 26' S y Long. 71° 40 ' W	**VII**	9.7	8.7	5.7	2.0	-0.9	-1.9	**-2.0**	-1.8	1.8	2.6	5.7	9.1	**-2.0**	**28.40**
Chillan Lat. 36° 34' S y Long. 72° 06' W	**VIII**	7.0	5.1	2.5	-0.4	-2.3	-2.0	**-3.6**	-2.4	-1.5	0.3	3.5	4.1	**-3.6**	**25.52**
Angol Lat. 37° 47' S y Long. 72° 42' W	**IX**	6.4	5.5	2.8	0.4	-2.0	-2.3	-2.3	**-2.6**	-0.5	0.6	1.9	3.7	**-2.6**	**27.32**
Remehue															

Lat. 40° 35' S y Long. 73° 09' W	**X**	2.4	2.4	0.3	-1.7	-1.3	**-4.2**	-3.5	-2.8	-2.6	-1.0	0.0	1.8	**-4.2**	**24.44**
Chile Chico Lat. 46° 36' S y Long. 71° 43' W	**XI**	5.5	5.2	3.2	-0.9	-4.4	**-8.0**	-6.9	-5.5	-3.4	-0.5	3.4	5.6	**-8.0**	**17.60**
Punta Arenas Lat. 53° 10' S y Long. 70° 54' W	**XII**	2.0	0.8	-1.0	-3.2	-5.0	-6.4	**-9.3**	-6.5	-6.0	-2.5	-2.5	-0.2	**-9.3**	**15.26**

Source: Novoa et al., 1989 Mapa Agroclimático de Chile, Instituto de Investigaciones Agropecuarias

Appendix VIII. Host Range and Threatened and Endangered Species Data

Table 1. Reported host plants of Brevipalpus chilensis, Proeulia auraria, and Proeulia chrysopteris and USFWS Threatened and Endangered Plants (T&E)within the same genera (See Appendix IX; CABI, 2001; USFWS, 2002).

Host Plant Family	**Host plants of *Brevipalpus chilensis***	**Host plants of *Proeulia auraria***	**Host plants of *Proeulia chrysopteris***	**T & E plants in same family as host plants**	**T & E plants in same genera as host plants**	**T & E plant status**	**Distribution of T & E plants in host genera**
Aceraceae		Acer pseudoplatanus	*Acer* spp.	No	No		
Actinidaceae	*Actinidia deliciosa*	*Actinidia deliciosa*	*Actinidia deliciosa*	No	No		
Aristolochiaceae		*Aristolochia chilensis*		Yes	No		
Annonaceae	*Annona* spp.			Yes	No		
Apiaceae	*Apium graveolens*			Yes	No		
Apocynaceae	*Vinca* sp.			Yes	No		
Asteraceae	*Chrysanthemum* sp.			Yes	No		
Bignoniaceae	*Catalpa speciosa*			Yes	No		
Chenopodiaceae	*Chenopodium ambrosiodes*			Yes	No		
Convolvulaceae	*Convolvulus arvensis*			Yes	No		
Ebenaceae	*Diospyros kaki*			No	No		
Elaeocarpaceae		*Aristotelia chilensis*		No	No		
Fabaceae		*Robinia pseudoacacia*		Yes	No		
Geraniaceae	*Pelargonium* spp.			Yes	No		
Grossulariaceae	*Ribes* sp.			Yes	*Ribes echinellum*	T	FL, SC
Moracae	*Ficus carica*			No	No		
Myrtaceae		Reported to Family					See Table 2
Myrtaceae		*Myrceugenia* sp.		Yes	No		
Oleaceae	*Ligustrum sinense*			Yes	No		
Pinaceae			*Pinus radiata*	No	No		
Platanaceae		*Platanus orientalis*	*Platanus orientalis*	No	No		

Rosaceae		Reported to Family	Reported to Family	Yes	Nine genera		See Table 2
Rosaceae	*Cydonia oblinga*			"	No		
Rosaceae		*Eriobotrya japonica*		"	No		
Rosaceae	*Malus domestica*	*Malus pumila*	*Malus pumila*	"	No		
Rosaceae	*Prunus dulcis*	*Prunus* spp.	*Prunus* spp.	"	*Prunus geniculata*	E	FL
Rosaceae		*Pyrus communis*	*Pyrus communis*	"	*No*		
Rutaceae			*Reported to Family*	Yes	*Three genera*		HI, PR, VI
Rutaceae	*Citrus spp.*	*Citrus spp.*		"	*No*		
Simmondsiaceae			*Simmondsia chinensis*	No	*No*		
Solanaceae	*Cestrum parqui*			Yes	*No*		
Vitaceae			*Reported to Family*	No	*No*		See Table 2
Vitaceae	*Ampelopsis spp.*			"	*No*		
Vitaceae	*Vitis vinifera*	*Vitis vinifera*	*Vitis vinifera*	"	*No*		
Winteraceae		*Drimys winteri*		No	*No*		

Table 2. Reported host families of Proeulia auraria, and Proeulia chrysopteris and the USFWS Threatened and Endangered Plants within these host families. (See Appendix I; CAB, 2001; USFWS, 2002).

