Movement of Commercially Packed Citrus Fruit from Citrus Canker Disease Quarantine Area

Revised Risk Management Analysis

United States
Department
of Agriculture

Animal and
Plant Health
Inspection Service

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Executive Summary

This document analyzes the potential of fresh commercially packed citrus fruit and associated packing material to serve as a pathway for the introduction of *Xanthomonas axonopodis* pv. *citri* (Xac) into new areas. It also identifies and evaluates options for regulating the interstate movement of fresh citrus fruit with the goal of reducing the potential for Xac introduction and spread. This document follows an earlier APHIS pest risk analysis entitled "*Evaluation of asymptomatic citrus fruit (Citrus spp.) as a pathway for the introduction of citrus canker disease* (USDA 2007) by extending its application to all commercially packed citrus fruit. That analysis concluded that asymptomatic, commercially produced citrus fruit that has been treated with disinfectant dips and subjected to other mitigations is not epidemiologically significant[1] as a pathway for the introduction of citrus canker disease.

The current evaluation independently reviewed available evidence regarding the biology and epidemiology of Xac and the management of citrus canker disease and determined that commercially packed fresh citrus fruit is unlikely to serve as an epidemiologically significant pathway for the introduction and spread of the bacterium because:

- fresh citrus fruit is produced and harvested using techniques that reduce the prevalence of Xac-infected fruit;
- citrus fruit is commercially packed using techniques that reduce the prevalence of infected or contaminated fruit including disinfectant treatment for epiphytic contamination;
- mortality of Xac associated with fresh citrus fruit and/or packing materials occurs following harvest and packing;
- for a successful Xac infection that results in disease outbreaks an unlikely sequence of epidemiological events would have to occur;
- reports of citrus canker disease outbreaks linked to fresh fruit are absent; and
- large quantities of fresh citrus fruit shipped from regions with Xac have not resulted in any known outbreaks of citrus canker disease.

The evidence is not currently sufficient to conclude that fresh citrus fruit produced in a Xac infested grove cannot serve as a pathway for the introduction of Xac into new areas. This analysis evaluates several packinghouse-centered risk management options for the interstate movement of fresh commercially packed citrus fruit from regions with citrus canker disease to regions without the disease. These packinghouse measures were evaluated to determine if they provide an appropriate level of phytosanitary protection without the practical considerations that make it difficult to maintain the grove-centered regulatory systems approach in Florida that ensures only asymptomatic fruit will be shipped. The risk management options evaluated were:

[1] The term "epidemiologically significant" refers to minimum conditions required for successful Xac infection.

Option 1 Allow unrestricted distribution of all types and varieties of *commercially packed* citrus fruit to all U.S. States[2].

Option 2 Allow distribution of all types and varieties of *commercially packed* citrus fruit to all U.S. States, subject to packinghouse treatment with APHIS-approved disinfectant and APHIS inspection of finished[3] fruit for citrus canker disease symptoms.

Option 3 Allow distribution of all types and varieties of *commercially packed* citrus fruit (except tangerines) in U.S. States except U.S. commercial citrus producing States[4]. Allow distribution of *commercially packed* tangerines to all U.S. States including commercial citrus-producing States. Require packinghouse treatment of all such citrus fruit with APHIS-approved disinfectant and APHIS inspection of finished fruit (all types and varieties) for citrus canker disease symptoms.

Option 4 Allow distribution of all types and varieties of *commercially packed* citrus fruit in U.S. States except U.S. commercial citrus-producing States and require packinghouse treatment of citrus fruit with APHIS-approved disinfectant and APHIS inspection of finished fruit.

Option 5 Leave the current regulations for the interstate movement of citrus fruit from citrus canker disease quarantined areas in place and unchanged.

Each option was considered within the context of available scientific evidence. Option 1 would allow unrestricted distribution of all types and varieties of commercially packed citrus fruit to all U.S. States. But, given that the available evidence suggests fresh citrus fruit is unlikely to be an epidemiologically significant pathway but is not currently sufficient to conclude that fresh citrus fruit cannot serve as a pathway for the introduction of Xac into new areas, unrestricted movement of citrus fruit from quarantine areas was determined not to be scientifically justified. Consequently, the more restrictive Options 2, 3, 4 and 5 were evaluated and Option 1 was no longer considered.

A packinghouse-based inspection, included as part of Options 2, 3, and 4, could ensure an appropriate level of phytosanitary security; would be more reliable and less easily circumvented than the preharvest grove survey required by Option 5; would be consistent with the risk associated with citrus canker and commercially packed fruit from Florida; and would be easier and potentially less costly to implement and enforce than a grove-centered system of mitigations. In addition, a phytosanitary packinghouse inspection creates a performance standard for packed fruit that allows citrus producers greater flexibility to determine the most efficient and effective means of producing a compliant product.

To assist in evaluating Options 2, 3 and 4, we prepared a quantitative model (Appendix 1) based on Florida production and shipping data to determine the efficacy of three levels of phytosanitary inspection in ensuring that symptomatic commercially packed fruit does not enter U.S. commercial citrus-producing States. The three inspection levels were

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[2] For clarity, the term "State" is defined here as any of the 50 U.S. States or U.S. Commonwealths, Trusts and Territories

[3] Fruit that has completed the packinghouse washing, disinfection, culling and grading processes.

[4] American Samoa; Arizona; California; Florida; Guam; Hawaii; Louisiana; Northern Mariana Islands; Puerto Rico; Texas; and the Virgin Islands of the United States

determined by preliminary estimates of United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Citrus Health Response Program staff of inspection levels that might be operationally feasible. The three inspection levels evaluated were 500 fruit per lot; 1,000 fruit per lot; and 2,000 fruit per lot. Statistically, inspection of 500 fruit, 1,000 fruit or 2,000 fruit per lot will ensure, with 95 percent confidence, that the proportion of undetected fruit with visible symptoms in a released lot is no more than 0.75, 0.38 and 0.19 percent, respectively.

The outputs of the quantitative model were probability distributions. The model determined, with 95 percent confidence, that the total number of citrus fruit shipped from Florida to five citrus-producing States (AZ, CA, HI, LA and TX) over a single shipping season would be 152,234,658 or less if unlimited distribution is permitted. The model estimated, with 95 percent confidence, that the number of fruit with visible symptoms of Xac reaching those five States in a single shipping season would be: 519,178 or less at the 1,000 fruit inspection levels; about half that number at the 2,000 fruit inspectional level; and about double that number at the 500 fruit inspectional level. The model further estimated with 95 percent confidence that the number of fruit with visible symptoms of Xac reaching citrus-producing areas within those States in a single shipping season would be: 1,794 or less at the 1,000 fruit inspectional level; about half that number at the 2,000 fruit inspectional level; and about double that number at the 500 fruit inspectional level. An inspection level of 1000 fruit per lot that achieves a detection rate of 0.38 percent with 95 percent confidence was adopted because it provides the maximum level of detection that is operationally feasible with the phytosanitary inspection resources in Florida. For the majority of lots, this would amount to inspection of about 1000 fruit per lot.

The recognition that there is a statistical likelihood that, under Option 2, a very small number of commercially packed fruit with visible symptoms of Xac will escape undetected and potentially reach citrus producing States, coupled with the aforementioned uncertainty regarding fruit as a pathway, led to the determination that additional mitigations were required.

Option 3 would allow the shipment of tangerines to all U.S. States. This option was evaluated in response to a proposal that tangerines have considerably less susceptibility to Xac and therefore are less likely to introduce Xac to previously free regions. Tangerines are grouped in the species *Citrus reticulata* which is widely regarded as less susceptible to citrus canker disease than other commercially grown *Citrus* species (Civerolo 1984). But many of the "tangerine" varieties grown in Florida are hybrids of *C. reticulata* with other more susceptible *Citrus* species (Morton 1987). Tangerines are not immune to Xac. APHIS records indicate that during the 2005-2006 growing season grove surveys; Xac was detected on 274 samples from tangerine, tangor and tangelo groves. APHIS pest interception data indicate that between 1985 and 2006, Xac was intercepted 632 times on *C. reticulata* fruit.

The level of susceptibility is expressed as a continuum across "tangerine" varieties rather than as a discrete immunity for all varieties. This creates a regulatory problem when an overlap occurs in the level of susceptibility expressed by, for example, a more susceptible tangerine variety and a more resistant non-tangerine citrus variety. Sufficient evidence does not exist to exclude tangerines from regulations applicable to all other Florida citrus varieties.

Option 4 prohibits distribution of all types and varieties of citrus fruit, including tangerines, to citrus-producing States. Option 4 includes all the requirements of Option 3 and further mitigates the risk of Xac introduction by prohibiting the distribution of all types and varieties of citrus fruit, including tangerines, from areas with citrus canker disease to U.S. commercial citrus producing States. Like Options 2 and 3, Option 4 would change the regulations by substituting the packing house inspection described in Appendix 1 for the preharvest grove inspections currently in the regulation. The recognition that there is a statistical likelihood that a very small number of commercially packed fruit with visible symptoms of Xac will escape undetected and potentially reach citrus producing States, coupled with the aforementioned uncertainty regarding fruit as a pathway, led to the determination that the limited distribution mitigation was required.

Accordingly, this analysis recommends implementation of Option 4

To compensate for uncertainty in the rate of illegal fruit movement and ensure compliance with the distribution restrictions of this final rule, APHIS will routinely monitor wholesalers and fresh fruit markets in commercial citrus-producing States and distribution routes bound for commercial citrus-producing States to ensure that Florida citrus fruit does not unlawfully enter U.S. commercial citrus producing States. This monitoring will be conducted primarily by APHIS' Smuggling Interdiction and Trade Compliance program, which works with Federal, State and local cooperators to interdict smugglers, close illegal pathways, and prevent the unlawful entry and distribution of prohibited agricultural products that may harbor harmful, exotic plant and animal pests, disease, or invasive species. The packinghouse measures of inspection and disinfection ensure that even if a given shipment were illegally moved to a prohibited State, the shipment would have a low likelihood of containing fruit with the potential to cause an outbreak of citrus canker disease.

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1 Purpose and Scope

On January 10, 2006, the U.S. Department of Agriculture (USDA) announced the termination of its Florida eradication program for Asiatic citrus canker disease, caused by *Xanthomonas axonopodis* pv. *citri* ("Xac"). A letter from U.S. Deputy Secretary of Agriculture Chuck Conner to Florida Agriculture Commissioner Charles Bronson (2006) stated that the decision was made "in light of…expert analysis on the distribution of the disease and the infeasibility of eradication."

As a result, the USDA's, Animal and Plant Health Inspection Service (APHIS) published an interim rule (FR 2006) quarantining the entire State of Florida for citrus canker disease and amending the regulatory requirements for the movement of fresh fruit from Florida. APHIS considered allowing interstate movement of Florida citrus fruit to any domestic location, but did not have sufficient epidemiological information at the time to justify such a decision.

Since then, APHIS has prepared an analysis entitled "*Evaluation of asymptomatic citrus fruit (Citrus spp.) as a pathway for the introduction of citrus canker disease"* (USDA 2007), which has been made available for public comment and peer review (FR 2006). That analysis assumed that commercially produced citrus is cultivated under specific pest management practices including field treatments with copper-based pesticides for controlling the incidence of citrus canker; grove sanitation; fruit culling procedures during harvest and packing; and, a post-harvest surface disinfectant dip treatment. The evaluation concluded "…that asymptomatic, commercially produced citrus fruit that has been treated with disinfectant dips and subjected to other mitigations is not epidemiologically significant[5] as a pathway for the introduction of citrus canker."

Where the previous analysis (USDA 2007) assumed that citrus fruit was commercially produced under a specific set of pest management practices, the present document, while recognizing that effective pest management measures for Xac are available to private and commercial growers (Chamberlain *et al.* 2001; Timmer *et al.* 2006), and are normal production practices for many of these growers, does not assume that measures in the grove are mandatory. Furthermore, the previous analysis (USDA 2007) focused on the role of *asymptomatic* fruit only as a pathway for Xac introduction while the present analysis expands the scope of the aforementioned analysis and evaluates all commercially packed fresh citrus fruit.

The present document independently summarizes available scientific, technical and historical information relevant to the movement of fresh citrus fruit from citrus canker disease quarantine areas as a potential pathway for the introduction of Xac into areas where citrus canker disease does not occur. Based on that information, the analysis identifies and evaluates operationally feasible options for regulating interstate movement

[5] The term "epidemiologically significant" refers to minimum conditions required for successful Xac infection .

of fresh citrus fruit that reduce the potential for that fruit to serve as a pathway for the introduction of Xac. Together, USDA (2007) and this analysis provide the scientific basis for a change in APHIS regulations for the interstate movement of fresh commercial citrus fruit from regions with citrus canker disease.

2 Definitions

Abaxial: Directed away from the stem of a plant; pertaining to the lower surface of a leaf (see adaxial) (D'Arcy *et al.* 2001).
Adaxial: Directed toward the stem of a plant; pertaining to the upper surface of a leaf (see abaxial) (D'Arcy *et al.* 2001).
cfu (Colony Forming Units): The number of colonies formed per unit of volume or weight of a [bacterial] cell or spore suspension (D'Arcy *et al.* 2001).
Endoparasite: Parasitic organism that lives and feeds from inside its host (D'Arcy *et al.* 2001).
Epidermis: The superficial layer of cells occurring on all plant parts (Agrios 1997).
Epiphytic bacteria: Those bacteria that could be washed from the plant surface (Rybak and Canteros 2001).
Establishment: Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2006a).
Inoculum: The pathogen or its parts that can cause infection. That portion of individual pathogens that are brought into contact with the host (Agrios 1997).
Introduction: The entry of a pest resulting in its establishment (FAO 2006a).
Latent infection: Infection unaccompanied by visible symptoms (D'Arcy *et al.* 2001).
Lesion: Localized diseased area or wound (D'Arcy *et al.* 2001).
Lot: The inspectional unit for fruit; composed of a single variety of fruit that has passed through the entire packing process in a single continuous run not to exceed a single work day (*i.e*., a run started one day and completed the next is considered two lots); the lot size is used to determine the size of the sample for phytosanitary inspection; regulatory actions (*e.g.,* issuance of limited permits, rejection) are taken at the lot level.
Mesophyll: The tissue of a leaf, located between the upper and lower layers of epidermis (Stern 1982).
Pathway: Any means that allows the entry or spread of a pest (FAO 2006a).
Rutaceae: Botanical family comprising about 150 genera and 900 to 1500 species of warm temperate to tropical trees and shrubs. This family includes all of the citrus fruits such as oranges, lemons, limes, grapefruits and tangerines (Anonymous 2003).
Stoma (pl. stomata): A pore in the epidermis of aerial parts of the plant providing a means for gaseous exchange between internal tissues and the atmosphere (Blackmore and Toothill 1984).

3 USDA Regulatory Policy: Xac and Citrus Canker Disease

The USDA regulatory policy on citrus canker disease and its causal agent, Xac, has evolved along two different but related paths. The first path is the regulation of the movement of domestic citrus fruit after detections of Xac in Florida. The second is the regulation of imported citrus fruit to mitigate the likelihood of introducing Xac. This section describes the evolution of USDA's domestic and import regulatory policies for Xac.

3.1 Domestic Citrus Regulations

Xac was probably introduced into the United States around 1910 in nursery stock imported from Japan (Dopson 1964; Stall and Seymour 1983). By 1914, "…the disease had spread so fast and was so virulent in its effects that it was recognized as a threat to the existence of the entire citrus industry of the Gulf States" (Dopson 1964). The following year, Congress appropriated the first Federal funds to eradicate a plant disease and a USDA-Florida cooperative eradication program for canker was initiated. By 1927, at a cost of $6 million and with the destruction of millions of trees, canker was eradicated from Florida (Dopson 1964; Graham and Gottwald 1991a). By 1943, citrus canker disease was eradicated from the rest of the Gulf States (Dopson 1964).

Xac was again detected in Florida in the mid-1980s (Schoulties and Miller 1985) leading the USDA to take emergency action to eradicate the disease and to create a new domestic quarantine for citrus canker disease, 7CFR 301.75 (FR 1984). Focused primarily on eradicating citrus canker disease, the regulation was highly restrictive. The regulation implicitly assumed that all transmission pathways were at least conceptually possible and therefore appropriate to regulate. The regulation defined the limits of the quarantined area, identified regulated articles (which included fruit) and specified requirements for the movement of regulated articles. Under this regulation, fruit could be shipped interstate under limited permit, provided that "the fruit originated in an area found to be free of citrus canker disease based on surveys…the fruit is free of leaves, litter and stems…and…the fruit has been treated by a thorough wetting with a solution containing 200 parts per million active chlorine for at least two minutes" (FR 1985). The fruit was prohibited from moving to American Samoa, Arizona, California, Hawaii, Louisiana, Puerto Rico or Texas. Later, Guam, the Northern Marianas Islands and the U.S. Virgin Islands were added to the prohibited destinations (FR 1985). In 1988, these prohibitions were removed, allowing fruit to ship to all U.S. States and Territories, if it met additional grove survey and inspection requirements (FR 1988). On March 17, 1994, the USDA declared that Xac had been eradicated in Florida and that "Citrus canker is not known to exist in the United States" (FR 1994).

In September 1995, a third outbreak of Xac was detected on a residential citrus planting in Dade County, Florida (Schubert *et al.* 1996), and the citrus canker disease quarantine was reinstated in Florida in January, 1996 (FR 1996), again with the goal of disease eradication. The restrictions on the movement of regulated articles instituted during the previous outbreak and codified at 7CFR 301.75 remained in force. In 1999, provision was made to allow for fruit grown outside the quarantine area to move into the quarantine area for packing and subsequent shipment to all U.S. States and Territories (FR 1999, 2002).

On January 10, 2006, the USDA recognized the infeasibility of eradicating *Xac* in Florida (Conner 2006) and officially terminated the eradication program. On August 1, 2006, APHIS published an interim rule (FR 2006) extending the existing quarantine region within Florida to include the entire State. Being an emergency action taken in response to the recent extensive spread of citrus canker disease and the termination of the eradication program, the interim rule was not based on a formal risk assessment. The rule maintained the existing restrictions on the movement of regulated articles but applied them to articles originating anywhere in Florida. The rule noted that "The exceptionally active hurricane seasons in 2004 and 2005 were devastating to the citrus canker eradication program…surveys show that citrus canker has become so widespread within Florida that approximately 75 percent of commercial groves in the State are now located within 5 miles of a location where the disease has been detected…" The requirements for the movement of fresh fruit from Florida were amended to reflect that the entire State was now designated as a quarantine area.

3.2 Regulations for Imported Citrus

Based on its experience with the 1914 citrus canker disease outbreak, USDA perceived the likelihood and consequences of Xac introduction to be sufficiently high to justify implementing the trade regulations now known as Quarantine 19 (7CFR 319.19) and Quarantine 28 (7CFR 319.28). Quarantine 19, effective January 1, 1915, regulates the importation of citrus plants and plant parts, except fruit and seeds. Quarantine 28, effective August 1, 1917, prohibits the importation of citrus fruit and peel from specified countries and regions where Xac and certain other citrus diseases are known to occur. APHIS, with few exceptions, prohibited the importation of fresh citrus fruit from all regions with Xac. In those few instances where APHIS did allow the entry of fruit from countries or regions with citrus canker disease, the Agency required multiple, independent, and often complex mitigations.

In 1967, Quarantine 28 was amended to permit importation of Unshu oranges from Japan into Alaska, Hawaii, Idaho, Oregon and Washington. In 1987, Quarantine 28 was again amended to expand importation into all areas except citrus producing States, buffer States and U.S. Territories and in 1994, the regulation was amended further to allow importation into buffer States. Upon request from Japan, APHIS conducted an analysis to determine risks associated with Unshu orange importation into citrus producing States (USDA 1995). The analysis identified several quarantine pests of concern including Xac and recommended a variety of risk mitigating measures. These included requirements that, among other things, imported fruit be grown and packed in canker-free export areas, export groves are surrounded by 400m buffer zones, and that APHIS and Japanese inspectors jointly inspect production areas and buffer zones. Based on the analysis, in 2002, Japanese Unshu oranges were permitted entry into citrus producing U.S. States.

The 1995 analysis on which APHIS based its rule allowing the importation of Japanese Unshu oranges into citrus-producing U.S. States did not specifically assess the likelihood that fruit are a pathway for introducing Xac. Rather, the analysis was based on the longstanding position that symptomatic fruit could be an epidemiologically significant pathway for introduction; it then proposed risk mitigation measures to interrupt that pathway based on the Agency's interpretation of the evidence available at the time.

3.3 Policy Shift

The shift in domestic regulatory policy away from citrus canker disease eradication and towards disease management provides incentive to re-evaluate the scientific basis for the Agency's regulations on the movement of fresh citrus fruit. The approach of domestic citrus canker regulations had been to designate as quarantined areas those places where Xac was found and restrict the movement of fruit from these areas while allowing unrestricted movement of fruit from areas not under quarantine. The decision to terminate the citrus canker disease eradication program prompted APHIS to re-evaluate its citrus canker disease regulations for domestic citrus, especially its regulations for the movement of fresh citrus fruit from areas designated as quarantined areas for citrus canker disease. Most importantly, APHIS began to question whether fresh commercially packed citrus fruit is an epidemiologically significant pathway for the long distance introduction and spread of Xac in light of scientific evidence accrued since those regulations were originally promulgated.

4 Citrus Canker Disease

Citrus canker disease is caused by the plant pathogenic bacterium *Xanthomonas axonopodis* pv. *citri* (Xac). Recently, the bacterial nomenclature for the citrus canker disease bacterium has changed and the name with official standing in nomenclature is now *Xanthomonas citri* subspecies *citri* (ex Hasse 1915) Gabriel et al. 1989 (Schaad 2006; Euzéby 2007). Although this new name has been published, in this work, we preferred to use the *Xanthomonas axonopodis* pv. *citri* (Xac) nomenclature because the new one has not been adopted by plant protection regulatory services worldwide (including APHIS). The bacterium infects leaves, stems and fruit attached to the tree (Leite and Mohan 1990; Gottwald *et al.* 2002) of species in the plant family Rutaceae, including economically important citrus species (CABI/EPPO 1997).

Figure 1 Lesions on a citrus leaf and immature fruit caused by Xac (photo by Dan Robl).

Infections are non-systemic, *i.e*. they do not spread from inside the plant (Silva *et al.* 2002). Xac enters host plant tissues through natural openings, *e.g.*, stomata (Gottwald and Graham 1992) and wounds (Civerolo 1984). Xac enters its hosts naturally by rain splash directly through stomata or by way of wounds. There is no evident epiphytic growth stage (Brunings and Gabriel 2003). Symptom expression of citrus canker disease varies depending on the age of the lesions, the plant part affected and its age, and the species of *Citrus* infected. New leaf lesions develop as pin point spots then expand to lesions 2 to 10 mm in diameter on both surfaces of infected leaves, later become corky and crater-like, and often are surrounded by a yellow halo (Gottwald and Graham 2000; Pruvost *et al.* 2002; Timmer *et al.* 2005) (Figure 1). Xac lesions on fruit and stems generally resemble those on leaves (Gottwald and Graham 2000). Fruit lesions penetrate only the rind (Civerolo 1984) and are variable in size (Gottwald and Graham 2000).

The presence of free moisture triggers release of Xac bacteria as an ooze from lesions (Figure 2) (Pruvost *et al.* 2002). The oozing bacteria are dispersed by rain splashing and wind-driven rain (Pruvost *et al.* 2002) mostly within infected trees or to neighboring trees (Gottwald and Graham 2000). Short distance spread of Xac within trees, and from tree to tree, occurs primarily via wind-driven rain, especially during storms and hurricanes (Civerolo 1984; Goto 1992; Gottwald *et al.* 1997). Longer distance movement of bacteria is attributed to severe weather events or human assisted movement of infected or contaminated plants, plant material, equipment, containers or conveyances (Gottwald and Graham 2000). There is no authenticated record of the movement of fresh fruit infected with Xac being related to the epidemiology of citrus canker disease (CABI/EPPO 1997; Gottwald and Graham 2000). Long distance dispersal of Xac by animals, birds, and insects has not been conclusively demonstrated (Jetter *et al.* 2000).
Strong winds that cause injuries on leaves, twigs, and fruit, and rainstorms (as well as thunderstorms, tornadoes, tropical storms and hurricanes) that disperse the pathogen, facilitate infection. Xac infection can be facilitated by feeding activities of the citrus leaf miner (*Phyllocnistis citrella*) (Sinha *et al.* 1972; Gottwald *et al.* 2002).

Major outbreaks of citrus canker disease occur when abundant bacterial inoculum is present in combination with susceptible plant tissues (Gottwald and Graham 1992), and frequent rainfall with warm weather and high winds (Serizawa and Inoue 1974; Gottwald and Graham 1992). Three such outbreaks have occurred in the United States, one affecting the Gulf Coast States (beginning around 1910), and two others confined to Florida (from the mid 1980s to 1994 and the current outbreak which started in 1995).

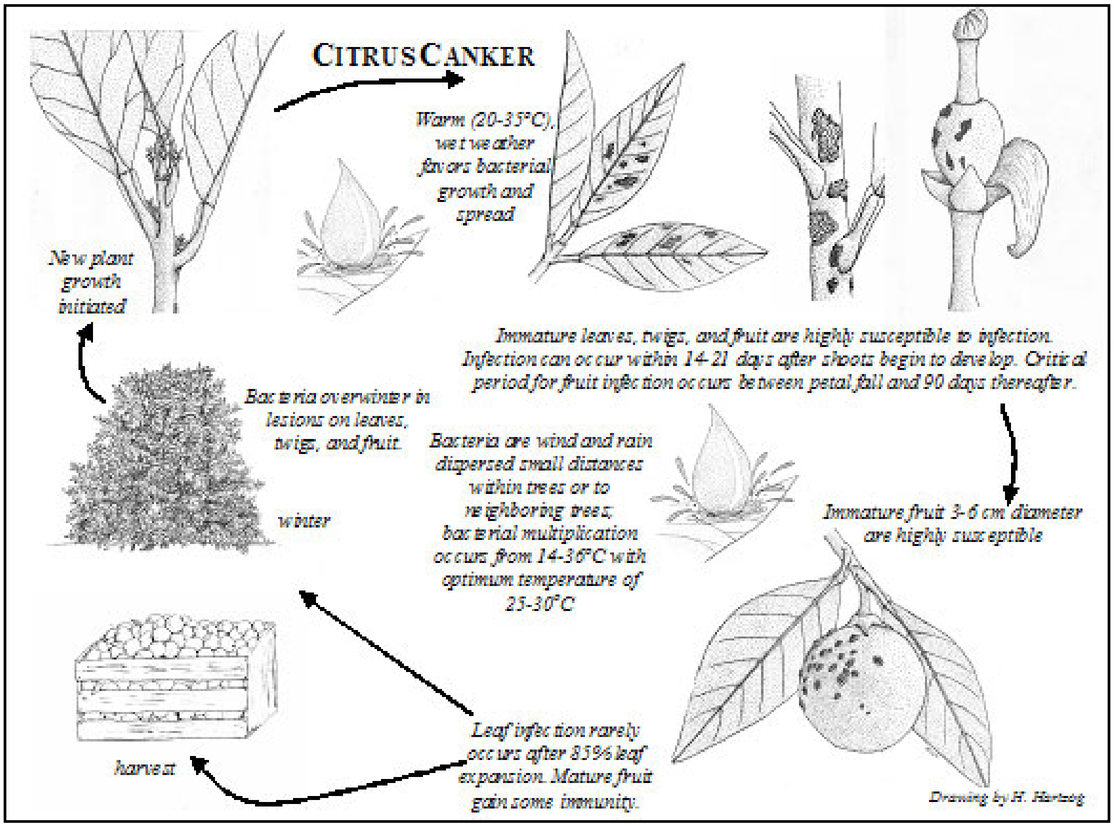

Figure 2. Disease cycle of citrus canker disease caused by *Xanthomonas axonopodis* pv. *citri*.

5 The Movement of Fresh, Commercial Citrus Fruit as a Pathway for the Introduction of Xac

This analysis focuses on commercially packed, fresh citrus fruit as a pathway for the introduction of Xac. Previous analyses on the topic (USDA 1995; Schubert *et al.* 1999b; USDA 2007) have concluded that the likelihood of introducing Xac into previously free areas on commercially produced and packed citrus fruit is low for the following reasons: 1) Fresh citrus fruit is produced and harvested using techniques that reduce the prevalence of Xac-infected fruit; 2) symptomatic fruit are culled and all fruit are treated for epiphytic contamination by Xac with disinfectants during commercial packing; 3) the mortality of Xac associated with fresh citrus fruit and/or packing materials that occurs following harvest and packing; 5) for a successful Xac infection that results in disease outbreaks an unlikely sequence of epidemiological events would have to occur; 6) reports of citrus canker disease outbreaks linked to fresh fruit are absent; and 7) large quantities of fresh citrus fruit shipped for many years from regions with Xac have not resulted in any known outbreaks of citrus canker disease. The following sections summarize available evidence supporting these conclusions.

This section evaluates evidence summarized from "*Evaluation of asymptomatic citrus fruit (Citrus spp.) as a pathway for the introduction of citrus canker disease*" (USDA 2007) and additional evidence from the scientific literature.

5.1 Fresh Citrus Fruit Production and Harvesting Techniques That Reduce the Prevalence of Xac-infected Fruit

This section evaluates evidence for the likelihood that Xac infected or contaminated citrus fruit will be harvested and delivered to the packinghouse. The magnitude of the hazard at this stage will depend in large part on the proportion of infected fruit, and the nature of the contamination. Groves in infested areas may have citrus canker infected fruit at varying levels, depending on the prevalence of inoculum, the susceptibility of the variety, climatic, environmental, and cultural conditions. Presence of Xac on fruit may be associated with lesions, injuries, or blemishes, or it may be epiphytic (surface contamination). We found no reports of endoparasitic infection inside fruit that does not exhibit symptoms. Infections are non-systemic; i.e., they do not spread from within the plant (Silva *et al.* 2002).

Guidelines. Practices such as pre-harvest grove inspections, designation and exclusion of infected trees, enhanced inspection of fruit in field bins, *etc*., may reduce the likelihood that symptomatic fruit is harvested and transported to the packinghouse (CHRP 2006; Kinney 2007). The efficacy of these measures and the level to which they are applied is difficult to assess since such practices are not required by any current State or Federal regulations and thus are not monitored.

Chemical and cultural control. Disease management practices in citrus groves and nurseries, including the application of prophylactic copper sprays and use of windbreaks, can reduce, but do not eliminate Xac populations in a grove (Stall *et al.* 1980; Stall *et al.* 1981; Gottwald and Timmer 1995; Dixon *et al.* 2000; Canteros 2004; Graham *et al.* 2004). Well-timed field treatments significantly reduce the prevalence of disease, the level of inoculum, and the number of symptomatic fruit in the field. Prophylactic sprays of copper oxychloride (or other copper-containing compounds) provide protection against initial infection in canker-endemic areas during growth flushes and early fruit development (fruit approximately 2-6 cm diameter) (Koizumi 1977b; Kuhara 1978; Stall *et al.* 1980; Medina-Urrutia *et al.* 1985; Leite and Mohan 1990; Das and Shyam 2003; Graham and Leite 2004) and reduce the prevalence of Xac infection in the field (Stall *et al.* 1980; Leite and Mohan 1990; Gottwald *et al.* 2002). Windbreaks "significantly reduced both disease increase and spatial spread of citrus canker [on grapefruit] over time" (Gottwald and Timmer 1995). Grapefruit with no windbreaks peaked at 35 percent disease incidence, while grapefruit with windbreaks never peaked above 5 percent disease incidence (Gottwald and Timmer 1995). Combinations of prophylactic sprays and cultural control practices, such as windbreaks and pruning diseased shoots, further reduce disease incidence (Kuhara 1978; Leite and Mohan 1990; Leite 2000; Das 2003).

Culling and selection in the field. Currently in Florida, harvesting measures to selectively pick fruit free of citrus canker disease lesions are not required by regulation, nor is it assumed by this document that they will be widely practiced. APHIS field personnel indicate that packinghouse buyers scout fields for disease incidence, but it is not known how widespread or effective this practice is. The Florida Citrus Packers (Kinney 2007) indicated the industry proposes to develop best management practices including: collaborative grower and packer grove inspections; diversion of fruit from infected trees to processing; and inspection of fruit in field bins before delivery to packinghouses. These best practices will be voluntary when implemented.

Symptom expression. Culling of Xac infected fruit, whether in the field or subsequently in the packinghouse, is based on the observation of symptoms. Citrus canker is mainly a leaf spotting and fruit blemishing disease (Gottwald and Graham 2000). Conspicuous lesions typically develop on leaves, stems and fruit (Civerolo 1984; Gottwald and Graham 2000). Immature fruit infected early in their development may develop severe symptoms including cracking and malformation (Verniere *et al.* 2003). Koizumi (1972) found that fruit inoculated by pin prick prior to 60 percent expansion developed typical erumpent, corky lesions 2 to 5 mm in diameter while late infections (65 to 85 percent expansion) developed less typical nonerumpent or pinpoint greenish spots 0.1 to 1.5 mm in diameter. The lesions Koizumi observed resulted from a combination of artificial (prick) inoculations and natural infections and therefore provides little information about how the ratio of typical to atypical lesions on fruit varies under natural conditions. Koizumi speculated that the atypical lesions were the result of restricted expansion brought on by physiological changes in the maturing fruit and lower ambient temperatures. As noted by Graham, *et al.* (1992b), the small late season lesions were characterized by a "lack of bacterial proliferation." While other studies have conducted similar inoculation tests on fruit before (Fulton and Bowman 1929) and after (Graham *et al.* 1992b; Verniere *et al.* 2003), Koizumi (1972) remains the only paper to describe this type of lesion. Goto (1969) found in a wound inoculation study that "…latent infections were never observed."

Tissue susceptibility. Fruit are susceptible to natural (stomatal) infection from petal fall until they are fully expanded (around 6 cm in diameter for some varieties), and are most susceptible after stomata form and fruit is in a stage of rapid expansion, a period of about 90 to 120 days (at a fruit diameter of about 2-6 cm for some varieties) (Goto 1972; Koizumi 1972; Graham *et al.* 1992b; Verniere *et al.* 2003). Mature citrus fruit have natural wax layers on their surface, decreasing susceptibility by reducing access to natural openings, such as stomata (Albrigo 1972; Albrigo 1976; Graham *et al.* 1992b). Mature, aboveground citrus tissues can be infected through wounds (Gottwald *et al.* 2002). Goto (1969) used carborundum rub inoculation to abrade the surface of mature fruit and extend the susceptible period of orange and mandarin fruit on the tree beyond the fruit maturity susceptible to natural (stomatal) infection. The Asian leafminer (*Phyllocnistis citrella* Stainton) interacts with Xac by providing wounds that serve as infection courts in leaves and, to a lesser extent, fruit (Schubert *et al.* 2001; Gottwald *et al.* 2002). Leafminer wounds create suitable microclimates for Xac development (Chagas *et al.* 2001). Leafminer-damaged leaves have more and larger lesions (Sohi and Sandhu 1968; Sinha *et al.* 1972). The presence of the leafminer can lead to significant field infection even on normally resistant cultivars and species of citrus (Sinha *et al.* 1972; Cook 1988).

Equipment decontamination. The Citrus Health Response Plan (CHRP 2006) recommends decontamination of vehicles and equipment moving between Xac infected groves and packinghouses. Such decontamination consists of the removal of all leaves, twigs, and other plant parts from the equipment and subsequent treatment with approved disinfectants, such as sodium hypochlorite, quaternary ammonium chloride, hot water and detergent under high pressure, or steam (Schubert *et al.* 1999a; Roberts *et al.* 2004; Code of Federal Regulations 2006a).

SUMMARY

- Disease management practices in the grove, including the application of prophylactic copper sprays and use of windbreaks, *etc.* may reduce, but do not eliminate Xac populations in a grove.
- Commercially produced fruit harvested in areas where Xac exists may be visibly infected or the fruit may carry the pathogen either on its surface or in wounds without showing typical symptoms.
- Commercially harvested fruit from Xac infested areas is likely to be contaminated with epiphytic populations of Xac.
- Infection of citrus fruit by Xac between harvest and packinghouse is not likely.

5.2 Commercial Citrus Fruit Packing Techniques That Reduce the Prevalence of Infected or Contaminated Fruit

Citrus fruit, once in a commercial packinghouse, are subjected to cleaning and sanitizing processes to minimize surface contaminants and pathogens, and produce clean and attractive fruit for the fresh market (Figure 3). Diseased, damaged, disfigured, and blemished fruits are culled in the packinghouse. These post-harvest measures are largely voluntary, but USDA-APHIS-Plant Protection and Quarantine (PPQ) provides guidance on their use in the Citrus Health Response Plan (CHRP 2006), without mandating their application. Citrus packinghouses in Florida vary in size, scale, and level of mechanization; however, most employ some or all of the following post-harvest measures which can reduce survival of Xac inoculum associated with fruit. This section documents evidence relating to the likelihood that viable Xac will survive packinghouse processes and treatments and will escape detection to be packed in or on commercial citrus fruit.