Host Plant Family	Host Families of *Proeulia auraria* and *P. chrysopteris*	T & E plants in host families within the climatically suitable range of *P. auraria* and *P. chrysopteris*	T & E plant status	Distribution of T & E plants in host family
Myrtaceae	Reported at Family Level	*Calyptranthes thomasiana*	E	PR, VI British VI
"		*Eugenia haematocarpa*	E	PR
"		*Eugenia koolauensis*	E	HI
"		*Eugenia woodburyana*	E	PR
"		*Myrcia paganii*	E	PR
Rosaceae	Reported at Family Level	*Acaena exigua*	E	HI
		Cercocarpus traskiae	E	CA
		Geum radiatum	E	NC, TN
		Ivesia kingii var. eremica	T	NV
		Potentilla hickmanii	E	CA
		Potentilla robbinsiana	E	NH, VT
		Prunus geniculata	E	FL
		Purshia =Cowania subintegra	E	AZ
		Spiraea virginiana	T	GA, KY, NC, OH, PA, TN, VA, WV
Rutaceae	Reported at Family Level	*Melicope adscendens*	E	HI
		Melicope balloui	E	HI
		Melicope haupuensis	E	HI
		Melicope knudsenii	E	HI
		Melicope lydgatei	E	HI
		Melicope mucronulata	E	HI
		Melicope munroi	E	HI
		Melicope ovalis	E	HI
		Melicope pallida	E	HI
		Melicope quadrangularis	E	HI
		Melicope reflexa	E	HI
		Melicope saint-johnii	E	HI
		Melicope zahlbruckneri	E	HI
		Zanthoxylum dipetalum var. tomentosum	E	HI
		Zanthoxylum hawaiiense	E	HI
		Zanthoxylum thomasianum	E	PR, VI
Vitaceae	Reported to Family	None		

APPENDIX IX. Background Pest Information Provided by Chile

BACKGROUND INFORMATION ON *Brevipalpus chilensis*

Identification and Taxonomy

Name: *Brevipalpus chilensis* Baker (1949); Order Acarina, Family Tenuipalpidae; Common name: Grape flat mite.

Baker determined the species, which he described as *Brevipalpus chilensis* on the basis of two female specimens and two para-types collected on lemons from Chile on June 14, 1933.

This species can be distinguished from other members of its genus, especially from *Brevipalpus obovatus* Donnadieu, present in Chile, by the following easily and quickly identified morphological characteristics; Female 0.8 mm long, red color with some black marks, very uniform dorsal reticulation, including the central part of the propodosoma. This latter characteristic distinguishes it from *B. obovatus*, which has a nonreticulated propodosoma in the central part. The species has a hysterosome with four pairs of marginal setae, apart from the humoral pair located in the transversal suture. The tarsus of the second pair of legs has only one cylindrical sensor (solenoid) (González, 1989).

Hosts

Primary hosts: Vine (*Vitis vinifera*), lemon (*Citrus lemon*), privet (*Ligustrum sinensis*).

Others hosts: Ampelopsis, orange (*Citrus sinensis*), sour orange (*Citrus aurantium*), mandarin (*Citrus reticulata*, *Citrus clementine*), Japanese persimmon (*Diospyros kaki*), cherimoya (*Anona cherimola*), fig (*Ficus carica*), kiwifruit (*Actinidia deliciosa*), quince (*Cydonia oblonga*), apple (*Malus domestica*), almond (*Prunus amigdalus*), *Chrysanthemum* sp., *Pelargonium* sp., catalpa (*Catalpa speciosa*), correhuela (*Convolvulus arvensis)*, palqui (*Cestrum palqui)*, zarzaparrilla (*Ribes georgianus*), celery (*Apium graveolens*), paico (*Quenopodium ambriosoides*), periwinkle (*Vinca sp*). (González, 1968, 1973, 1989; Jeppson *et al*., 1975, Ripa and Rodriguez, 1999).

Life history

Brevipalpus chilensis overwinters in vines as groups of fertilized adult females under the vine bark (González, 1968, 1983, 1989) where they hide in the tree's grooves and hollows.