Fruit handling and packinghouse sanitation. Packinghouses may have one to several steps at which fruit are handled by workers, from initial dump of fruit, to intermediate grading steps for blemishes, size or color, to the final packing stage where finished fruit[6] are placed in boxes or bags for transport. The U.S. Food and Drug Administration's (FDA) has developed Good Agricultural Practices (GAP) (Food and Drug Administration 2003) and the USDA has drafted the Citrus Health Response Plan (CHRP 2006) to provide packinghouse managers with guidelines for the production and packing of citrus. Sanitation measures included in GAP which would likely reduce Xac contamination in packinghouses include: maintenance of sanitizers (*e.g*. chlorine or sodium orthophenylphenate– SOPP) at proper concentrations and pH; use of good hygienic practices by workers; proper use of gloves; cleaning packing areas, storage facilities and bins with approved sanitizers before use; separation of unwashed fruit from clean packed fruit; cleaning, sanitizing, and maintenance of equipment; preparation of packing cartons as needed to prevent contamination; and prevention of fruit injury (Ritenour 2001; Goodrich 2005). To prevent product losses due to decay, producers also seek to reduce inoculum of postharvest decay pathogens on fruit (Narciso 2005).

Debris removal and washing. As fruit is initially emptied onto the packing line, field bins are washed using approved disinfectants (Schubert *et al.* 1999a; Roberts *et al.* 2004; Code of Federal Regulations 2006a). Potential sources of Xac inoculum such as infected stems, leaves, and rotten or split fruit are removed (Miller *et al.* 2001). Washing and sanitizing procedures may be done separately or combined in the packinghouse. If washing is done separately, the citrus fruit is washed with a detergent solution for a minimum of 20 to 30 seconds over rotating brushes (Jarrett and Tugwell 1975; Miller *et al.* 2001). Graham and Gottwald (1991b) reported significant reductions in *X. axonopodis* pv. *citrumelo* survival on citrus fruit by simulating packinghouse processes using brush-aided washing with and without SOPP. Washing removes organic matter and increases the effectiveness of sanitizing treatments, such as chlorine (Brown and Schubert 1987), and reduces surface bacterial populations, including Xac (Canteros *et al.* 2001). In laboratory tests in Argentina, Canteros, *et al.* (2001) noted reductions of one to three orders of magnitude in the number of Xac cells on the surface of artificially inoculated fruit when "fruits were prewashed as in a packinghouse".

[6] Fruit that has completed the packinghouse washing, disinfection, grading and inspection processes.

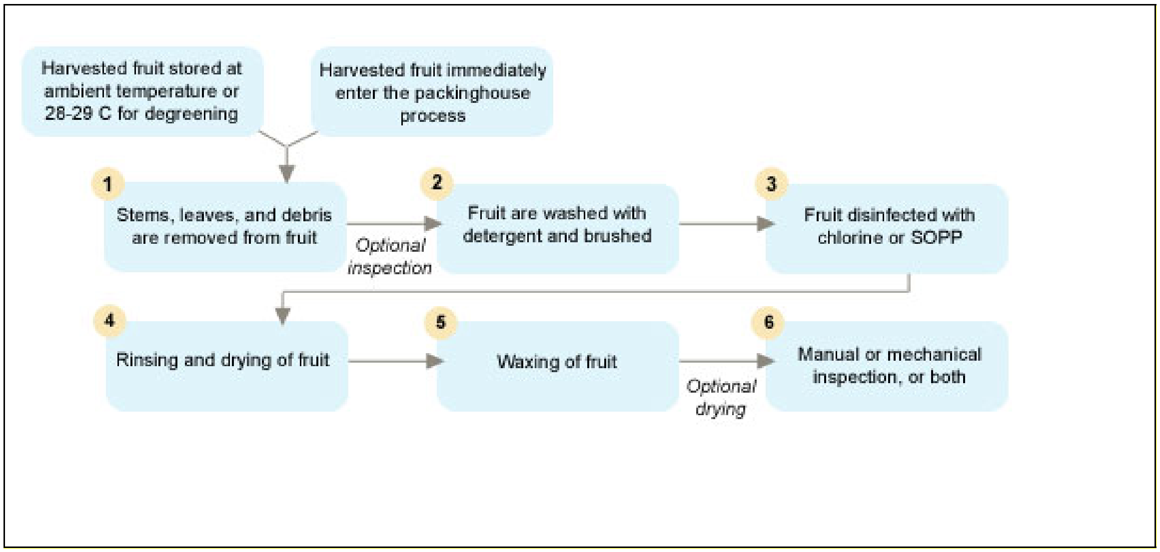

Figure 3. General steps of the standard packinghouse process for fresh citrus fruit. The blue boxes represent the main steps applied to citrus fruit. Italicized text in between the blue boxes represents optional steps that may be taken.

Disinfection of fruit. Two compounds are currently approved by USDA for disinfection of fresh citrus fruit: chlorine (treat 2 minutes at 200 ppm sodium hypochlorite, pH 6.0-7.5 where sodium hypochlorite concentrations are verified by monitoring the concentration of available chlorine) and SOPP (45 seconds to 1 minute, depending on detergent concentration, SOPP at 1.86-2.0 %) (Code of Federal Regulations 2006b). Various studies demonstrated the effectiveness of these disinfectants in reducing numbers of Xac cells or similar bacteria to low or undetectable levels (Obata *et al.* 1969; Brown and Schubert 1987; Canteros *et al.* 2001). Brown and Schubert (1987) studied disinfectants applied alone and during washing, to evaluate impacts on *Xanthomonas campestris* pv. *vesicatoria* (Xcv), as a proxy for Xac. Chlorine dips of artificially inoculated fruit have been shown to eradicate *Xanthomonas campestris* pv *vesicatoria*, a closely related bacterium (Brown and Schubert 1987). "All formulations [of SOPP tested] effectively eradicated cells of *X. c.* pv. *vesicatoria* from the fruit surfaces (Brown and Schubert 1987)."

When the washing process includes a disinfectant, such as 200 ppm chlorine or SOPP, Xac populations are significantly reduced to low or undetectable levels (Obata *et al.* 1969; Graham and Gottwald 1991a).The use of 200 ppm chlorine for 2 minutes reduces natural bacterial populations on citrus fruits by 77 to 99 percent; no Xac was recovered post-treatment, although the authors did not assess the level of Xac (if any) that was present on the fruit prior to treatment (Stapleton 1986). Similar results were obtained using chlorine and/or SOPP treatments; fruit with $<10^7$ cells/ml of Xac dipped in 100 ppm chlorine yielded no detectable levels of bacteria (Obata *et al.* 1969). In vitro tests exposing Xac to as little as 0.1 ppm chlorine eliminated all Xac bacteria (Stapleton 1987).

Successive treatments of sodium hypochlorite and SOPP, common in many packinghouse procedures are highly effective in eliminating epiphytic populations of Xac, although only single sanitizing agents are required in Florida packinghouses. "Disinfected fruits treated with SH [sodium hypochlorite] followed by SOPP in plates and plants did not yield any living bacteria: 0 (0) cells/fruit (Canteros *et al.* 2001)."

Verdier *et al.*(2006) in an unpublished study submitted with public comments to publication of the 2006 interim rule (FR 2006) reported that when a small number (five replications, total of 72 fruits) of asymptomatic, naturally infested citrus fruits were treated with chlorine and SOPP the number of Xac cfu in the solution used to wash the fruit was dramatically reduced. Only 3 percent (all from a single replication) of the treated fruit were positive for Xac when tested by plating the wash solution on selective media, as compared to 67 percent of the untreated controls and the bacterial population in the wash solution was reduced 99.8 percent from an average of 39.4 cfu/ml on untreated controls to an average of 0.06 cfu/ml on treated fruit.

APHIS has evaluated a third disinfectant treatment option to the currently approved disinfectant treatments. The treatment for use on citrus fruit and equipment is a solution containing 85 parts per million peroxyacetic acid (PAA) which is to remain in contact with the fruit surface for at least 1 minute. This use is consistent with the product label for PAA. PAA is effective against a broad range of microorganisms and their spores including the citrus canker bacterium (USDA-APHIS 1999). USDA PPQ Treatment Quality Assurance Unit evaluated data required by the Florida Department of Agriculture and Consumer Services for labeling and provided from third party laboratories on the efficacy of PAA products (Parra 2007).

For those experiments, *X. axonopodis* pv. *citrumelo* cultures were utilized in testing of the PAA products rather than the citrus canker bacteria, *X. axonopodis* pv. *citri*. *X. axonopodis* pv. *citrumelo* is considered to be a suitable surrogate. Experiments were conducted by third party laboratories in conformance with AOAC Method 960.09 for Germicidal and Detergent Sanitizing Action of Disinfectants and ASTM Standard Test Method (E 1153-94) for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces and fulfills EPA requirements. At product rates of 85 ppm and 200 ppm PAA, with exposure times of 30 seconds and 1 minute, the tests met the standard efficacy (99.999% reduction of a known concentration of *X. a.* pv. *citrumelo*) at all tested concentrations (Parra 2007). One test was conducted directly on citrus fruit surfaces for reduction of *Salmonella sp*. on the surface of the fruit. In general, *Salmonella* is more resistant to disinfection by peroxyacetic acid than *Xanthomonas*. The 85 ppm level of PAA provided a 99.999% reduction of Salmonella on the fruit surface (Parra 2007). Based on their evaluation of this data, USDA PPQ Treatment Quality Assurance Unit determined that PAA treatment at 85 ppm for a 1 minute exposure is efficacious against *Xanthomonas axonpodis* pv. *citri* on citrus fruit (Parra 2007).

Bacteria within lesions may be more protected from the detrimental effects of washing, disinfection and drying. Viable Xac has been recovered by APHIS pathologists from citrus canker lesions on fruit culled from packinghouse lines after postharvest treatments. (Riley 2007).

Rinsing and drying. After washing and disinfection, fruit are rinsed and excess water is removed, either mechanically, or with forced air or heat (Miller *et al.* 2001). Hot air drying (58ºC for 2.5 min.) is generally used after wax/fungicide application, but may be used before wax/fungicide application as well (Schubert *et al.* 1999b). Hot air drying, or even air drying, may further reduce viable bacteria on the surface of fruit, since artificially applied Xac inoculum on citrus fruit surfaces dies when exposed to air drying (Stapleton 1986). Survival of naturally occurring inoculum may differ from artificially applied inoculum (Schubert *et al.* 1999b) and inoculum levels present on fruit may also influence survival (Stapleton 1986).

Wax/fungicide application and drying. The fruit typically is coated in wax which may contain fungicide 1,794. Waxing itself seems to have limited impact on Xac populations on fruit surfaces. Rybak and Canteros (2001) detected low numbers of Xac cells on lesion-free, non-disinfected fruit of grapefruit, lemon, and orange whether they were waxed or not. Schubert, *et al.* (1999b) noted that an unpublished study by Schubert and Leahy in 1991 found that the combination of wax and hot air drying reduced *X. axonopodis* pv. *citrumelo* inoculum levels on citrus fruit to "very low levels."

Packinghouse culling and grading. Packinghouse culling and grading is intended to eliminate fruit that are injured, blemished, misshapen, off-color, non-uniform in size, or otherwise of low quality, including Xac-infected fruit. These eliminations occur during various grading and culling steps in the packinghouse conducted by trained personnel and/or electronic optical scanning equipment or combinations of both methods. Under compliance agreements for packinghouses currently issued by the Florida Department of Agriculture and Consumer Services (FDACS), Division of Plant Industry (DPI), the "packer is responsible for training its graders and field personnel each year in progressive fruit grading techniques for the detection of citrus canker lesions" (Florida Department of Agriculture and Consumer Services 2006; University of Florida - IFAS and FDACS-DPI 2006). This "lesion and symptom detection training is available through UF-IFAS" (Florida Department of Agriculture and Consumer Services 2006; University of Florida - IFAS and FDACS-DPI 2006). The CHRP (USDA-APHIS and FDACS/DPI 2006) also includes provisions for annual training of packers.

Packinghouse processes may be very effective at removing fruit with citrus canker lesions. Studies in Argentina have demonstrated that culling of symptomatic citrus canker fruit is highly effective in packinghouse operations. For example, trays of fruit known to contain either one percent or three percent of symptomatic fruit were visually inspected at three stages throughout the packing process, resulting in extremely low (near 0) numbers of symptomatic, injured or blemished fruit reaching the packing bench, and zero symptomatic fruit packed in boxes (Ploper *et al.* 2004). Other factors may affect the ability to detect blemished fruit including the size and appearance of lesions or blemishes, type of fruit being inspected, quality of lighting at inspection points, number of inspection points, number of personnel inspecting fruit, and the speed of fruit movement through the process (Miller *et al.* 2001).

The size, appearance, and abundance of Xac lesions on fruit entering and exiting the packing line may vary, influencing the ease with which they are detected and the infected fruit is removed. Variations observed in lesion appearance are attributed to many factors, including growth stage at which fruit became infected (Civerolo 1984; Graham *et al.* 1992b; Verniere *et al.* 2003; Graham and Leite 2004), susceptibility of the host (Zubrzycki and Zubrzycki 1986; Graham *et al.* 1992b; Gottwald *et al.* 1993), and association with wounds (Koizumi 1972; Sinha *et al.* 1972; Koizumi 1983; Goto 1992; Graham *et al.* 1992b; Verniere *et al.* 2003). Lesions begin as pin point spots, then depending upon the stage at which fruit are infected, may develop to 2 to 10 mm in diameter, becoming corky and crater-like, uniformly brown, approximately circular, and often are surrounded by a water-soaked margin and yellow halo (Gottwald and Graham 2000; Pruvost *et al.* 2002; Timmer *et al.* 2005; University of Florida - IFAS and FDACS-DPI 2006). Lesions on young grapefruit fruit expanded to 1 to 2 mm diameter after 2 to 3 months, enlarging to 9 mm after 200 days (Stall *et al.* 1980), whereas on fruit infected when more nearly fully expanded, lesions remained as minute (0.1 to 0.15 mm) or small (0.6 to 1.5 mm) greenish spots (Koizumi 1972). It is possible that very small or uncharacteristic lesions may escape detection.

During an evaluation of a diagnostic tool, APHIS plant pathologists collected approximately 75 pieces of fruit eliminated by packinghouse graders for Xac lesions. The average lesion size on these fruit was about 4 mm. APHIS plant pathologists have intercepted fruit in final packed cartons with lesions in the 2-3 mm range and have observed that the majority of the symptomatic fruit that APHIS inspectors intercepted after passing through the packing line undetected by graders have only one lesion (Riley 2007). In general, APHIS inspectors do not see fruit with only lesions smaller than 1 mm; small lesions occur in association with larger lesions (Riley 2007).

Phytosanitary inspection. Under the current regulations (Code of Federal Regulations 2006a), APHIS conducts monitoring phytosanitary inspections for Xac as part of the process for issuing requisite limited permits for interstate movement of citrus fruit. Up to 2 percent of the fruit in each inspected lot is examined by APHIS inspectors. Not every lot is inspected under the current system. This phytosanitary inspection generally takes place on finished fruit after all packinghouse treatments, grading and inspections are completed (Lowe 2007).

Currently, APHIS has approximately 126 inspectors who are trained and rigorously tested in citrus canker disease recognition. Inspectors are trained in citrus canker disease recognition within 3 weeks of hiring. Training sessions are followed by testing. Tests involve a lab practical where the inspector must determine the citrus canker disease status of plant samples. Included in the test are leaf and fruit samples with Xac lesions at various stages of development or samples that contain lesions or blemishes caused by an array of fungal or bacterial diseases that can be easily mistaken for canker (greasy spot, citrus scab, anthracnose, melanose, citrus bacterial spot, *Alternaria*, *etc.*). Inspectors are given approximately 40 seconds to make a determination as to whether the specimen has citrus canker disease. Inspectors must correctly identify at least 80 percent of leaf and fruit samples to receive a passing grade. Inspectors who fail their first test are given the opportunity to re-test after taking additional training. Failure to pass the re-test may be grounds for dismissal from employment. Refresher training and testing is repeated each year for all inspectors. From 2004 through 2006 APHIS inspectors averaged a score of 93.4 percent on these tests.

Summary

- Procedures for cleaning and disinfecting fruit are routinely applied by packinghouses.
- The individual efficacy of each of these procedures for removing or destroying Xac may not be known in detail, but the effect of packinghouse treatments in combination with grading, culling and inspections reduces the prevalence of Xac and the level of inoculum associated with commercially packed fresh citrus fruit.
- Grading and inspection procedures are effective in removing fruit with visible lesions.

5.3 Mortality of Xac Associated with Fresh Citrus Fruit and/or Packing Materials Following Harvest and Packing

The most important factors which may influence Xac bacterial survival are likely storage duration, temperature, and moisture, as well as safeguarding to prevent contamination of disinfected fruit or containers. This section documents evidence relating to the likelihood that viable Xac will survive if contaminated or infected fruit are harvested, survive commercial packing processes and are shipped.

Xac survival in lesions. Bacteria survive in lesions formed on above-ground parts of susceptible hosts, including fruit still attached to the tree, leaves, twigs, stems, and the bark of the trunk (Leite and Mohan 1990). Bacteria in leaf and twig lesions are a source of inoculum for secondary infections (Pruvost *et al.* 2002); and stem lesions can act as reservoirs of inoculum for longer periods than fruits and leaves (Leite and Mohan 1990; Verniere *et al.* 2003). Timmer *et al.* (1991) inoculated grapefruit and Swingle citrumelo leaves with Xac in the field, and then collected the leaves at 14, 21 and 49 days after inoculation to assess bacteria concentrations within active lesions.