During winter the females are able to withstand high humidity and low temperature conditions. When bark is removed, exposing groups of females, the majority are able to move slowly to other protected sites. During tree budding and after feeding for 4 to 6 days, females start to deposit eggs on the shoots, in leaves or in unopened buds. Females' lay a maximum of 130 to 140 eggs during their average 30-day lifespan. After 10 or 12 days, nymphs hatch from the eggs. These go through three stages (first nymph, protonymph and deutonymph), and reach adulthood, in 30 to 40 days. During the active period, from the spring to the end of March, four complete generations are produced, plus a partial fifth generation that does not lay eggs. Studies have shown that a temperature of 25 °C and 50% relative humidity are suitable for incubation under laboratory conditions (González, 1968, 1983, 1989, Jeppson *et al.* 1975).

Studies on biology of *B. chilensis* populations in clementine orchards were carried out by the Catholic University of Valparaiso. These studies indicated the highest population levels of the mite present on leaves, twigs and fruits occur from December through March. ("Population follow-up of *B. chilensis* in clementine orchards in the IV and V Region", UCV, 2000).

Movement and Dispersal

This species is thought to move from one host plant to another by direct contact, generally by vegetative material falling to the ground and carrying live mites. The main source for long distance dissemination of *B. chilensis* is grafted plants, and in some cases even vegetative material to be used for grafting (González, 1983). A general feature of these species belonging to the Tenuipalpidae family is that they are slow moving mites (Jeppson *et al*, 1975, Doreste, 1988).

Geographic distribution

Brevipalpus chilensis is found from Region III to Region X in Chile. This area comprises different agro-climatic zones all of them characterized by registering an average annual minimum temperature from over 40° F to an average absolute minimum of 0.85° C at the cooler place, Remehue, X Region (Novoa *et al*, 1989). At present *B. chilensis* is categorized as a native species of Chile, being absent in other countries, except for Mendoza, Argentina (González, 1989, Baker 1949).

Damage symptoms

This species may be harmful to red wine grapevines such as Cot, Rouge and Cabernet. At very high levels, it kills buds as a result of tissue dehydration. It also causes bronzing and curling of leaves, brown marks or necrosis and dehydration of the rachis and stem. In response to attack the new leaves are smaller in size, the new canes are shorter and production drops. In table grapes, the species can be found in varieties such as Ribier and Cardinal where in some cases necrosis of the rachis causes dehydration and wrinkling of the grapes (González, 1968, 1983, 1989, Jeppson *et al*. 1975).

In other economically important hosts, no symptoms have been seen.

Economic impact

Brevipalpus chilensis can cause economic damage in vines especially wine grape vines such as Cabernet, Cot, Rouge, Sémillon, and Sauvignon, affecting production and decreasing the wine's alcohol content (González, 1983). In table grape varieties, budding and rachis are only affected in cases of very severe attacks, especially in the Ribier variety.

Any other *B. chilensis* hosts with agricultural importance, such as lemons, mandarins, kiwifruits and other table grape varieties such as Thompson Seedless, Flame, etc. do not suffer economic damage because of this pest.

No damage or losing has been reported in any species of citrus fruits or other host except *Vitis vinifera* mention The species reaches a low population level in citrus fruits compared to other hosts which can have up to 400 or 500 mites per leaf is only reached in wine grapes and ligustrum (González, 1983).

BACKGROUND INFORMATION ON *Proeulia auraria* and *Proeulia chrysopteris*

The genus *Proeulia* was established in 1962 by Clarke for native species of Chile. Actually it includes 22 species from which only *Proeulia auraria* Clarke, *P chrysopteris* Butler and *P triqueta* Obrazston have been recorded on cultivated plants. None of these species have been recorded on *Citrus reticulata.*

Identification and Taxonomy

Proeulia auraria Clarke, 1949; Syn: *Eulia auraria* Clarke, 1949, Order Lepidoptera, Family Tortricidae; Common name: Fruit leaf folder (CABI, 2001).

Proeulia chrysopteris Butler, 1883; Syn: *Tortrix chrysopteris* Butler, 1883, *Eulia chrysopteris* Meyrick, 1912; Order Lepidoptera, Family Tortricidae; Common name: Kiwi leaf roller (CABI, 2001).

Hosts

Proeulia auraria

Has been collected from “maqui” (*Aristotelia chilensis*), “arrayan" “(*Myrceugenia obtusa),* grapevine *(Vitis vinifera)*, apricot (*Prunus armeniaca*), plum (*Prunus domestica*), peach and nectarine (*Prunus persica*), European pear (*Pyrus communis*), apple (*Malus pumila*), loquat (*Eryobotria japonica*), “canelo” (*Drymis winteri*), navel orange (*Citrus sinensis*), grapefruit (*Citrus paradisi*), cherry (*Prunus avium*), kiwifruit (*Actinidia deliciosa*), sycamore (*Platanus orientalis*), locust tree (*Robinia pseudoacacia*), “oreja de zorro” (*Aristolochia chilensis*).