The multiplication of Xac bacteria associated with lesions is closely related to lesion expansion. Bacterial populations within the lesions were closely correlated with lesion age. Young lesions (4 to 6 weeks old) exude approximately 10^4 to 10^6 cfu/ml in the first 48 hours of wetting, while older lesions (4 to 6 months old) exude about 10^2 to 10^3 cfu/ml in the same time period (Timmer *et al.* 1991). In expanding lesions, Xac bacteria multiply abundantly, but as lesion expansion ceases, bacteria multiplication noticeably decreases (Koizumi and Kuhara 1982; Graham *et al.* 1992a). In the late stages of lesion expansion, bacterial multiplication becomes inhibited in the peripheral area of the lesion (Koizumi 1977a). The atypical late season lesions described by Koizumi (1972) that fail to expand and remain small are characterized by a lack of bacterial proliferation (Graham *et al.* 1992b) and would not provide an epidemiologically significant source of inoculum for Xac infections. Bacteria survive in the margin of the lesions in citrus leaves and fruit, until they fall or are removed from the tree (Graham *et al.* 2004).

Xac bacteria do not increase in number on fruit once the fruit is removed from the tree, but rather populations decline within the lesions of infected fruit following harvest (Koizumi 1972; Civerolo 1981). Fulton and Bowman (1929) that there is apparently a marked difference between the behavior of Xac when inoculated into mature fruit attached to the tree as opposed to mature fruit removed from the tree. They speculated that physiological changes in the fruit were responsible for the difference and they noted changes to the fruit postharvest favor the growth of strongly saprophytic fungi that cause postharvest rots. They went on to say that it was not "inconsistent to presume that these changes would in equal degree hinder the development of an organism having definitely parasitic habits like *Pseudomonas citri* [Xac]."

Bacteria may survive for a few weeks to several months on decomposing plant litter (fallen fruit, leaves, and limbs) on the soil surface (Civerolo 1984; Graham *et al.* 1987; Leite and Mohan 1990; Schubert *et al.* 2001; Gottwald *et al.* 2002), or in plant material buried in the soil (Graham *et al.* 1987). Survival in decomposing leaves, both in and on the soil surface, is dependent on moisture and temperature (Graham *et al.* 1987; Goto 1992).

Epiphytic survival. Epiphytic populations of Xac may aid in pathogen dispersal, but substantial evidence indicates that bacterial populations do not infect mature fruit or survive on mature fruit long enough to infect other hosts. Goto (1962) reported that epiphytic populations of Xac applied to the surface of leaves of outdoor citrus trees lost infectivity after 3 days under spring (May 24) conditions and after only 8 hours under summer conditions (July 15) in Japan. Epiphytic Xac applied to leaves of potted citrus trees declined dramatically within 24 hours but were detectable at low levels for as long as five days (Timmer *et al.* 1996). Timmer *et al.* (1996) states, "we detected epiphytic [Xac] on asymptomatic plants, but the occurrence of epiphytic populations was not related to subsequent appearance of symptoms", and additionally "our evidence indicates that [Xac] is highly unlikely to persist on hosts or non-hosts in the absence of symptoms for long periods." Rybak and Canteros (2001) found in examining field grown fruit "…that populations of Xac are generally low even from highly infected plots in lesionless leaves and fruits and almost always undetectable in low disease intensity groves." Researchers in Brazil sprayed asymptomatic fruit, picked from trees, with a bacterial suspension of 10^6 cfu/ml; no bacteria were recovered after 5 days at room temperature under laboratory conditions (Belasque and Rodriguez Neto 2000). Epiphytic bacteria do not multiply in water on leaf surfaces or on dry leaves (Timmer *et al.* 1996). Graham *et al.* (2000) found that Xac survived for 48 to 72 hours on a variety of inanimate surfaces in sun or shade, respectively. Any Xac remaining on the surface of citrus fruit or in lesions are unlikely to infect harvested mature fruit and unlikely to multiply on fruit surfaces (Timmer *et al.* 1996).

Wounds. The term "wound" in this document is meant to describe an injury to any external surface of the plant by its being torn, pierced, cut, or broken. Unlike a lesion, the occurrence of a wound does not imply that disease has developed. In previous decisions (FR 1983), USDA has determined that “It is unlikely that new citrus canker infections would be established in the United States because of the importation of fruit or peel of citrus or citrus relatives carrying bacteria trapped in the pores or wounds. In order for the bacteria to cause an infection an unlikely sequence of events would have to occur. First, bacteria trapped in the pores or wounds of the fruit would have to be released without coming in contact with any of the acid of the fruit since citrus canker bacteria are quickly killed by contact with the acid. Next bacteria would have to come into intimate contact with young live twigs or leaves of host plants and, in addition, such contact would have to occur under optimum temperature and humidity conditions.”

Fulton and Bowman (1929) reported that, during inoculation studies, wounding needed to be done with care not to cut oil glands in order for infection to occur. They noted, “The exuding oil had a tendency to injure a portion of the adjacent tissue and to interfere with a normal infection reaction.” They also reported that infection only occurred if the wound stayed moist until the time of inoculation. Wounds that were allowed to dry and were inoculated after 26 hours did not result in infection. That is, infections occurred only when oil glands were avoided and inoculum was applied within 26 hours of wounding (Fulton and Bowman 1929). Verniere *et al.* (2003) reported a disease incidence of zero when inoculating mature fruit either by pin prick or spray inoculation.

Effect of shipping and storage temperature. Temperatures during shipping and storage influence Xac inoculum survival. In general, to maintain fruit quality, temperatures during storage and shipment of citrus fruit would range from 4 to 10 º C for tangerines and mandarin-type fruits to 10 to 15º C for grapefruit (Sunkist Growers Inc. 1983; Wills et al. 1998). In host plant tissues, Xac infection and subsequent multiplication only occurs at temperatures above 14º C and below 38º C (Koizumi 1976). Dalla Pria *et al.* (2006) reported 20° C temperatures, interfere in the infection process, reducing disease incidence. Bacterial populations in existing lesions decreased from 10^7 to between 10^2 and 10^4 cells when the average maximum temperature was below 20° C and average minimum temperature was below 10°C (Koizumi 1977b). Stall *et al.* (1980) noted “the populations of viable cells in lesions decreased about 100-fold during the winter months.”

SUMMARY

- The cool temperatures at which citrus fruit are stored and shipped will restrict the ability of Xac to reproduce and cause infection.
- Xac bacteria do not increase in number on fruit once the fruit is removed from the tree, but rather populations decline within the lesions of infected fruit following harvest.
- Epiphytic populations of Xac may aid in pathogen dispersal, but substantial evidence indicates that bacterial populations do not infect mature fruit or survive on mature fruit long enough to infect other hosts.
- No published reports were found regarding the prevalence or survival of Xac in naturally occurring wounds without typical lesions of citrus canker disease.

5.4 Environmental and Epidemiological Conditions Required for Xac Establishment

This section evaluates evidence relating to the environmental and epidemiological conditions required for Xac establishment. Even if fruit with Xac are shipped to a previously free region, introduction requires proximity of that fruit to a susceptible host, spread of a sufficient amount of inoculum from the fruit to host tissue at a susceptible growth stage and environmental conditions conducive to year-round survival, dispersal, and infection.

In previous decisions (FR 1983), USDA has determined that “It is unlikely that new citrus canker infections would be established in the United States because of the importation of fruit or peel of citrus or citrus relatives carrying bacteria trapped in the pores or wounds. In order for the bacteria to cause an infection an unlikely sequence of events would have to occur. First, bacteria trapped in the pores or wounds of the fruit would have to be released without coming in contact with any of the acid of the fruit since citrus canker bacteria are quickly killed by contact with the acid. Next bacteria would have to come into intimate contact with young live twigs or leaves of host plants and, in addition, such contact would have to occur under optimum temperature and humidity conditions.”

In a preliminary study in Florida described in a public comment to an earlier draft of this document (DPI 2007), grapefruit fruit with Xac lesions that had received typical packinghouse wash, disinfectant and wax treatments were placed in outdoor plots surrounded by four Duncan grapefruit seedlings maintained as much as possible in a continual canker-susceptible growth phase. These trees were continually observed for any signs of citrus canker disease and the leaves of plants as well as the surface areas of the cankered fruit were assayed for the presence of Xac. During the course of the experiments, canker lesions never appeared on the grapefruit seedlings surrounding cankered fruit, in spite of extensive leafminer damage. Xac bacteria were not detected in assays of the foliage or on the fruit that had been placed within. Upon the breakdown of the experiments, the lesions were assayed for viable Xac within the lesions with none being detected. While these results are preliminary and the study is being repeated, they do suggest that the very specific conditions that must be met for a Xac outbreak to occur makes commercially packed citrus fruit unlikely to be an epidemiologically significant pathway for introducing citrus canker disease. The research can be viewed at http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&d=APHIS-2007-0022-0053.

Areas at risk. The majority of citrus fruit exported from Florida moves to non-citrus producing States or other countries (Florida Department of Citrus 1997, 1998, 1999, 2000, 2001, 2002, 2003a, 2004a, 2005a, 2006a). For example, in the 2005-2006 shipping season, approximately 96 percent of Florida’s domestic and Canadian citrus exports were shipped to non-citrus producing States or Canada. Demographics derived from United

States Census data may be useful in predicting the distribution of Florida citrus fruit by indicating population centers where demand is greatest. Two of the four most populous States in the United States, Texas and California (U.S. Census Bureau 2002), are citrus-producing States. If we assume that citrus is proportionally distributed across the United States, in accordance with population, then it is reasonable to assume that some fruit will be shipped to these States; however, only a small portion of each State actually produces citrus (USDA-NASS 2002) (see Appendix 1), and an even smaller portion has a climate suitable for canker disease development (Borchert *et al.* 2007).

Climate. At the present time, Xac is established primarily in tropical and subtropical areas (CABI 2006). In the United States, the pathogen is established in Florida (CABI 2005) and is capable of establishment in the Gulf States (Alabama, Georgia, Mississippi, Louisiana, South Carolina, and Texas) as seen in the initial citrus canker disease outbreak in the early 1900's (Dopson 1964). Using hourly wind speed and precipitation, monthly average temperature, and annual and seasonal precipitation data to determine the expected incidence and severity of citrus canker if introduced into California, Borchert *et al.* (2007) concluded that favorable events in California citrus growing areas occurred "… predominantly during the winter season when precipitation is greatest, but temperatures are less conducive for infection activity and citrus growth. This would likely result in low incidence and severity of citrus canker in California if the disease were introduced…" According to that study, Florida climate had the most potential of any contiguous U.S. citrus producing State for establishment and spread of Xac (Borchert *et al.* 2007). Peltier and Frederich (1926) suggest that a Mediterranean type climate is unfavorable for the development of citrus canker disease, though they concede that the disease "could develop in all of the citrus regions of the world *sometime* over the growing season". The European and Mediterranean Plant Protection Organization (CABI/EPPO 1997) uses the same rationale in designating Xac a quarantine pest for Europe. The "Mediterranean" climate (dry summers) typical of most of California and the arid climate of Arizona make Xac establishment less likely in those States. However, in microclimates with highly susceptible cultivars such as along the California coast between San Diego and Ventura establishment is still possible, as demonstrated by the occurrence of citrus canker disease in Iran and the Arabian Peninsula on a highly susceptible variety of Mexican lime (Mohammadi *et al.* 2001; Das 2003).

Temperature. Temperature affects both the ability of Xac to cause infection and subsequent disease development (Peltier and Frederich 1926; Koizumi 1976; Koizumi 1977b; Dalla Pria *et al.* 2006). It also affects survival of Xac within lesions (Koizumi 1977b; Stall *et al.* 1980). Temperatures between 15 to 20° C and 35 to 40° C are conducive for infection and development of citrus canker disease (Peltier and Frederich 1926; Dalla Pria *et al.* 2006). Bacteria inoculated on wounded citrus leaves during months with an average maximum temperature below 20° C and an average minimum temperature below 10° C were undetectable soon after inoculation with no reoccurrence the following spring (Koizumi 1977b). At these temperatures, bacterial populations in existing lesions decreased from 10^7 and 10^4 to between 10^4 and 10^2 cells, respectively (Koizumi 1977b); Stall *et al.* (1980) noted "the populations of viable cells in lesions decreased about 100-fold during the winter months..."

Moisture. Wind-driven rain or overhead irrigation facilitate dispersal of Xac within and between citrus trees (Gottwald *et al.* 1988; Pruvost *et al.* 1999; Bock *et al.* 2005); aid the movement of bacteria into stomata (Serizawa and Inoue 1974; Gottwald and Graham 1992); and, enhance the exudation of bacteria from lesions (Timmer *et al.* 1991; Timmer *et al.* 1996). In experiments simulating wind-driven rain, Bock *et al*. (2005) found that the greatest quantity of bacteria was dispersed within the first few minutes of exposure; 70 to 80 percent of the total bacteria collected during the experiments were detected within the first hour. Studies have found that between 10^4 and 10^6 cells are exuded from lesions when exposed to a period (less than 1 hour) of wetting or rainfall (Timmer *et al.* 1991; Bock *et al.* 2005).

Inoculum. Another factor influencing the likelihood of Xac causing infection is the size of the bacterial population in or on the fruit. In experiments simulating wind-driven rain, concentrations less than 10^4 cfu/ml for one bacterial strain were insufficient to cause infection on unwounded grapefruit leaves under an impact pressure of 8.05 kPa, however 10^6 cfu/ml gave consistent and successful infection (Gottwald and Graham 1992). Goto (1962) ascertained that the minimal dose of Xac necessary for stomatal infection was 10^5 cells/ml and that for wound infection, about 10^2 to 10^3 cells /ml were required. Pruvost, *et al.* (2002) reported a threshold of 10^3 cfu/ml inoculum for stomatal infection of Mexican limes. However, Christiano, *et al.* (2007) recently reported that the minimum inoculum concentration to cause symptom development in intact leaves was 10^4 cfu ml^{-1}; while in leaves with citrus leaf miner injuries at the third instar and pupa stage, the minimum inoculum concentration required was reduced to 10^1 cfu ml^{-1}. The injuries from the third instar and pupa stages also resulted in greater disease severity (five times higher than in the intact leaf).

Gottwald and Graham (1992) estimated that as few as 2.4 Xac bacteria forced into a water congested stomatal cavity of a susceptible plant were sufficient to cause a lesion. However, they also determined that the minimum concentration of bacteria in the inoculum needed to produce an infection, and presumably to place the estimated 2.4 bacteria in a stomatal cavity, was 10^5 cfu/ml. Thus, although it may take only 2.4 infective bacteria in the right place to cause infection, it takes exponentially greater numbers of bacteria in the inoculum for those 2.4 bacteria to occur in the right place at the right time.

Xac populations within the lesions of infected fruit decline after harvest (Koizumi 1972). After 5 days at room temperature under laboratory conditions, researchers were unable to recover Xac from asymptomatic fruit, removed from trees and sprayed with a bacterial suspension of 10^6 cfu/ml (Belasque and Rodriguez Neto 2000). There was "no evidence that Xcc [Xac] multiplies on the leaf surface…"(Timmer *et al.* 1996). Graham *et al.* (2000) found that Xac survived for 48 to 72 hours on a variety of inanimate surfaces in sun or shade, respectively. Rybak and Canteros (2001) found in examining field grown citrus "…that populations of Xac are generally low even from highly infected plots in lesionless leaves and fruits and almost always undetectable in low disease intensity groves." The rapid decline in Xac populations on surfaces coupled with the Xac population size necessary to cause infection creates a limited window of time when surface populations are high enough to potentially infect susceptible host tissue.

Availability of susceptible host. Most of known hosts of Xac are members of the family Rutaceae (which contains citrus species) (CABI/EPPO 1997; CABI 2005), and many of these are found in the United States (USDA-NRCS 2007). Even if viable Xac cells arrive in an area with suitable environmental conditions, to become successfully established in that area the Xac would still need to come in contact with a susceptible host at the proper growth stage for infection to occur. Species of *Citrus* grow naturally in the United States in Florida, Georgia, Hawaii, New Mexico, Texas, Arizona, and California, among other places (FAO 2006b; USDA-NRCS 2007). *Poncirus trifoliata* has a fairly broad, 16 States, distribution in the United States (USDA-NRCS 2007).

Xac can infect any above-ground parts of citrus; *i.e.*, leaves, stems, and fruit (Goto 1972; Graham *et al.* 1992a; Graham *et al.* 1992b; Pruvost *et al.* 2002). However, susceptibility to infection, at least to natural infection through stomata, decreases with tissue maturity (Gottwald and Graham 1992) (see discussion of tissue susceptibility in section 5.1. Production Practices and the Likelihood of Harvesting Xac Infected or Contaminated Fruit).

Leaves can become infected within 14 to 21 days after shoots begin to develop (Stall 1982) with maximum susceptibility when leaves are between 50 and 75 percent expanded (Gottwald and Graham 1992). Fruit are susceptible to natural (stomatal) infection from petal fall until they are fully expanded (around 6 cm in diameter for some varieties), and are most susceptible after stomata form and fruit is in a stage of rapid expansion, a period of about 90 to 120 days (at a fruit diameter of about 2-6 cm for some varieties) (Goto 1972; Koizumi 1972; Graham *et al.* 1992b; Verniere *et al.* 2003) Koizumi (1972) indicates that mature fruit can be infected via wounding, but form different types of lesions than fruit infected at earlier stages. Verniere, *et al.*(2003) state "The age of tissues at the time of infection was a good predictor for disease resulting from the spray inoculation method on fruits and leaves, which represents natural rain splash deposition of inoculum... The age of tissue was also a significant factor for determining disease on fruits following a wound inoculation." In this study, designed to mimic wounds caused naturally by thorns, “The needle-prick method of inoculation increased the susceptibility of the fruit over a longer period. However, it did not overcome a general resistance of fruit that was nearing maturity.” As noted above, the presence of the citrus leafminer, *Phyllocnistis citri*, can lead to significant field infection even on normally resistant cultivars and species of citrus (Sinha *et al.* 1972; Cook 1988).

Several ways by which fruit could be brought into close proximity with potential host trees have been suggested in comments on the March 2006 analysis (updated in USDA 2007) made available in the August 1, 2006 interim rule (FR 2006), including the transport of citrus peel by squirrels, the use of citrus fruit as outdoor tree ornaments, and the use of citrus peel as an outdoor cat deterrent. APHIS notes that even if citrus peel is transported by squirrels, used as an outdoor tree ornament or as cat deterrent, the citrus, for reasons discussed elsewhere, is unlikely to contain viable canker bacteria; further, even if it did contain viable bacteria, those bacteria would still need to be transported to and successfully infect susceptible host tree tissues. APHIS believes that it is possible that all of these circumstances could prevail, but such a "perfect risk" scenario would be an extremely rare event. The commenter provided no evidence that could be used to empirically estimate the frequency of this behavior, and APHIS is unaware of any reports of these events resulting in the successful establishment of Xac.