(Campo et al, 1981; Alvarez and González, 1982; González, 1989; Artigas, 1994; CABI, 2001).

Proeulia chrysopteris

From the wide array of native host plants, *P. chrysopteris* has been slowly moving to economic crops, particularly to fruit trees (CABI, 2001).

P. chrysopteris has been recorded from apple (Malus pumila), kiwifruit (Actinidia deliciosa), apricot (Prunus armeniaca), peach and nectarine (Prunus persica), grapevine (Vitis vinifera), European pear (Pyrus communis), plum (Prunus domestica), jojoba (Simmondsia chinensis), navel orange (Citrus sinensis), grapefruit (Citrus paradisi), (Acer pseudoplatanus), (Platanus orientalis), pine (Pinus radiata).

(Alvarez and González, 1982; González, 1989; Artigas, 1994; CABI, 2001).

Life history

Proeulia auraria

P. auraria and *P. chrysopteris* hibernate as newborn larvae on caducs trees. In spring they begin to feed on rolled leaves, in flowers and fruits. The adults of this generation may change hosts and begin to be found on November. The female deposits plates of 15 to 40 eggs on the leaves, (Campos *et al*., 1981). In search for shelter, the new born larvae form a protecting tube by folding a leaf or by joining leaves by a silk thread. In summer, a complete cycle takes 35 to 50 days (Artigas, 1994; Campos *et al*., 1981). Larvae born in autumn spend the winter diapausing inside a cocoon in twigs, adhered to leaves or in other protected places. Mature larvae die after 2-3 weeks of cold storage (CABI, 2001). These larvae are supposed to complete their development and cycle in sheltered places (Artigas, 1994; Campos *et al*., 1981).

Pupation takes place on the leaves. Two annual generations have been reported, with the possibility of a partial third generation (Campos et al., 1981). Some sporadic captures in pheromone traps have been registered at temperatures between 6 and 7 °C (Artigas, 1994, González, 1989).

Movement and Dispersal

Adults can disperse locally as they have a wide range of hosts on which they can feed.

Proeulia chrysopteris

This species has a similar biology to *P. auraria*: The second generation starts in mid December. (González, 1989; Artigas, 1994).

Movement and Dispersal

Adults can disperse locally as they have a wide range of hosts on which they can feed and as they search for them.

Geographic distribution

Proeulia auraria

This species has been reported at places ranging from the III to the VIII Region, including the Metropolitan Region, (Prado, 1989; Artigas, 1994)).The climate in this area have average absolute minimum of 0.86 °C at the cooler place, Chillán (Novoa et al,1989).

Proeulia chrysopteris

This species has been reported from the V to the VII Region (Prado, 1989; Artigas, 1994) The climate in this area have average absolute minimum of 1.75°C at the cooler place, La Platina, Region Metrolitana. (Novoa et al,1989).

Damage symptoms

Proeulia auraria

First generation larvae may feed on buds, on apical shoots, flowers, fruits, and leaves. The direct damage to shoots and flowers is detrimental to the production of fruit twigs and to fruits, respectively. Second-generation larvae attack fruits making scars and wounds as they are superficial feeders in fruits, the symptoms are scars and webs. In fields, rolled leaves can be seen, as well as leaves webbed together and superficial feeding damage.

During development, fruit suffer deformations and scars in the surface reducing their quality due to deficient appearance. In export table grapes, the presence of silk and debris on the clusters makes the cleaning work difficult.

All of these symptoms plus the size of the larvae, make the detection easy in field, packinghouse and inspection.

Proeulia chrysopteris

From the beginning of sprouting (in pomaceous crops) larvae move to the foliage, flowers and young fruit and attack them until the end of October. Damaged fruits, frequently bearing adhered leaves and floral rests remain. Also, leaves are webbed together as with *P. auraria*. In kiwifruits, the pest produces irregular superficial galleries in the fruit's pedicel base (González, 1989).

Economic Impact

Proeulia auraria and Proeulia chrysopteris.

Both species can be found in different host but only have caused isolated and sporadic damages on, pear trees, table grapevines, vineyards, kiwi and orange trees.

As these pests move from native hosts to crops, they are subjected to pesticide treatments that tend to eliminate natural enemies and in some fields create local problems especially on pears.

These pests have not been reported in the *Citrus sp.* (*reticulata*) addressed in this PRA.

APPENDIX X- Addendum: Emergency Outbreak of Ceratitis capitata (Medfly) Risk Assessment, Emergency Eradication, and Treatment Protocol

September 25, 2003

United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
4700 River Road
Riverdale, Maryland 20737

Introduction

In September, 2002 the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) published a pathway-initiated plant pest risk assessment entitled "Importation of Fresh Commercial Citrus Fruit: Clementine (*Citrus reticulata* Blanco var. Clementine), Mandarin (*Citrus reticulata* Blanco) and Tangerine (*Citrus reticulata* Blanco) from Chile into the United States. Along with the risk assessment, APHIS made available a risk management document, "Measures Suggested For Quarantine Pest Risk Management In Clementines, Mandarin Oranges And Tangerines Exported From Chile To The United States Of America" prepared by the Government of Chile. These documents identified three pests of concern for further analysis: two lepidopterans *Proeulia auraria* and *P. chrysopteris*; and the mite *Brevipalpus chilensis*. Fruit flies, and in particular *Ceratitis capitata* or Medfly, was not addressed because at that time, there were no known outbreaks of Medfly in Chile.

On Thursday April 17, 2003 a single Medfly was captured in the Santiago Metropolitan Region, primarily in the Township of Maipu. This triggered the installation of additional traps in a 200 meter radius around the capture, and a delimiting survey was begun encompassing the equivalent of 6,400 hectares (or 64 square kilometers). On Monday April 21, 2003, a second Medfly capture was confirmed approximately 1,300 meters from the location of the first capture. Per the protocol between APHIS, PPQ and Servicio Agricola y Ganadero (SAG - Chile's national plant protection organization), once two adult flies are captured within 3 miles distance within one cycle, the trigger point for quarantine actions was reached.

As a result of this outbreak APHIS' Phytosanitary Issues Management Team requested that this addendum be prepared to document the pest risk posed by Medfly, emergency procedures instituted by Chile and available phytosanitary treatments approved for citrus fruit from infested areas.

Pest Risk Assessment:

Medfly was previously analyzed by APHIS on numerous occasions (*e.g.*, USDA, 1997a; USDA, 1997b; USDA,1997c; USDA, 2001; USDA, 2003). Most recently, *C. capitata* was assessed in a pest risk assessment for proposed citrus imports from Peru (USDA, 2003). The assessment conducted for Peru is considered valid for Chile as well. The following analysis of Medfly risk was taken from the Peru document, which is titled, "**Importation of Fresh Commercial Citrus Fruit: Clementine (*Citrus reticulata* Blanco var. 'Clementine'); Grapefruit (*C.* x *paradisi* Macfad.); Key Lime (*C. aurantifolia* [Christm.] Swingle); Mandarin Orange (*C. reticulata* Blanco); Navel Orange (C. sinensis [L.] Osbeck) var. 'Washington'; Tangelo (*Citrus* x *tangelo* J.W. Ingram & H.E. Moore); Unshu Orange (*C. reticulata* Blanco var. 'Unshu' Swingle) from Peru into the United States".** The estimates of risk are expressed qualitatively (high, medium or low). Details of the risk assessment method may be found in the document: *Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, Version 5.0* USDA, 2000). This document is available from the Agency contact listed on this document or on the Internet at: http://www.aphis.usda.gov/ppq/pra/commodity/cpraguide.pdf.

Consequences of Introduction—Economic/Environmental Importance

Risk Element 1:Climate/Host Interaction	
Ceratitis capitata is found in southern Europe and west Asia, throughout Africa and South and Central America (CAB International 2002), and in northern Australia (Hassan 1977). This species has the capacity to tolerate colder climates better than most other species of fruit fly (Weems 1981). The area in which it survives is of Mediterranean climate, virtually coinciding with where citrus is grown (CAB International 2002). It is estimated that the species could become established in areas of the U.S. corresponding to 4 Plant Hardiness Zones (8-11) and is given a High (3) rating for this risk element. One or more hosts of *C. capitata* are present in these Plant Hardiness Zones in the U.S. (USDA-NRCS 2002).	High (3)
Risk Element 2: Host Range	
This pest has been recorded from a wide variety of host plants in several families,	High (3)