SUMMARY

- As a condition for successful establishment, Xac in amounts sufficient to cause infection, must encounter not only an environment with a temperature, relative humidity, and moisture events conducive to infection, it also must encounter host plant tissue that is either at a susceptible growth stage or is wounded and then must successfully enter this tissue.

5.5 Host Resistance- Tangerines

Xac is virulent on all plants in the genus *Citrus* (Koizumi 1981). According to Graham (2001), “The disease affects all major [citrus] varieties, especially grapefruit and early oranges (Hamlin and Navels) that comprise more than 50 percent of the trees in Florida.” In the scientific literature, commercially important *Citrus* species are classified into the susceptibility categories. For example, grapefruit (*C. paradisi*), limes (*C. aurantifolia, C. limettoides*), and *P.*[*oncirus*] *trifoliata* are highly susceptible; sweet oranges (*C. sinensis*), sour oranges (*C. aurantium*), lemons (*C. limon*, *C. jambhiri*) are moderately susceptible; and thick-skinned East Indian pummelos (*C. grandis*) and mandarins and tangerines (*C. reticulata*) are less susceptible to moderately resistant (Civerolo 1984; Gottwald *et al.* 2002). The available evidence was evaluated regarding the relative resistance of tangerine varieties and its potential as a mitigation measure.

APHIS has employed the reduced susceptibility of Unshu orange (*C. reticulata*) as part of a systems approach to mitigate the risk of introducing Xac on fruit imported from Japan where Xac is considered endemic (Code of Federal Regulations 2006c). That regulation requires, among other things, that only resistant cultivars are planted in and around groves producing fruit destined for export to the United States. In the State of Parana, in Brazil, the use of susceptible varieties is prohibited by the State government and growers are encouraged to plant resistant varieties (Graham 2001).

The taxonomic classification of the genus *Citrus* is complicated and has been the subject of debate (Moore 2001). Tangerines are generally grouped in the species *Citrus reticulata* but many if not most of the tangerine varieties grown in Florida are hybrids of *C. reticulata* with other *Citrus* species (Morton 1987). Table 1 describes the lineage of some Florida citrus varieties.

Table 1. Lineage of selected Florida citrus varieties (Morton 1987)

Variety	Lineage
Dancy tangerine	*Citrus reticulata*
Clementine	*C. reticulata*
Orlando tangelo	Duncan grapefruit X Dancy
Minneola tangelo	Duncan grapefruit X Dancy
Murcott (Honey tangerine)	*C. reticulata* X *C. sinensis*
Temple orange (Tangor)	*C. reticulata* X *C. sinensis*
Fallglo tangerine	(Clementine X Orlando) X Temple
Robinson tangerine	Clementine X Orlando
Osceola tangerine	Clementine X Orlando
Sunburst tangerine	Robinson X Osceola

Crosses between *C. reticulata* and *C. sinensis* (sweet orange) created hybrids like Temple referred to as tangors, possessing characteristics of both tangerines and oranges (Morton 1987). Likewise crosses between *C. reticulata* varieties and grapefruit or pummelo produced the hybrid tangelos (Morton 1987).

The extensive crossing among citrus varieties may explain why varying degrees of susceptibility to citrus canker disease occur within a single variety. Canteros (2004) reports, "…some tangerines and some oranges can be affected to moderate degree, other oranges and tangerines are very resistant." What has not been reported in the literature is the absolute immunity to citrus canker disease of tangerines or any other citrus variety.

APHIS records indicate that during the 2005-2006 growing season grove surveys, Xac was detected on 274 samples from tangerine, tangor and tangelo groves. APHIS pest interception data indicate that between 1985 and 2006, Xac was intercepted 632 times on *C. reticulata* fruit.

SUMMARY

- Taxonomy in the genus *Citrus* is complex; defining "tangerine" would also be complex.
- Tangerines, *sensu lato*, are susceptible to citrus canker; this susceptibility ranges from highly susceptible to highly resistant, but none are completely immune.

5.6 *International and Interstate Movement of Citrus Fruit and Its Relation to the Introduction of Xac*

There are no accounts in the published literature indicating that fresh citrus fruit or seeds can serve as pathways for the dissemination of Xac. Long-distance dissemination of the pathogen occurs primarily through the movement of propagative material, such as budwood and rootstock seedlings or budded trees from nurseries (CABI/EPPO 1997).

5.6.1 The Origins of Citrus Canker Disease Outbreaks

Xac is widely accepted as having been introduced into the United States on trifoliate orange and Satsuma orange trees from Japan (Wolf 1916; Dopson 1964; Civerolo 1984). In his 1916 treatise (Wolf 1916), F.A. Wolf writes, "Citrus canker is not of American origin, but beyond doubt was introduced into the Gulf States from Japan…it appeared in the United States several years ago simultaneously with the importation of Satsuma and trifoliate stock into Texas in order to supply the large demand for trees for Citrus plantings…Since its introduction into Texas it has been disseminated by the shipment of diseased trees to other States and has further been introduced by shipments to these States direct from the orient…"

Citrus canker disease was again detected in Florida in the mid-1980s (Schoulties and Miller 1985). The source for this outbreak is not known and although most scientists believe Xac was reintroduced "…a few speculate that this outbreak might have resulted from perennial holdover from 1910…" (Schubert *et al.* 2001). In the mid 1990s, new outbreaks were detected in the same area of the west Florida coast (Manatee County) where the 1980s outbreak occurred and in Dade County (Schubert *et al.* 1996; Gottwald *et al.* 2001). In reporting the Dade County outbreak, Schubert *et al.* (1996) stated, "No information is available about the origin of the inoculum responsible for the current outbreak of citrus canker." In their review of the outbreaks, Gottwald *et al.* (2001) report that, "Genomic analysis of bacterial isolates from both time periods indicates that the latest Manatee County outbreak is a hold over from the 1980s outbreak that escaped the eradication program."

In a literature review of citrus canker outbreaks in Australia, Broadbent *et al.* (1992) speculated that a 1912 outbreak in northern Australia had originated from Japan or China due to the fact that citrus trees and fruit were being imported from these sources. They did not clearly state if they considered trees or fruit the more likely source of the inoculum. With regards to an outbreak in 1991, the same authors stated, "The origin of the outbreak is unknown…Because few pummelo cultivars have been legally imported into Australia, and given that the pummelo is indigenous to the Malayan and East Indian archipelagos, where canker is endemic, it is possible that an illegal introduction may have resulted in the current outbreak." The origins of a 2004 outbreak of citrus canker disease occurred in Queensland, Australia are also unknown; however, Australian authorities investigated reports of illegally imported trees on the property where the outbreak was first detected (DAFF 2004).

In her review of citrus canker disease in Latin America, Rossetti (1977) states, based on information in Bitancourt (1957), "Citrus canker was introduced in the state of São Paulo, probably in 1953 or 1954 on smuggled, infected budwood brought from Japan in violation of Brazilian legislation, either by boat through the port of Santos or by air through the São Paulo airport." Citing Sánchez (1968), she furthermore suggests that the introduction of Xac into Paraguay may have resulted from the introduction of infected trees, either from Japan or from Brazil.

Citrus canker disease was first reported from Yemen in 1984 on trees that had been imported as part of a consignment of trees from India where Xac is endemic (Dimitman and Gassert 1984).

Other citrus canker outbreaks in Argentina (from 1972 to 1975) (Civerolo 1984); Uruguay (1979) (Rossetti 1977); Australia (in 1981 and again in 1984) (Shivas 1987; Catley 1988); United Arab Emirates (1984 to 1985) (El-Goorani 1989); and Bolivia (in 2002) (Braithwaite *et al.* 2002) are of unknown origin.

In summary, there is an unfortunate lack of conclusive information regarding the origins of previous outbreaks. Most published accounts are speculative. However, whatever the lack of certainty may be regarding the theories of Xac introduction pathways, they all agree that trees or propagative tree parts are most likely the original source of Xac introduction. Conclusive evidence that fresh fruit is a pathway for the introduction of Xac has never been presented.

5.6.2 International and Interstate Movement of Citrus Fruit

That there is no authenticated record of fresh fruit as a pathway for Xac is especially significant in light of the fact that citrus fruit ranks very high in international fruit trade, with production and trade having been increasing steadily over the last decades (UNCTAD 2006) and much of the traded fruit originating in countries where citrus canker is present.

For example, substantial amounts of citrus fruit are exported from South American countries with citrus canker, such as Argentina, Uruguay, Bolivia, *etc.* to the European Union (EU) where Xac is a quarantine pathogen. In 2004 the EU imported 18 percent of its citrus from Argentina (FAS 2006); and between 2003-2005, Spain, Europe's dominant citrus producer, imported 642,769 tons of citrus (an equivalent of approximately 3.8 billion pieces of fruit) from Argentina (GTIS 2005). During that same time, Spain imported 86,124 tons of citrus fruit (548 million pieces of fruit) from Uruguay (GTIS 2005). Despite these large volumes of citrus fruit imported into Spain from citrus canker affected countries, there have been no reported outbreaks of Xac in Spain.

It could be argued the lack of outbreaks is the result of EU regulations, that require imported citrus fruit originate in an area or grove officially recognized as Xac-free (EU 2000). However, it should be noted that Xac-infested fruit have been intercepted by Spain in spite of these regulations. In 2003, "Spain informed the other Member States and the Commission that in plant health checks carried out in 2003, numerous infestations of citrus fruits originating in Argentina or Brazil with …*Xanthomonas campestris* [Xac] …" (EU 2004). And, in 2005, Spain reported 17 interceptions of Xac on commercial shipments of citrus fruit from Uruguay (EPPO 2005).

While Peltier and Frederich (1926) suggest that the Mediterranean climate, such as that of Spain, may simply be unfavorable for the development of citrus canker disease, the same authors also concede that the disease "could develop in all of the citrus regions of the world *sometime* over the growing season." EPPO (CABI/EPPO 1997) uses the same rationale in designating Xac a quarantine pest for the region.

Trade of fresh citrus fruit does occur between countries where Xac is present and countries that do not have Xac but do have climates conducive to its establishment (CABI 2006; FAO 2006b). For example, in 2004, India (where Xac is reported) shipped 8 metric tons of citrus to Ghana and 2 metric tons to South Africa (where Xac is not reported) (FAO 2006b). Similarly, China (where Xac occurs) exported 66 metric tons of citrus to Angola (where Xac does not occur) (FAO 2006b). No outbreaks of Xac have been reported in any of the recipient countries.

In the United States, fresh citrus fruit from Florida was shipped during years of Xac outbreaks (1995, and from 1997 to the present) to other citrus producing States (California, Texas, and Arizona based on USDA-National Agricultural Statistics Service data for 1997 to 2002). An average of just over 1 million 4/5-bushel cartons of citrus (including grapefruit, temple oranges, tangerines, honey tangerines, etc.) were shipped to California and an average of 63,000 4/5-bushel cartons were shipped to Texas (predominantly honey tangerines) each year from 1996 through 2005 (Florida Department of Citrus 1997, 1998, 1999, 2000, 2001, 2002, 2003a, 2004a, 2005a). No outbreaks of citrus canker disease resulted from these shipments. It must be noted, though, that shipments may have originated in areas of low prevalence or free of Xac.

This evidence is not sufficient to prove that fresh fruit cannot possibly serve as a pathway for the introduction of Xac. Nevertheless, no canker outbreaks have ever been associated with the entry of fruit into the United States or anywhere in the world, nor has the ability of fruit to serve as a pathway of Xac dissemination ever been demonstrated in any scientific experiment and it seems very unlikely that fruit would be an epidemiologically significant pathway.

SUMMARY

- There are few instances where the origins of citrus canker disease outbreaks have been conclusively demonstrated and reported.
- Where origins have been reported or suggested, imported or smuggled trees and budwood are reported as the source of infection.
- Despite substantial international trade between Xac infected and noninfected countries, there is no authenticated record of movement of diseased fruit as the origin for a citrus canker disease outbreak.

6 Conclusions and Summary of Evidence Regarding Fruit as a Pathway for Xac Introduction

APHIS has regulated the importation and interstate movement of citrus fruit for many years to prevent the introduction and/or spread of the bacterial pathogen Xac. APHIS regulations have, with few exceptions, restricted the movement of fruit from production areas within the United States affected by citrus canker disease and the importation of fruit from foreign countries and regions reported or suspected of having citrus canker disease. Implicit in all these regulations has been the assumption that fruit represents a potentially important pathway for the long-distance dissemination of Xac. Multiple lines of evidence now suggest that conclusions about the importance of citrus fruit as a pathway for the introduction of Xac may not be valid.

Commercial citrus fruit production. Citrus fruit is produced and harvested using techniques that reduce the prevalence of Xac-infected fruit. These techniques include the use of prophylactic copper sprays in citrus groves, use of windbreaks to suppress bacterial spread, grove inspections and surveys and decontamination of harvesting equipment. Similar principles and practices apply to noncommercial production as well (Chamberlain *et al.* 2001).

These procedures are not all required by either statute or regulation nor are they are all utilized by every commercial citrus producer. Further, none of these procedures ensure that any individual piece of fruit is not infected or contaminated with canker. However, APHIS concludes that collectively, these procedures reduce the prevalence of Xac in commercially packed fruit, even when that fruit originates from regions with citrus canker disease.

Packing and shipping of commercial citrus fruit. APHIS found that commercial citrus fruit is packed using techniques that reduce the prevalence of infected or contaminated fruit. These packinghouse techniques include the decontamination of packing equipment, washing and disinfection of harvested citrus fruit, and elimination of blemished fruit. These are all normal procedures for most commercial producers and packers.

Under the current regulations (Code of Federal Regulations 2006a), APHIS inspects up to 2 percent of each inspected lot, but not all lots are inspected. APHIS inspectors have averaged above 90 percent in proficiency examinations.

The cool temperatures at which citrus fruit are shipped limits the ability of Xac to reproduce during shipping and any epiphytic Xac populations do not survive long, thus reducing the likelihood that commercially packed fresh citrus fruit is a good pathway to introduce Xac.

These packing and shipping procedures and conditions are not all required by either statute or regulation nor are they are all utilized by every commercial citrus packer or shipper. Further, none of these procedures ensures that any individual piece of fruit is not infected or contaminated with Xac. However, APHIS concludes that collectively, these procedures do reduce the prevalence and inoculum level of Xac in commercially packed fruit, even when that fruit originates from regions with citrus canker disease. APHIS also concludes that a phytosanitary inspection at the packinghouse is an effective measure to detect fruit with Xac symptoms and reduce the likelihood that fruit with symptoms are shipped.

Epidemiological and environmental factors affecting establishment potential of Xac. The environmental and exposure conditions associated with the naturally occurring spread of canker within known infected regions were reviewed. As a condition for successful establishment, Xac, in sufficient amounts to cause infection, must encounter not only an environment with temperatures, relative humidity, and rain events conducive to infection. Xac also must encounter plant tissue of a host that is either at a susceptible growing stage or is wounded and then the bacteria, in sufficient numbers to incite infection must successfully enter this tissue. The review found that that tree-to-tree transmission generally requires wind-driven rain. APHIS concludes that even if Xac infected fruit were shipped out of an area with citrus canker disease and by chance were moved to a location close to susceptible host trees, infection of the host trees is unlikely. APHIS, however, does not have sufficient evidence to conclude that such infection is impossible.

Origins of citrus canker disease outbreaks. While many outbreaks of citrus canker disease have been of unknown or unreported origin, the source of others has been reported with varying degrees of confidence. In every citrus canker disease outbreak in which the source has been determined or suggested, that source has been propagative material such as nursery stock or budwood. There are no authenticated reports in the scientific literature of citrus canker disease outbreaks attributed to commercial fresh fruit movement.

APHIS concludes that the absence of reports of citrus canker disease outbreaks linked to commercial fresh fruit combined with the multiple reports of outbreaks due to propagative material is important evidence. This evidence is not sufficient to prove that fruit cannot possibly serve as a pathway for the introduction of Xac. The evidence is sufficient to conclude that if such a pathway exists at all, it is rarely successful in natural environments compared to other pathways of Xac introduction.

International and interstate movement of citrus fruit. Large quantities of commercial citrus (i.e., billions of pieces of fruit) have moved in trade from countries and regions with citrus canker disease to regions without citrus canker disease. While the precise citrus canker disease status of the exporting region is difficult to determine, the presence of at least some infected fruit in this trade is certain. European phytosanitary inspection of imported citrus fruit has detected symptomatic fruit in commercial shipments from South America multiple times. Nonetheless, APHIS is not aware of any reports of citrus canker disease outbreaks in the importing countries.

APHIS concludes that the absence of citrus canker disease outbreaks in countries importing fruit from countries and regions with citrus canker disease, while not sufficient to prove that fruit cannot possibly transmit canker, is nonetheless important evidence to support the hypothesis that fruit is not an epidemiologically significant pathway for introducing Xac.

Host resistance as a regulatory measure: tangerines. Planting of disease resistant varieties is an accepted production measure to reduce disease incidence (Agrios 1997). Tangerines are widely reported to have some level of resistance to citrus canker disease. APHIS assessed the potential for employing tangerine's putative resistance to citrus canker disease. APHIS evaluated evidence that tangerines are less susceptible to citrus canker. Published literature indicates that "tangerines" are regarded as ranging from moderately resistant to moderately susceptible to citrus canker disease. Clearly, though, tangerines are not immune to citrus canker as APHIS records indicate that during the 2005-2006 growing season grove surveys, Xac was detected on 274 samples from tangerine, tangor and tangelo groves. APHIS pest interception data indicate that between 1985 and 2006, Xac was intercepted 632 times on *C. reticulata* fruit.

The level of resistance was expressed as a continuum across tangerine varieties rather than as a discrete immunity for all varieties. This creates a regulatory problem when an overlap occurs in the level of resistance expressed by, for example, a more susceptible tangerine variety and a more resistant non-tangerine citrus variety.

Based on this evidence, APHIS concludes that tangerines may be less susceptible to canker than other species and varieties of citrus. However, APHIS was not able to conclude that tangerine groves are never infected with canker or that sufficient evidence exists to exclude all tangerines from regulations applicable to other Florida citrus varieties.

In summary, fruit produced and packed utilizing the various measures described in this document to reduce the prevalence of viable Xac is unlikely to serve as an epidemiologically significant pathway for the introduction and spread of the bacterium. This similar to the conclusion reached in the previous analysis for asymptomatic fruit (USDA 2007) except that the present document acknowledges that it is not possible to design a viable system that ensures only uninfected fruit moves from quarantined areas. Furthermore, practical considerations make it difficult to implement a grove-centered regulatory systems approach in Florida that ensures only asymptomatic fruit will be shipped.