including *Coffea* sp. (Rubiaceae), *Capsicum annuum* (Solanaceae), *Citrus* spp. (Rutaceae), *Malus pumila*, *Prunus* spp. (Rosaceae), *Ficus carica* (Moraceae), *Psidium guajava* (Myrtaceae), *Theobroma cacao* (Sterculiaceae), *Phoenix dactylifera* (Arecaceae), and *Mangifera indica* (Anacardiaceae) (CAB International 2002). Because this species attacks multiple species among multiple plant families, it is given a rating of High (3) for the Host Range risk element.	
Risk Element 3: Dispersal Potential	
Females may deposit up to 22 eggs per day and as many as 800 eggs in a lifetime, although 300 is the more typical number (Weems 1981). Eggs are inserted into host fruit in small batches of one to 10 (Weems 1981). In Australia, breeding is continuous throughout the year, the species exhibiting several overlapping generations (Hassan 1977). Adult flight, with a range of 20 km or more (Fletcher 1989), and the transport of infested fruits are the major means by which this fruit fly is able to move and disperse to previously uninfested areas (CAB International 2002). Since 1985, *Ceratitis capitata* has been intercepted 2,366 times by PPQ at ports of entry, the majority of which were with fruit (PIN309 2003), which is evidence of this species' ability to be transported long distances with infested fruit. This species may also be dispersed via puparia in soil or growing medium accompanying plants (CAB International 2002). As this species has both high biotic potential (several generations per year and many offspring per reproduction) and capability for rapid dispersal (over 10 km/year via natural and/or human-mediated means), it is given a rating of High (3) for the Dispersal Potential risk element.	High (3)
Risk Element 4: Economic Impact	
Ceratitis capitata is one of the world's most destructive fruit pests (Weems 1981). Because of its wide distribution, its ability to tolerate colder climates compared to most other fruit flies, and its wide host range, it is ranked as the most important among economically important fruit flies (Weems 1981; CAB International 2002). It is a major pest of citrus, but is often an even more serious pest of some deciduous fruits, such as peach, pear, and apple (Weems 1981). In Mediterranean countries, it is particularly damaging to citrus and peach crops (CAB International 2002). It may also transmit fruit-rotting fungi (CAB International 2002). The species is of quarantine significance throughout the world, especially for Japan and the U.S. Its presence, even as temporary adventive populations, can lead to severe additional constraints for export of fruits to uninfested areas in other parts of the world. In this respect, *C. capitata* is one of the most significant quarantine pests for any tropical or warm temperate areas in which it is not yet established (CAB International 2002). Based on this evidence, *C. capitata* is given a rating of High (3) for the Economic Impact risk element.	High (3)
Risk Element 5: Environmental Impact	
Its broad host range predisposes this species to attack plants in the U.S. listed as Threatened or Endangered in 50 CFR §17.12. Examples of potential host plants listed as Threatened or Endangered are: *Opuntia*, *Prunus*. As it represents a significant economic threat, the wider establishment of *C. capitata* in the U.S. undoubtedly would trigger the initiation of chemical or biological control programs, as has occurred in California and Hawaii. Consequently, it is given a rating of High (3) for the Environmental Impact risk element.	High (3)

Pest	Risk Element 1: Climate/ Host Interaction	Risk Element 2: Host Range	Risk Element 3: Dispersal Potential	Risk Element 4: Economic Impact	Risk Element 5: Environmental Impact	Cumulative Risk Rating
Ceratitis capitata	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)

Likelihood of Introduction

We rate each pest with respect to introduction (i.e., entry and establishment) potential. We consider two separate components. First, we estimate the amount of commodity likely to be imported. More imports lead to greater risk; the result is a risk rating that applies to the commodity and country in question and is the same for all quarantine pests considered. Second, we consider five biological features (i.e., sub-elements) concerning the pest and its interactions with the commodity. The resulting risk ratings are specific to each pest. Details of elements and rating criteria are provided in (USDA 2000). For each pest, the sum of the sub-elements produces a cumulative risk rating for likelihood of introduction. The cumulative risk rating for introduction is considered to be an indicator of the likelihood that a particular pest would be introduced. Likelihood of introduction is a function of both the quantity of the commodity likely to be imported annually, converted into standard units of 40-foot-long shipping containers, and pest opportunity, estimated using five criteria that consider the potential for pest survival along the pathway (USDA 2000).

Risk Element 1: Quantity of commodity imported annually

Chilean exporters estimate that exports of clementines, mandarins and tangerines would total 250,000 boxes a year. They also estimate that 40 percent of the boxes would be 10 to 15 kg cardboard boxes and the remaining 60 percent would be 2.3 kg wood boxes. This translates to a predicted volume of approximately 60 to 70 standard 40-foot shipping containers annually, based on a conversion factor of 20 metric tons per 40-foot shipping container (Cargo Systems 2001). The quantity of commodity imported is estimated to fall within the range of 10 to 100 containers per year, so the Quantity Imported Annually is rated **Medium (2)** for all of the pests.

Risk Element 2: Survive Post Harvest	**Risk Rating**
Among the arthropod pests, all of the tephritid fruit flies, as internal feeders, would be expected to survive these post-harvest treatments, especially if infestation of the fruit was not of such great age that damage was obvious. Fruit attacked by *Anastrepha* can show signs of oviposition punctures; however, "these, or any other symptoms of damage, are often difficult to detect in the early stages of infestation" (CAB International 2002)	High (3)
Risk Element 3: Survive Shipment	
The current (as of 3/24/03) USDA approved cold treatment schedule (T107-a-1) for *Ceratitis capitata* in grapefruit, oranges, and clementines is either 34° F (1.11° C) or below for 15 days or 35° F (1.67° C) or below for 17 days (PPQ 2003a). Consequently, it is assumed that at least some of the larvae and eggs of *C. capitata* would be expected to survive the standard shipping method, for which the refrigeration temperatures are above that of the USDA approved cold treatment schedule. The larvae and eggs are inside the fruit and, therefore, protected somewhat from the refrigeration temperatures. Both *Anastrepha* sp. and *C. capitata* have been intercepted by PPQ at ports of entry with citrus fruit in cargo, which is evidence that at least a small percentage of these fruit flies have the ability to survive the transport conditions of citrus.	Medium (2)
Risk Element 4: Not Detected at Port of Entry	
The eggs and larvae of the fruit flies are borne internally and, therefore, would be difficult to detect by officers at the port of arrival, especially if infestation of the fruit was not of such great age that damage was obvious. Fruit fly-infested fruit can go unrecognized (White and Elson-Harris 1992). The fruit can show signs of oviposition punctures; however, these are often difficult to detect in the early stages of infestation (CAB International 2002). The fruit flies may easily go undetected even if the fruit is dissected. The fruit flies may easily go undetected even if the fruit is dissected. (Gould 1995) examined inspectors' ability to detect *Anastrepha suspensa* infesting a variety of fruit, including grapefruit. He found that the inspectors were not able to detect infested grapefruit in most cases.	High (3)
Risk Factor 5: Contact with host material	

Fruit fly hosts, include temperate-zone or widely cultivated plants (USDA-NRCS 2002; USDA-NASS 1997) and should be available throughout the potential range. Peru's proposed shipping season extends from February to September. Based on commercial fruit phenology data compiled by (Sequeira et al 2001), suitable hosts would be available throughout this shipping season in the southern States and would be available during most of the shipping season (approximately April through September) in the rest of the U.S. Medfly were given a High rating for dispersal potential based on the fact that they have high biotic potential and could be transported long distances on infested plant material. Fruit flies could probably spread locally; as there is evidence that adults of *Ceratitis capitata* can fly 20 km or more (Fletcher 1989).	High (3)
Risk Factor 6: Moved to Suitable Habitat	
This sub element considers the geographical location of likely markets and the chance of the commodity to move to locations suitable for the pest's survival. Fruit that arrives in the United States does not normally arrive at a single port, and instead, it is distributed according to market demand.	High (3)
Risk Factor 7: Survive Post Harvest Treatment	
Demographics derived from United States Census data may be useful in predicting the distribution of imported citrus fruit by indicating population centers where demand may be greatest. Three of the four most populous States in the United States, Florida, Texas, and California, are in the southern tier of States where the climate most closely resembles the native climates for the pests analyzed (U.S. Census 2000). These three States account for approximately 25 percent of the total U.S. population (U.S. Census 2000). We assume that Peruvian citrus is distributed proportionally across the United States according to population.	High (3)

Risk Rating for Likelihood of Introduction (USDA, 2003)

Pest	Quantity Imported Annually	Survive Post-harvest Treatment	Survive Shipment	Not Detected at Port of Entry	Moved to Suitable Habitat	Contact with Host Material	Cumulative Risk Rating
Ceratitis capitata	Medium (2)	High (3)	Medium (2)	High (3)	High (3)	High (3)	High (16)

Cumulative Risk for the Likelihood of Introduction

Pest	Quantity Imported Annually	Survive Post-harvest Treatment	Survive Shipment	Not Detected at Port of Entry	Moved to Suitable Habitat	Contact with Host Material	Cumulative Risk Rating

Ceratitis capitata	Medium (2)	High (3)	Medium (2)	High (3)	High (3)	High (3)	High (16)

Pest Risk Potential

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

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
Ceratitis capitata	High (15)	High (16)	High (31)

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

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

Medium: Specific phytosanitary measure may be necessary.

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

Treatment for *Ceratitis capitata* infested fruit

The eggs and larvae of the fruit flies (*Ceratitis capitata*) are borne internally and, therefore, would be difficult to detect by officers at the port of arrival, especially if infestation of the fruit was not of such great age that damage was obvious. Fruit fly-infested fruit can go unrecognized (White and Elson-Harris 1992). The fruit can show signs of oviposition punctures; however, these are often difficult to detect in the early stages of infestation (CAB International 2002). The fruit flies may easily go undetected even if the fruit is dissected.