Finally, the evidence is not currently sufficient to conclude that fresh citrus fruit cannot serve as a pathway for the introduction of Xac into new areas. In a similar situation regarding the importation of Mexican citrus fruit (FR 1983), USDA determined that "It is unlikely that new citrus canker infections would be established in the United States because of the importation of fruit or peel of citrus or citrus relatives carrying bacteria trapped in the pores or wounds. In order for the bacteria to cause an infection an unlikely sequence of events would have to occur." But the rule went on to state, "Even though it was determined that the risk was small, it was determined that action should be taken because of the possibility of live citrus canker bacteria being present in the pores or wounds of restricted articles."

In the present case, even though it was determined that commercially packed citrus fruit is unlikely to be an epidemiologically significant pathway for the introduction and spread of Xac, the evidence is not currently sufficient to prove that such fruit cannot possibly serve as a pathway for the introduction of Xac. That has led us to develop and evaluate several risk management options for the interstate movement of fresh commercially packed citrus fruit from regions with citrus canker disease to regions without the disease. This analysis evaluates several packinghouse-centered risk management options for the interstate movement of fresh commercially packed citrus fruit from regions with citrus canker disease to regions without the disease. These packinghouse measures were evaluated to determine if they provide an appropriate level of phytosanitary protection without the practical considerations that make it difficult to implement a grove-centered regulatory systems approach in Florida that ensures only asymptomatic fruit will be shipped. A packinghouse-based inspection could ensure an appropriate level of phytosanitary security, but would be easier to implement and enforce than grove measures, and because it focuses on the end product, would be more reliable; would be less easily circumvented and consistent with the risk associated with citrus canker and commercially packed fruit from Florida. A phytosanitary packinghouse inspection creates a performance standard for packed fruit that allows citrus producers greater flexibility to determine the most efficient and effective means of producing a compliant product.

7 Risk Management Options

APHIS published an interim rule on August 1, 2006 (Code of Federal Regulations 2006a) listing the entire State of Florida as a quarantined area for citrus canker and amending the requirements for the movement of regulated articles from Florida. The regulations had required every tree in a given orchard in a quarantined area be inspected not more than 30 days before harvest and found free of canker, that regulated fruit is accompanied by a limited permit, and that regulated fruit may not be distributed to Arizona, California, Hawaii, Louisiana, Texas, American Samoa, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. By designating the entire State as a quarantined area, the August 2006 interim rule thus placed these requirements on all Florida fruit produced for interstate movement.

Under the current regulation (Code of Federal Regulations 2006a), APHIS conducts monitoring phytosanitary inspections for Xac as part of the process for issuing requisite limited permits for interstate movement of citrus fruit. Up to 2 percent of the fruit in each inspected lot is examined by APHIS inspectors. Not every lot is inspected under the current system. This phytosanitary inspection generally takes place after all packinghouse treatments, grading and inspections are completed (finished fruit).

It is not possible to design a viable system that ensures only uninfected fruit moves from quarantined areas. Furthermore, the evidence is not currently sufficient to conclude that fresh citrus fruit produced in a Xac infested grove cannot serve as a pathway for the introduction of Xac into new areas.

After considering the evidence for commercially packed citrus fruit as a pathway for the introduction of Xac, and the available mitigation measures, APHIS evaluated five risk management options for the interstate movement of fresh citrus fruit from Florida. Those options and details of the phytosanitary inspection are outlined in this section.

7.1 Option 1– Unrestricted movement

- Allow distribution of all types and varieties of *commercially packed* citrus fruit to all U.S. States[7] including commercial citrus-producing States[8].

The evidence discussed in preceding sections of this document suggests that fresh citrus fruit may not be an epidemiologically significant pathway for introducing Xac into previously free areas. If, in fact, fruit is not an epidemiologically significant pathway, the rationale for regulating fruit movement disappears. Accordingly, Option 1 would remove all APHIS restrictions on the movement of commercially packed fruit from regions quarantined for citrus canker disease.

In support of the hypothesis that commercially packed fruit is not an epidemiologically significant pathway for introducing citrus canker disease, evidence was considered regarding fruit production and harvest; commercial citrus fruit packing; epidemiological and environmental factors; the origins of citrus canker disease outbreaks; and international and interstate movement of citrus fruit. This evidence suggests that fruit is unlikely to be an epidemiologically significant pathway; no canker outbreaks have ever been associated with the movement of commercial fresh fruit into the United States or anywhere in the world, nor has the ability of commercial fresh fruit to serve as a pathway of Xac dissemination ever been demonstrated in any scientific experiment.

However, the evidence is not currently sufficient to prove that such fruit cannot serve as a pathway for the introduction of Xac. This uncertainty weighs against an option that allows unrestricted distribution of fruit from areas with citrus canker disease. Consequently, this option was rejected. It is described here only for the sake of completeness in illustrating the spectrum of regulatory options considered.

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[7] For clarity, the term "State" is defined here as any of the 50 U.S. States or U.S. Commonwealths, Trusts and Territories

[8] American Samoa; Arizona; California; Florida; Guam; Hawaii; Louisiana; Northern Mariana Islands; Puerto Rico; Texas; and the Virgin Islands of the United States.

7.2 Option 2– Unlimited distribution, disinfectant, phytosanitary inspection

- Allow distribution of all types and varieties of *commercially packed* citrus fruit to all U.S. States including commercial citrus-producing States.
- Require packinghouse treatment of citrus fruit with APHIS approved disinfectant treatment and APHIS inspection of finished fruit (all types and varieties) for citrus canker disease symptoms.

Option 2 would change the regulations to allow the movement of commercially packed fresh citrus fruit to all U.S. States with APHIS approved disinfectant treatment and a mandatory packinghouse phytosanitary inspection.

Substantial evidence exists that commercially packed citrus fruit is not an epidemiologically significant pathway for introducing Xac to previously free regions. Pathways, by which citrus fruit could introduce Xac, though unlikely, are possible. The probability of such introductions is "unknown," in the sense that a specific numerical value or even a range of values cannot be calculated. Recognizing these uncertainties, Option 2 proposes to mitigate the risk of Xac introduction with a mandatory packinghouse disinfectant treatment of fruit and a mandatory phytosanitary inspection of finished citrus fruit. The purpose of the inspection will be to ensure, within limits of statistical certainty, that fruit with injuries or lesions indicative of citrus canker disease is not moved out of the quarantine zone (*i.e.*, Florida).

A packinghouse-based inspection could ensure an appropriate level of phytosanitary security; would be more reliable and less easily circumvented than the preharvest grove survey required by Option 5; would be consistent with the risk associated with citrus canker and commercially packed fruit from Florida; and would be easier and potentially less costly to implement and enforce than a grove-centered system of mitigations. In addition, a phytosanitary packinghouse inspection creates a performance standard for packed fruit that allows citrus producers greater flexibility to determine the most efficient and effective means of producing a compliant product.

In this approach, the citrus growers, harvesters, and packers will be given the flexibility to implement phytosanitary measures that prevent and control the presence of Xac infection in the fruit they produce. APHIS will then inspect randomly selected finished fruit from every lot. Detection of one or more Xac-infected fruit will result in the rejection of that lot. Statistically, an inspection level will be established by the Deputy Administrator that will ensure, with a high level of confidence, that the proportion of undetected symptomatic fruit in a released lot is low (see discussion below).

The objective in designing the proposed risk management options was to ultimately ensure that visibly infected fruit is not shipped and does not reach citrus producing States. To that end we set out to design an inspection protocol that would achieve the maximum level of sensitivity (the protocol that would allow the fewest fruit with visible symptoms to escape detection by the APHIS packinghouse phytosanitary inspection) given the constraints of operational feasibility. To assist in evaluating Option 2 and the subsequent options 3 and 4 that all recommend a mandatory phytosanitary inspection by APHIS, we prepared a quantitative model (Appendix 1) based on Florida production and shipping data to evaluate the efficacy of three levels of phytosanitary inspection in ensuring that fruit with visible symptoms of Xac does not enter U.S. commercial citrus-producing States. The model answers the following questions:

1. If commercially packed and APHIS inspected fresh citrus fruit is shipped interstate from Florida, what proportion of that fruit is fruit with visible symptoms of Xac?
2. If commercially packed and APHIS inspected fresh citrus fruit is shipped interstate from Florida, how many fruit with visible symptoms of Xac from Florida reach five citrus-growing U.S. States (AZ, CA, HI, LA, TX) per shipping-season?
3. If commercially packed and APHIS inspected fresh citrus fruit is shipped interstate from Florida, how many fruit with visible symptoms of Xac from Florida reach citrus-growing areas within those citrus-growing U.S. States per shipping-season?

The model was developed for three inspection levels determined by preliminary estimates of PPQ, Citrus Health Response Program staff of inspection levels that might be operationally feasible. The three inspection levels evaluated were 500 fruit per lot; 1,000 fruit per lot; and 2,000 fruit per lot. Statistically, inspection of 500 fruit per lot will ensure, with 95 percent confidence, that the proportion of undetected fruit with visible symptoms of Xac in a released lot is no more than 0.75 percent. Inspection of 1,000 fruit per lot will ensure, with 95 percent confidence, that the proportion of undetected fruit with visible symptoms of Xac in a released lot is no more than 0.37 percent. Inspection of 2,000 fruit per lot will ensure, with 95 percent confidence, that the proportion of undetected fruit with visible symptoms of Xac in a released lot is no more than 0.19 percent.

The outputs of the quantitative model were probability distributions. The model determined, with 95 percent confidence, that the total number of citrus fruit shipped from Florida to five citrus-producing States (AZ, CA, HI, LA and TX) over a single shipping season would be 152,234,658 or less if unlimited distribution is permitted. The model estimated, with 95 percent confidence, that the number of fruit with visible symptoms of Xac reaching those five States in a single shipping season would be: 519,178 or less at the 1,000 fruit inspection levels; about half that number at the 2,000 fruit inspectional level; and about double that number at the 500 fruit inspectional level. The model further estimated with 95 percent confidence that the number of fruit with visible symptoms of Xac reaching citrus-producing areas within those States in a single shipping season would be: 1,794 or less at the 1,000 fruit inspectional level; about half that number at the 2,000 fruit inspectional level; and about double that number at the 500 fruit inspectional level. An inspection level that achieves a detection rate of 0.38 percent with 95 percent confidence was adopted because it is operationally feasible with small adjustments to the current phytosanitary inspection process in Florida. For the majority of lots, this would amount to inspection of about 1000 fruit per lot. According to the sampling algorithm for the probability distribution used in the model, the sampling rates, 500, 1,000, 2,000 fruit per lot, are sufficient to detect fruit with visible symptoms of Xac at levels of *at least* 0.75, 0.38 and 0.19 percent, respectively, regardless of lot size. Indeed for lot sizes less than about 100,000 fruit, the lots are over sampled to achieve those detection rates or, put differently, the detection rates are actually slightly better than the minimum rates listed above. For additional details of the quantitative model see Appendix 1.

PPQ Staff from the Melbourne, Florida office of the Citrus Health Response program conducted a small test of the 2,000 fruit sampling protocol to evaluate its operational feasibility. The study found that the normal complement of two inspectors at the packinghouse chosen for the evaluation were physically unable to achieve the 2,000 fruit per lot inspection level. It was estimated that the number of inspectors would have to have been doubled to four in order to inspect 2,000 fruit per lot, but the packinghouse physically had room for only two inspectors. Based on this test and additional input from PPQ operational staff, it was determined that the higher inspection level that achieves 95 percent confidence of detecting at least 0.19 percent rate of fruit with visible symptoms of Xac (about 2,000 fruit per lot), is only feasible with increased inspectional resources and/or more substantial modifications to the packing/phytosanitary inspection processes, and could be justifiable only if the risk reduction benefits outweighed the cost. An inspection level of 1000 fruit per lot that achieves a detection rate of 0.38 percent with 95 percent confidence was adopted because it provides the maximum level of detection that is operationally feasible with the phytosanitary inspection resources in Florida. Inspection of 500 fruit per lot was rejected because it did not meet the criteria of achieving the maximum level of detection that was operationally feasible.

It is important to recognize that the quantitative analysis described in Appendix 1 estimates that commercially packed fruit with visible symptoms of Xac may be shipped to citrus-producing States. These values reflect *only* the likelihood that commercially packed fruit with visible symptoms of Xac reach citrus-producing States and citrus growing areas within those States. For an outbreak to occur, the fruit must be discarded in such a way that Xac, in sufficient amounts to cause infection, survive, encounter not only an environment with a temperature, relative humidity, and rain events conducive to infection, but also must encounter plant tissue of a host that is either at a susceptible growing stage or is wounded and then viable bacteria, in sufficient numbers to incite infection need to successfully enter this tissue.

Despite the determination that commercially packed fresh citrus fruit is an unlikely to be an epidemiologically significant pathway for the introduction and spread of Xac, and a phytosanitary inspection that ensures, with high confidence, that a low amount of shipped fruit has symptoms of citrus canker disease, the model indicates the potential for fruit with visible symptoms of Xac to be shipped to citrus producing States. That potential for commercially packed fruit with visible symptoms of Xac to reach citrus producing States coupled with the aforementioned uncertainty regarding fruit as a pathway led to the determination that additional mitigations were required.

7.3 Option 3– Limited distribution (except tangerines) to non-citrus producing States, disinfectant, phytosanitary inspection

- Prohibit distribution of all types and varieties of *commercially packed* citrus fruit (except tangerines) to U.S. commercial citrus-producing States. Allow distribution of *commercially packed* tangerines to all U.S. States including commercial citrus-producing States.
- Allow distribution of all types and varieties of *commercially packed* citrus fruits to all U.S. non-citrus producing States.
- Require packinghouse treatment of citrus fruit with APHIS approved disinfectant and APHIS inspection of finished fruit (all types and varieties) for citrus canker disease symptoms.

Option 3 retains the requirements in Option 2, including disinfection of all fruit prior to packing, and mandatory phytosanitary inspection by APHIS sufficient to ensure, with a high level of confidence, that the proportion of packed fruit with visible lesions in each processed lot is low. The quantitative analysis described in Appendix 1 estimates that even with a mandatory phytosanitary inspection in place, fruit with visible symptoms of Xac may be shipped to citrus-producing States and evidence is not currently sufficient to prove that such fruit cannot possibly serve as a pathway for the introduction of Xac. For these reasons, Option 3 also proposes, with one exception described below, to further mitigate the risk of Xac introduction by prohibiting the distribution of fruit from regions with citrus canker disease to those U.S. citrus-producing States.

Option 3, however, would allow the shipment of tangerines to all U.S. States. This exception was evaluated in response to an industry proposal that tangerines have considerably less susceptibility to Xac and therefore are less likely to introduce Xac to previously free regions.

Tangerines are grouped in the species *Citrus reticulata* which is widely regarded as less susceptible to citrus canker disease than other commercially grown *Citrus* species. But many of the “tangerine” varieties grown in Florida are hybrids of *C. reticulata* with other more susceptible *Citrus* species. Tangerines are not immune to citrus canker as APHIS records indicate that during the 2005-2006 growing season grove surveys Xac was detected on 274 samples from tangerine, tangor and tangelo groves. APHIS pest interception data indicate that between 1985 and 2006, Xac was intercepted 632 times on *C. reticulata* fruit.

The level of susceptibility is expressed as a continuum across “tangerine” varieties rather than as a discrete immunity for all varieties. This creates a regulatory problem when an overlap occurs in the level of susceptibility expressed by, for example, a more susceptible tangerine variety and a more resistant non-tangerine citrus variety. While the relative resistance of certain tangerine varieties has been successfully employed as a component of a multicomponent systems approach to mitigate the risk of citrus canker disease, sufficient evidence does not exist to exclude tangerines from regulations applied to other

Florida citrus varieties. Mitigating the risk of Xac introduction and spread via interstate movement of commercially packed Florida fresh citrus fruit based on variety clearly was untenable, so APHIS evaluated limited geographic distribution for all varieties as a mitigation in Option 4.

7.4 Option 4– Limited distribution (all varieties) to non-citrus producing States, disinfectant, phytosanitary inspection

- Prohibit distribution of all types and varieties of citrus fruit (including tangerines) to U.S. commercial citrus producing States.
- Allow distribution of all types and varieties of *commercially packed* citrus fruits to all U.S. non-citrus producing States.
- Require packinghouse treatment of citrus fruit with APHIS approved disinfectant and APHIS inspection of finished fruit (all types and varieties) for citrus canker disease symptoms.

Option 4 includes all the requirements of Option 3 and further mitigates the risk of Xac introduction by prohibiting the distribution of all types and varieties of citrus fruit, including tangerines, from areas with citrus canker disease to U.S. commercial citrus producing States. Option 4 would change the regulations by substituting the packing house inspection described in Appendix 1 for the preharvest grove inspections currently in the regulation.

Option 4 includes the prohibition of interstate movement of all types and varieties of citrus fruit to commercial citrus-producing States because the quantitative analysis described in Appendix 1 estimates that commercially packed fruit with visible symptoms of Xac may be shipped to citrus producing States (see also Section 7.3 Option 2). That potential for fruit with visible symptoms of Xac to reach citrus producing States coupled with the aforementioned uncertainty regarding fruit as a pathway led to the determination that the mitigation of limited distribution was required.

7.5 Option 5– No change

- Leave August 1, 2006 interim rule in place and unchanged.

Option 5 is the most restrictive option. It leaves the current regulations in place and unchanged including the requirement for preharvest grove surveys. APHIS has concluded that a mandatory packinghouse treatment of citrus fruit with APHIS approved disinfectant and phytosanitary inspection, by APHIS, of finished fruit provides an effective safeguard to prevent the spread of Xac via the movement of commercial citrus fruit especially when combined with a limited distribution requirement that excludes shipment to U.S. citrus-producing States.

A packinghouse-based inspection could ensure an appropriate level of phytosanitary security, but would be easier to implement and enforce than a grove-centered system of mitigations. Because it focuses on the end product, a packinghouse-based inspection would be more reliable and less easily circumvented than the preharvest grove survey. In addition, a phytosanitary packinghouse inspection creates a performance standard for packed fruit that allows citrus producers greater flexibility to determine the most efficient and effective means of producing a compliant product.