Because *C. capitata* are more difficult to detect compared to the other quarantine pests analyzed here, USDA requires a specific cold treatment schedule prior to entry for potential citrus fruit hosts of these pests. The current (as of 3/24/03) USDA approved cold treatment schedule (T107-a-1) for *Ceratitis capitata* in grapefruit, oranges, and clementines is either 34E F (1.11E C) or below for 15 days or 35E F (1.67E C) or below for 17 days (PPQ ,2003a). There are no other USDA approved treatment schedules for citrus fruit that may harbor *C. capitata.*

Treatment schedules are designed to approximate a probit 9 (9.9968%) mortality (APHIS, 2002a). In 2001, live *C. capitata* larvae were reported in imported Spanish clementines, which resulted in a review by USDA of the evidence supporting cold treatments (APHIS ,2002b)and a subsequent increase in the T107 cold treatment schedules for this fruit fly by two days (APHIS ,2002a); (Powell 2003). Research conducted by (Back 1916; Mason 1934; Baker 1939; Sproul 1976) were cited by the USDA review (APHIS 2002b) in recommending this increase by two days (*i.e.*, 34E F for 14 days and 35E F for 16 days). For example, using (Back 1916)data, (Baker 1939) estimated that the time needed at 34E F to provide probit 9 mortality of *C. capitata* is 14 days. This same 1916 data was also recently used to develop a time-temperature response surface model that further supports the conclusion that the previous treatment schedule fell short of the intended probit 9 level of security (Powell 2003). The T107-a-1 schedule described above (which is prescribed for *C. capitata*) was newly created because of the change to T107. The use of cold temperatures to destroy fruit flies has long been the subject of research (Back 1916; Mason 1934; Nel 1936; Petty 1931) as cited by (APHIS ,2002a). More recent research has refined and expanded the use of cold treatment to many more species and with a variety of equipment and conditions that all result in mortality close to 100% (Hill 1988 ;Santaballa 1999; Sproul 1976) as cited by (APHIS 2002a).

Historical Performance of Existing Cold Treatment Program

Nearly a century of experience in the movement of different commodities from infested to non-infested areas attests to the effectiveness of cold treatments. APHIS experiences with Spanish clementines during 2001 (i.e., the occurrence of live larvae in imported fruit after cold treatment) prompted the Agency to update its T107 cold treatment to provide additional safeguards and to minimize variability (APHIS 2002a).

As a result of live larval finds in Spanish clementines, not only was the T107 treatment schedule modified, but additional safeguards against *C. capitata* in Spanish clementines were also implemented, including traps to monitor adult populations in preferred hosts and a preharvest field certification/management plan to reduce the infestation rate of fruit to below detectable levels of 1 ½ percent after harvest (APHIS 2002a). APHIS (APHIS 2002a) examined these risk mitigation measures, as well as others, implemented to prevent the introduction of *C. capitata* in imports of citrus from Spain. The authors concluded that two elements are fundamental to the successful reduction of risks: the limitation of the pest population in the field and the application of quarantine cold treatments such that probit 9 mortality is approximated. In other words, the authors concluded that the combination of population control in production fields combined with effective cold treatments reduced overall risk compared to cold treatment alone. As the cold treatment schedules are designed to approximate probit 9 (9.9968%) mortality, this corresponds to a survival rate of 0.000032 (0.0032 percent) of all individuals exposed to the treatment. Because the treatment does not result in 100% mortality, the more larvae initially (that is, the higher the infestation rate), the higher is the total number of larvae able to survive treatment. In other words, high numbers of larvae in the fruit may overwhelm the ability of the cold treatment to provide quarantine security, which justifies the requirement reduced population levels after harvest. Also, the authors (APHIS 2002a) state that supplementary phytosanitary measures (e.g., surveys, port inspections, quality assurance, training, field trapping, and management of the pest in other hosts; US domestic fruit fly trapping, and others) provide additional safeguards that further diminish the potential effects of uncertainties and variability inherent in the system.

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

Emergency plan for *Ceratitis capitata* outbreaks

SAG has an emergency protocol in place in case a Medfly is captured during their routine trapping procedures. This protocol involves increasing the trapping rates, using both Trimedlure and hydrolyzed protein traps, fruit sampling, and trapping distance surrounding the initial capture. This protocol will continue for two life cycles of the Medfly as calculated by the degree/day formula. However, a single fly will be considered a single capture, only if there are no further captures within one life cycle. Multiple captures (i.e. more than one specimen, repeated captures within one life cycle, immature stages, or inseminated female) will trigger eradication actions.

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