7.6 Illegal Movement of Fruit

Under any of Options 2, 3, 4, and 5, commercially packed fruit can be illegally moved, intentionally or unintentionally. For example, Option 4 prohibits distribution of all types and varieties of citrus fruit, including tangerines, to citrus-producing States, but fruit can still be moved illegally to prohibited States, even though fruit boxes are labeled to prevent such movement. Under the regulations in place before the publication of the final rule, USDA-APHIS-PPQ-Smuggling Interdiction and Trade Compliance (SITC) staff report six known interceptions of Florida citrus fruit since 2006 in citrus-producing States out of an estimated 12,400 shipments.

APHIS staff cannot estimate the frequency of unreported illegal movement of Florida citrus to citrus-producing States or the proportion of reported illegal movement to total illegal movement. Since Option 4 would maintain the current prohibition on movement of citrus fruit to citrus-producing States, the rate of intentional or unintentional movement of Florida citrus fruit to prohibited States is not expected to change under this option.

To compensate for uncertainty in the rate of illegal fruit movement and ensure compliance with distribution restrictions, APHIS will routinely monitor wholesalers and fresh fruit markets in commercial citrus-producing States and distribution routes bound for commercial citrus-producing States to ensure that Florida citrus fruit does not unlawfully enter U.S. commercial citrus producing States. This monitoring will be conducted primarily by SITC, which works with Federal, State and local cooperators to interdict smugglers, close illegal pathways, and prevent the unlawful entry and distribution of prohibited agricultural products that may harbor harmful, exotic plant and animal pests, disease, or invasive species. The packinghouse measures of disinfection and APHIS inspection ensure that even if a given shipment were illegally moved to a prohibited State, the shipment would have a low likelihood of containing fruit with the potential to cause an outbreak of citrus canker disease.

7.7 Conclusion

Under § 412(a) of the Plant Protection Act (PPA 2000), the Secretary of Agriculture may prohibit or restrict the movement in interstate commerce of any plant or plant product if the Secretary determines that the prohibition or restriction is necessary to prevent the dissemination of a plant pest within the United States. APHIS has determined, based on the best available evidence, that it is not necessary to prohibit the interstate movement of commercially packed citrus fruit that has been treated and inspected by APHIS at the packinghouse into non-citrus-producing States. While APHIS has concluded that commercially packed citrus fruit is unlikely to serve as an epidemiologically significant pathway for the introduction and spread of citrus canker, the remaining uncertainty about the precise level of risk associated with the movement of citrus fruit from a quarantined area has led us to determine that it is necessary maintain the current prohibition on the movement of that citrus fruit into citrus-producing States.

Accordingly, this analysis recommends implementation of Option 4.

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9 Appendix 1. Probabilistic analysis of the efficacy of the proposed phytosanitary inspection

This appendix presents the methodology and results of the quantitative analysis.

9.1. Summary

The risk management options for the interstate movement of fresh commercially packed citrus fruit from regions with citrus canker disease to regions without the disease presented in Section 7 are summarized below:

Option 1	Allow unrestricted distribution of all types and varieties of *commercially packed* citrus fruit to all U.S. States[9].
Option 2	Allow distribution of all types and varieties of *commercially packed* citrus fruit to all U.S. States, subject to packinghouse treatment with APHIS-approved disinfectant and APHIS inspection of finished[10] fruit (all types and varieties).
Option 3	Allow distribution of all types and varieties of *commercially packed* citrus fruit (except tangerines) in U.S. States except U.S. commercial citrus producing States[11]. Allow distribution of *commercially packed* tangerines to all U.S. States including commercial citrus-producing States. Require packinghouse treatment of all such citrus fruit with APHIS-approved disinfectant and APHIS inspection of finished fruit (all types and varieties) for citrus canker disease symptoms.
Option 4	Allow distribution of all types and varieties of *commercially packed* citrus fruit in U.S. States except U.S. commercial citrus-producing States and require packinghouse treatment of citrus fruit with APHIS-approved disinfectant and APHIS inspection of finished fruit (all types and varieties).
Option 5	Leave the current regulations for the interstate movement of citrus fruit from citrus canker quarantined areas in place and unchanged.

To assist in evaluating Option 2, APHIS constructed a probabilistic model to evaluate the movement of commercially packed fresh citrus fruit to all U.S. States with APHIS approved disinfectant treatment and a mandatory packinghouse phytosanitary inspection. The model determines the potential quantity of *Xanthomonas axonopodis* pv. *citri* (Xac)-infected fruit with visible[12] lesions, shipped from Florida to citrus growing areas in the

[9] For clarity, the term "State" is defined here as any of the 50 U.S. States or U.S. Commonwealths, Trusts and Territories

[10] Fruit that has completed the packinghouse washing, disinfection, grading and inspection processes.

[11] American Samoa; Arizona; California; Florida; Guam; Hawaii; Louisiana; Northern Mariana Islands; Puerto Rico; Texas; and the Virgin Islands of the United States

[12] Visible in the context of this probabilistic assessment means that the fruit have visible symptoms of Xac, i.e., Xac lesions 1 mm in diameter and greater.

commercial citrus-producing states of Arizona, California, Hawaii, Louisiana, and Texas during the course of a shipping season for three different scenarios of lot[13] inspection.

Model input parameters, were: a) the number of 4/5-bushel cartons of commercially packed and APHIS-inspected Florida citrus shipped to citrus-producing States per shipping season; b) the number of fruit per 4/5-bushel container; c) the proportion of fruit with visible symptoms of Xac in the shipments; and d) the proportion of the shipments reaching citrus-growing areas in the citrus producing States.

APHIS estimates the true prevalence of fruit with visible symptoms of Xac based on the apparent prevalence, adjusted to account for inspection sensitivity. The beta distribution is used to estimate the apparent prevalence, the quantity of fruit shipped from Florida, and the true prevalence of undetected fruit with visible symptoms of Xac, were used to determine the potential number of fruit with visible symptoms of Xac that get to citrus growing areas of commercial citrus producing States.

The outputs of the quantitative model were probability distributions. The model determined, with 95 percent confidence, that the total number of citrus fruit shipped from Florida to five citrus-producing States (AZ, CA, HI, LA and TX) over a single shipping season would be 152,234,658 or less if unlimited distribution is permitted. The model determined, with 95 percent confidence, that the number of fruit with visible symptoms of Xac reaching those five States in a single shipping season would be: 519,178 or less at the 1,000 fruit inspection levels; about half that number at the 2,000 fruit inspectional level; and about double that number at the 500 fruit inspectional level. The model further determined with 95 percent confidence that the number of fruit with visible symptoms of Xac reaching citrus-producing areas within those States in a single shipping season would be: 1,794 or less at the 1,000 fruit inspectional level; about half that number at the 2,000 fruit inspectional level; and about double that number at the 500 fruit inspectional level.

[13] A lot is described as the inspectional unit for fruit; composed of a single variety of fruit that has passed through the entire packing process in a single continuous run, during the course of one day; regulatory actions (e.g., issuance of limited permits, rejection) are taken at the lot level.

Table 2. Number (per shipping season) of fruit with visible symptoms of Xac reaching citrus producing States, and citrus growing areas in those States (95% confidence level results), for three scenarios under risk management Option 2.

	Scenario 1	Scenario 2	Scenario 3
	500 fruit sampled per lot	1000 fruit sampled per lot	2000 fruit sampled per lot
Number of fruit shipped with visible symptoms of Xac to commercial citrus producing states each shipping season.	1024892	519178	260221
Number of fruit with visible symptoms of Xac reaching citrus growing areas in commercial citrus producing states	3,563	1,794	907

9.2. Purpose and Scope

This Appendix evaluates the effectiveness of the proposed packinghouse phytosanitary inspection; as part of the proposed options for regulating the interstate movement of commercially packed citrus fruit from Florida.

The phytosanitary hazard[14] is the introduction of Xac into citrus-growing U.S. States where it is not known to occur after having been moved there on Xac-infected Florida citrus that had been commercially packed and undergone a pre-shipment inspection by APHIS.

Under natural conditions, Xac-infected citrus fruit will most likely have visible Xac-lesions larger than 1 mm in diameter (see sections 5.1 and 5.3 of this document). The phytosanitary inspection has been designed to prevent lots with Xac infected fruit from being shipped interstate. We do not assume that fruit with Xac-lesions smaller than 1mm in diameter are detected by the visual phytosanitary inspection at the packinghouse. In addition, fruit with epiphytic Xac contamination cannot be detected by a visual phytosanitary packinghouse inspection. However, for reasons discussed elsewhere in this document, fruit with epiphytic Xac contamination and fruit with lesions smaller than 1 mm do not have levels of Xac that are epidemiologically significant in Xac establishment. Therefore, fruit with lesions smaller than 1 mm and fruit with epiphytic Xac contamination are not quantitatively analyzed. Only fruit with Xac lesions greater than 1 mm in diameter (fruit with visible symptoms of Xac) are analyzed quantitatively.

A model was developed to determine the number of citrus fruit with visible[15] symptoms of Xac arriving in citrus-producing States, and citrus growing areas within these States,

[14] A hazard is: something that has the potential to cause harm, and that we do not want to happen,
[15] A visible canker lesion is one that is 1mm or more in diameter.

per shipping-season[16] for three inspection scenarios: inspection of 500 fruit per lot; inspection of 1000 fruit per lot; and inspection of 2000 fruit per lot.

The model answers the following questions:

1. What proportion of the commercially packed and APHIS inspected citrus fruit shipped interstate from Florida has visible symptoms of Xac?
2. How many citrus fruit from Florida with visible symptoms of Xac reach commercial citrus-growing U.S. States per shipping-season?
3. How many fruit from Florida with visible symptoms of Xac reach citrus-growing areas in commercial citrus-growing U.S. States per shipping-season?

As noted elsewhere in this document (section 5), introduction as defined by the IPPC includes entry and establishment of a pest. This model quantitatively describes the likelihood of entry. This appendix does not quantitatively assess the likelihood of Xac establishment, given the shipment of fruit with visible symptoms of Xac to citrus growing areas. As a condition for successful establishment, Xac, in sufficient amounts to cause infection, must encounter not only an environment with a temperature, relative humidity, and rain events conducive to infection, it also must encounter plant tissue of a host that is either at a susceptible growing stage or is wounded and then the bacteria, in sufficient numbers to incite infection, needs to successfully enter this tissue.

9.3. Methodology

APHIS intends to regulate the interstate movement of fresh citrus fruit from Florida (where citrus canker exists), by using a performance standard approach to mitigating the likelihood of movement of fruit with visible Xac symptoms. In this approach, the citrus growers (including backyard citrus growers) and harvesters will voluntarily implement phytosanitary measures that prevent and control the presence of symptomatic citrus canker infection in the fruit they produce. These fruit are required to be processed in a commercial packinghouse, if they are intended for interstate commerce. In each commercial packinghouse, APHIS will inspect a specified number of randomly sampled fruit from each produced lot. A lot will be released for interstate shipment, on condition that upon phytosanitary inspection, no fruit with visible Xac symptoms are detected. If any fruit with visible lesions are detected, then no fruit from the lot can move interstate.

A probabilistic model was developed to determine the potential quantity of fruit with visible Xac symptoms shipped from Florida to citrus growing areas in the commercial citrus-producing states of Arizona, California, Hawaii, Louisiana, and Texas during the course of a shipping season for three scenarios of lot inspection: inspection of 500 fruit per lot; inspection of 1000 fruit per lot; and the inspection of 2000 fruit per lot.

The development of the model involved the following four steps:

1. Developing a risk pathway tree, labeling it and assigning units;

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[16] The shipping-season in Florida is August 1st till July 31st of the next year.

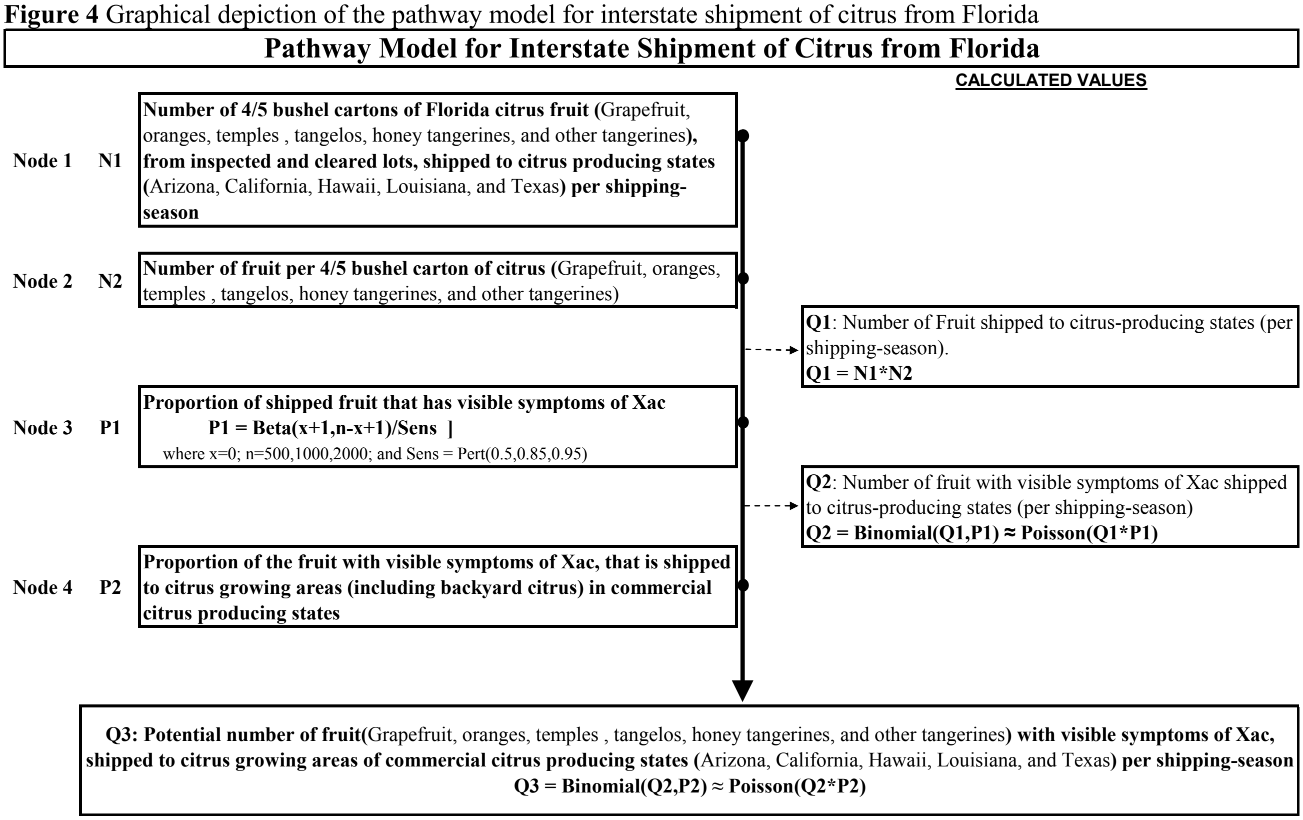
2. Stating assumptions;
3. Estimating Parameters: Gathering and documenting the evidence, and assigning values to the branches of the risk pathway tree;
4. Performing calculations to summarize the likelihood of the hazards occurring.

9.3.1. Risk pathway tree

A risk pathway tree (Figure 4) is a visual representation of the events that could lead to fruit from Florida with visible symptoms of Xac reaching citrus producing areas in other states. These events were modeled and include:

1. During each shipping-season some quantity of Florida citrus is packed, inspected and released by APHIS for interstate shipment.
2. Some proportion of the fruit in the released shipments has visible symptoms of Xac. For this to be the case, the following must be true:
   i. Xac-infected fruit were harvested and packed.
   ii. Packed lots containing fruit with visible symptoms of Xac escaped detection during PPQ-APHIS pre-shipment inspection and were released for interstate movement.
3. Some proportion of the fruit with visible symptoms of Xac is shipped to citrus growing areas in commercial citrus-producing States (directly or indirectly)

Figure 4 Graphical depiction of the pathway model for interstate shipment of citrus from Florida



9.3.2 Model assumptions

The model assumes the following:

1. If Xac infection exists in a lot, fruit with visible Xac symptoms are distributed randomly throughout the population of packed fruit, i.e., all fruit have the same likelihood of having visible symptoms of Xac, and thus the same likelihood of having visible Xac symptoms.
2. Fruit inspection is modeled as a binomial process in which every fruit has an equal chance of being inspected and the size of the sample is small compared to the lot size.
3. The per-capita citrus consumption in the population is assumed to be uniform. No differentiation was made in the interstate and intercounty consumption habits.
4. Fruit consumption is assumed to be directly proportional to the population. The number of citrus fruit reaching citrus growing areas in citrus producing States is directly proportional to the proportion of the population living in citrus producing counties in those States, and the proportion of citrus acreage in the citrus producing counties.
5. Xac infected fruit are equally likely to be consumed in citrus growing areas as non Xac-infected fruit. They are no more or less likely to be consumed than non infected fruit.

Under the intended action, APHIS requires the surface disinfection of the fruit, a phytosanitary inspection, and the limited distribution of citrus shipped from Florida to non-citrus producing States. The model presupposes no prior knowledge of the prevalence of fruit with visible symptoms of Xac in inspected lots.

9.3.3. Estimating parameters

Values for the model input parameters (i.e., of the model nodes) are estimated based on available evidence. Many of these inputs are uncertain, and are defined as probability distributions rather than single values. The input parameters and their units are summarized and explained in Table 3.

Table 3 Model parameters and units

NODE	Parameter and description		UNITS
1	N1	Number of 4/5 bushel cartons of Florida citrus fruit shipped to citrus producing states per shipping-season[17]	4/5 bushel cartons shipped to citrus producing states / shipping season
2	N2	Number of fruit per 4/5 bushel carton shipped	fruit shipped / 4/5 bushel carton shipped to a citrus producing state
3	P1	Proportion of fruit with visible Xac lesions	fruit with visible symptoms of Xac shipped to citrus producing states / Fruit shipped
4	P2	Proportion of fruit with visible Xac lesions consumed in citrus growing areas (including backyard) of citrus producing states	fruit with visible symptoms of Xac consumed in citrus growing areas of citrus producing states / fruit with visible symptoms of Xac shipped to citrus producing states

The estimation of each parameter (N1, N2, P1, and P2) is now presented.

9.3.3.1 Node 1 (N1): The number of 4/5 bushel cartons of Florida citrus shipped interstate per shipping-season

Unit: *4/5-bushel cartons shipped to citrus producing States / shipping season*

The number of 4/5-bushel containers of Florida citrus shipped during each of the last ten shipping seasons for each variety of fruit, and for each fruit size, were obtained from the Florida Department of Citrus (Florida Department of Citrus 2003b, 2004b, 2005b, 2006b). This historical fruit shipping data is contained in Table 18 of Appendix 2.

The expected number of 4/5 bushel cartons inspected, released and shipped interstate is based on the minimum and maximum amounts of citrus shipped during the last five shipping seasons. This analysis assumes that the quantity of fruit shipped per season may vary, but, in the long term, will not exceed the maximum shipment values of the past five seasons. The trends and changes occurring in the Florida citrus industry suggest that the last five seasons are typical. The 2006 Commercial Citrus Inventory for Florida (USDA-NASS 2007) states the following about the 2-year trend for Florida citrus fruit production: "Florida's citrus acreage peaked again at 857,687 in 1996 but has been declining ever since. The 2006 total is 621,373, down 17.0 percent in a 2-year period noted for hurricanes, diseases, and urban development. The net change, a loss of 127,182 acres, is the greatest in any non-freeze period and 2nd overall. The Indian River District

[17] The shipping-season in Florida is August 1st till July 31st of the next year.

bore one-third of this loss. Removals out-numbered new plantings by a ratio of more than 5:1. The 23,623 acres of new plantings are the least recorded in any two-year period since 1970-71."

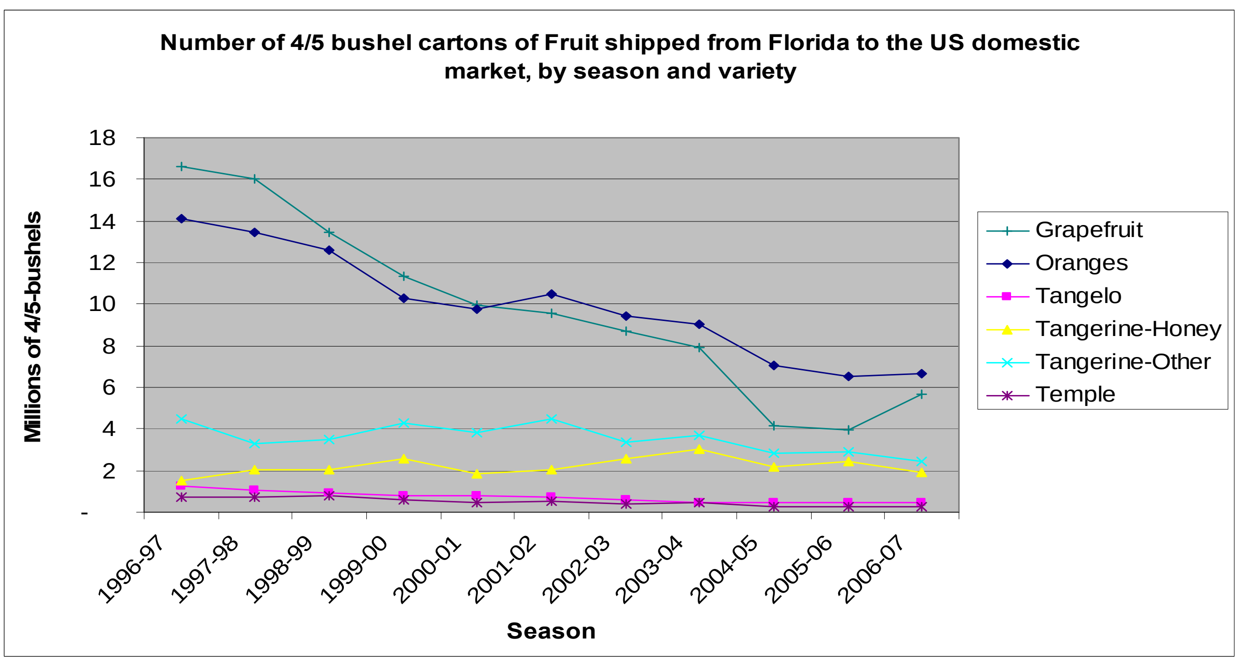
Evidence:

Table 4. Thousands of 4/5-Bushel cartons of Florida citrus by variety shipped to citrus growing states during 1996-97 to 2006-07 shipping-seasons (Florida Department of Citrus 2007)

Year	Grapefruit	Oranges	Tangelo	Tangerine-Honey	Tangerine-Other	Temple	Grand Total
1996-97	16,626	14,128	1,254	1,529	4,465	742	38,745
1997-98	16,034	13,442	1,082	2,030	3,300	725	36,614
1998-99	13,483	12,617	909	2,064	3,489	817	33,378
1999-00	11,333	10,300	813	2,577	4,306	572	29,901
2000-01	9,973	9,774	777	1,821	3,853	471	26,669
2001-02	9,593	10,477	729	2,073	4,514	502	27,889
2002-03	8,719	9,434	620	2,562	3,389	397	25,121
2003-04	7,926	9,027	478	3,054	3,689	463	24,636
2004-05	4,121	7,087	452	2,169	2,844	255	16,928
2005-06	3,976	6,542	480	2,416	2,905	236	16,555
2006-07	5,641	6,685	441	1,905	2,409	265	17,345

Over the past five shipping seasons, the domestic shipments of fresh citrus from Florida have declined (Figure 5).

Figure 5. Florida's shipment of 4/5 bushel cartons of fresh citrus between the 1996-97 and the 2006-07 seasons



Similarly, shipments of Florida citrus to commercial citrus producing States have also declined (Figure 6). In Figure 7, it is notable that since the 1999-2000 shipping season, over 60% of the shipments from Florida has been of the tangerine variety.

Figure 6. Florida's shipment of 4/5 bushel cartons of fresh citrus fruit to commercial citrus producing States between the 1996-97 and the 2006-07 seasons

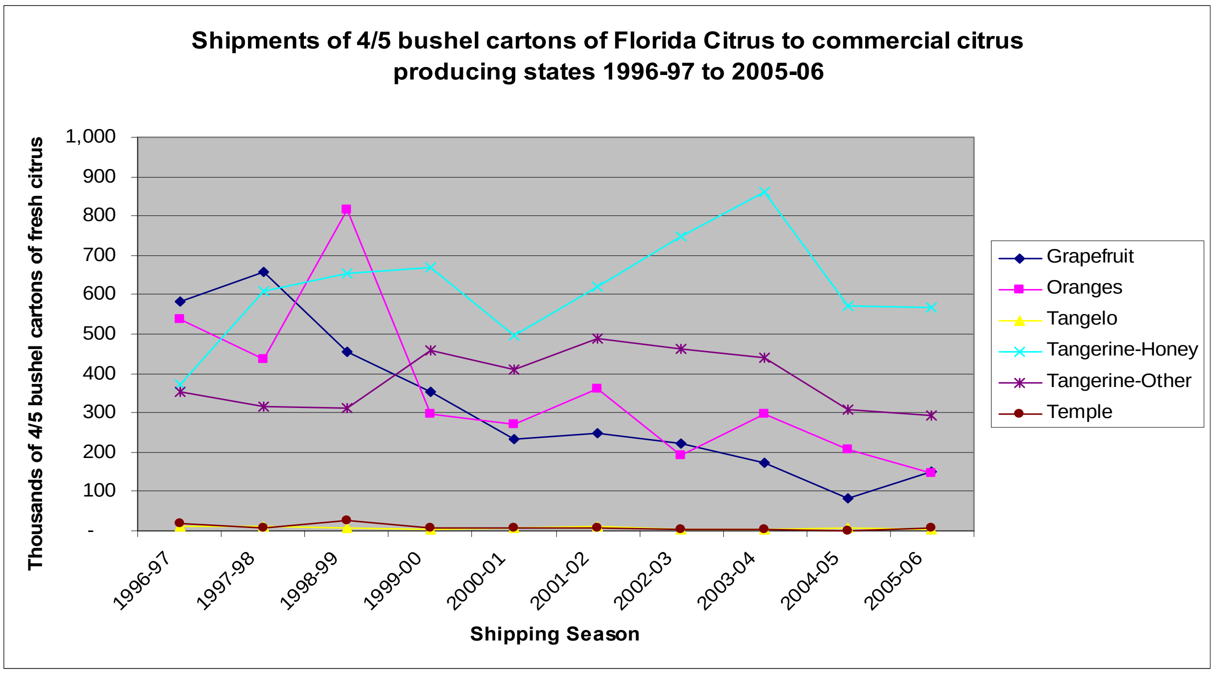
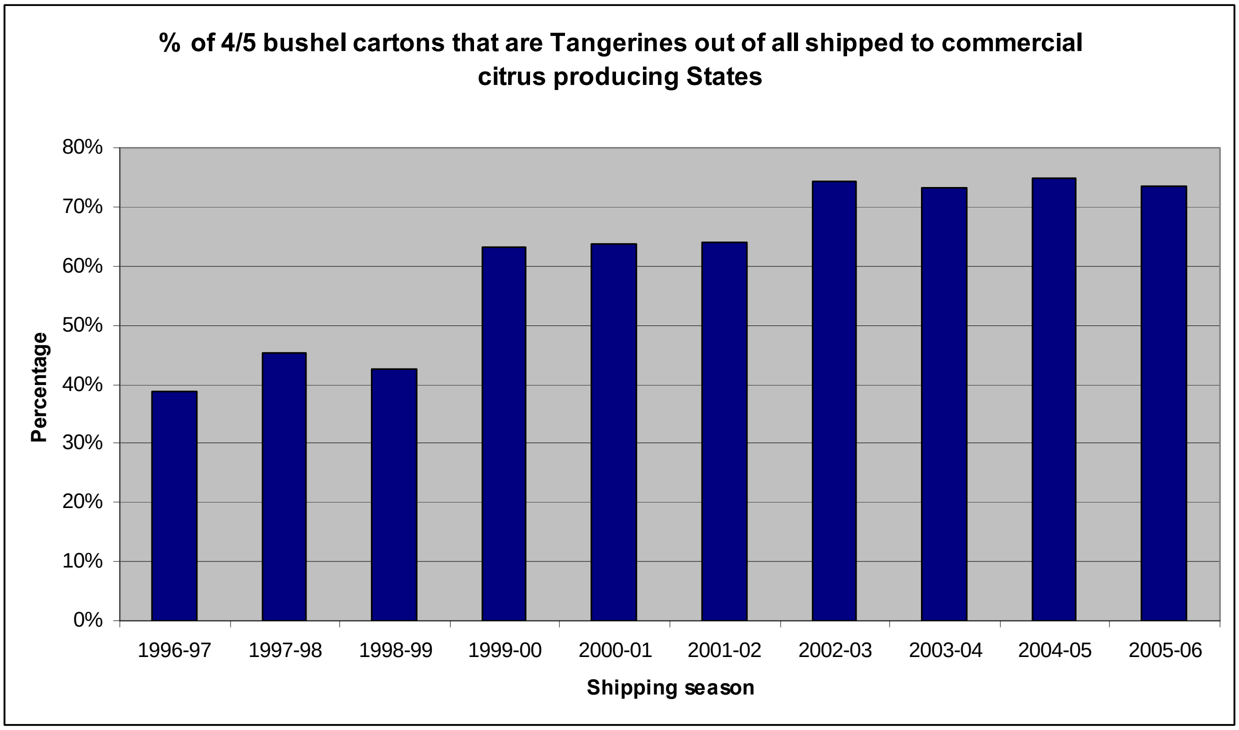


Figure 7. Percentage of 4/5 bushel cartons that are tangerines shipped to commercial citrus producing States.



9.3.3.2. Node 2 (N2): Number of fruit shipped per 4/5 bushel carton shipped

Unit: *Fruit / 4/5-bushel carton*
The number of fruit per 4/5 bushel carton varies by variety of citrus. For each variety of citrus, there are up to ten fruit sizes. The average number of fruit per 4/5 bushel carton for the various fruit sizes was obtained from the Florida Department of Citrus (Florida Department of Citrus 2003b, 2004b, 2005b, 2006b), and is presented in Table 5.

Table 5. Average number of fruit in 4/5-bushel containers **(Florida Department of Citrus 2003b, 2004b, 2005b, 2006b)**

	GFT 14	GFT 18	GFT 23	GFT 27	GFT 32	GFT 36	GFT 40	GFT 48	GFT 56	GFT 64
	ORG 48-50	ORG 56	ORG 64	ORG 72-80	ORG 100	ORG 120	ORG 125	ORG 150	ORG 156	ORG 163
	SPEC 64+	SPEC 64	SPEC 80	SPEC 100	SPEC 120	SPEC 150	SPEC 176	SPEC 210	SPEC 246	SPEC 294
Grapefruit	14	18	23	27	32	36	40	48	36	64
Oranges	49	56	64	76	100	120	125	150	156	163
Specialty fruit	64	64	80	100	120	150	176	210	246	294

According to the Florida Department of Citrus (FDOC):

> "The headings at the top of Table 5 indicate the average number of fruit per 4/5 bushel carton. If the variety is 103 (white seedless grapefruit) and there are 1000 boxes listed under the column titled GFT 14, that means those cartons each held 14 grapefruit. If the variety had been 203 (navel oranges) in that same column the second title – ORG 48-50 would apply. Each carton would hold 48 to 50 oranges.
>
> Varieties in the 100 range would use the GFT sizes; 200 range would use ORG sizes; and 300 range would use SPEC sizes."

Accordingly, the values presented in Table 6 were used as the number of fruit of each variety per 4/5-bushel container of a particular fruit size.

Table 6. Average number of fruit per 4/5-bushel carton of Florida citrus for each fruit size and variety of citrus

		Average Number of fruit per 4/5 Bushel carton									
Variety code	**Variety Name**	**size1**	**size2**	**size3**	**size4**	**size5**	**size6**	**size7**	**size8**	**size9**	**size10**
101	Seedy white grapefruit	14	18	23	27	32	36	40	48	36	64
102	Seedy pink grapefruit	14	18	23	27	32	36	40	48	36	64
103	Seedless white grapefruit	14	18	23	27	32	36	40	48	36	64
104	Seedless pink grapefruit	14	18	23	27	32	36	40	48	36	64
119	other grapefruit	14	18	23	27	32	36	40	48	36	64
202	K-early oranges	49	56	64	76	100	120	125	150	156	163
203	Navel oranges	49	56	64	76	100	120	125	150	156	163
205	Early oranges	49	56	64	76	100	120	125	150	156	163
206	Midseason oranges	49	56	64	76	100	120	125	150	156	163
207	Late oranges	49	56	64	76	100	120	125	150	156	163
208	Temple oranges	49	56	64	76	100	120	125	150	156	163
209	Tangelo	49	56	64	76	100	120	125	150	156	163
210	Ambersweet orange	49	56	64	76	100	120	125	150	156	163
220	Other oranges	49	56	64	76	100	120	125	150	156	163
302	Robinson tangerine	64	64	80	100	120	150	176	210	246	294
303	Honey tangerine	64	64	80	100	120	150	176	210	246	294
304	Sunburst tangerine	64	64	80	100	120	150	176	210	246	294
305	Fallglo tangerine	64	64	80	100	120	150	176	210	246	294
309	Dancy tangerine	64	64	80	100	120	150	176	210	246	294
321	Other tangerine	64	64	80	100	120	150	176	210	246	294

9.3.3.3. Node 3 (P1): Proportion of fruit with visible symptoms of Xac in each released lot (undetected prevalence of fruit with visible symptoms of Xac)

Unit: *(Xac-infected fruit with visible symptoms of Xac) / Fruit*

APHIS is estimating the true prevalence (p_{true}) of fruit with visible symptoms of Xac, based on apparent prevalence ($p_{apparent}$), adjusted to account for inspection sensitivity (Se). The equation is:

$$P1 = p_{true} = \frac{p_{apparent}}{Se} \quad \textbf{(1)}$$

The beta distribution is used to estimate the apparent prevalence, $p_{apparent}$, assuming a sample size of n, and no fruit with visible symptoms of Xac detected in an inspection sample from a lot (x= 0). The equation (Vose 2000) is:

$$p_{apparent} = \text{Beta}(x+1, n-x+1) = \text{Beta}(1, n+1) \quad \textbf{(2)}$$

Given a minimum, mode and maximum value of sensitivity, the Pert distribution is used to model the probability distribution for the sensitivity of inspection. The minimum, mode and maximum values of sensitivity are 0.5, 0.85, and 0.95, respectively (As described later in this section under the subtitle “Inspection sensitivity”). The equation is:

$$\text{Se} = \text{Pert (minimum, mode, maximum)} = \text{Pert}(0.5, 0.85, 0.95) \quad \textbf{(3)}$$

Substituting Equations 2 and 3 into Equation 1 yields:

$$P1 = p_{true} = \frac{p_{apparent}}{Se} = \frac{Beta(x+1, n-x+1)}{Pert(\min imum, \mathrm{mod}\, e, \max imum)} \quad \textbf{(4)}$$

The model uses equation 4 to evaluate the probability distribution of the true prevalence for three different sampling (i.e., inspection) levels – 500 fruit, 1,000 fruit and 2,000 fruit per lot.

Based on these inspection levels, sensitivity, and the requirement that no infected fruit are found (x=0) in the inspected fruit (Options 2, 3, and 4), the probability distribution for the true prevalence of fruit with visible symptoms of Xac in each inspected lot can be calculated by substituting for n and x in equation 4 as follows:

$$P1(n = 500, x = 0) = \frac{Beta(1,501)}{Pert(0.5,0.85,0.95)}$$

$$P1(n = 1000, x = 0) = \frac{Beta(1,1001)}{Pert(0.5,0.85,0.95)}$$

$$P1(n = 2000, x = 0) = \frac{Beta(1,2001)}{Pert(0.5,0.85,0.95)}$$

This determination requires the assumptions that fruit with visible symptoms of Xac are randomly distributed within a packed lot, that fruit for inspection are selected randomly, and that the number of inspected fruit is small compared to the size of the entire inspected lot. With these assumptions, the inspection is modeled as a binomial process. The determination presupposes no prior knowledge of the prevalence of fruit with visible symptoms of Xac within an inspected lot.

Figures 8, 9, and 10 represent the cumulative distributions for the true prevalence of fruit with visible symptoms of Xac that leave Florida under inspection scenarios of 500, 1,000 and 2,000 fruit inspected per lot, respectively. The graphs show the probability (i.e., confidence) (vertical axis) that the prevalence of fruit with visible symptoms of Xac in any (and every) inspected lot is a given proportion *or less* (horizontal axis), given that the lot has passed the inspection.

Figure 8. Cumulative probability distribution of the true prevalence of fruit with visible symptoms of Xac in inspected and released lots when a sample size of 500 fruit per lot is used

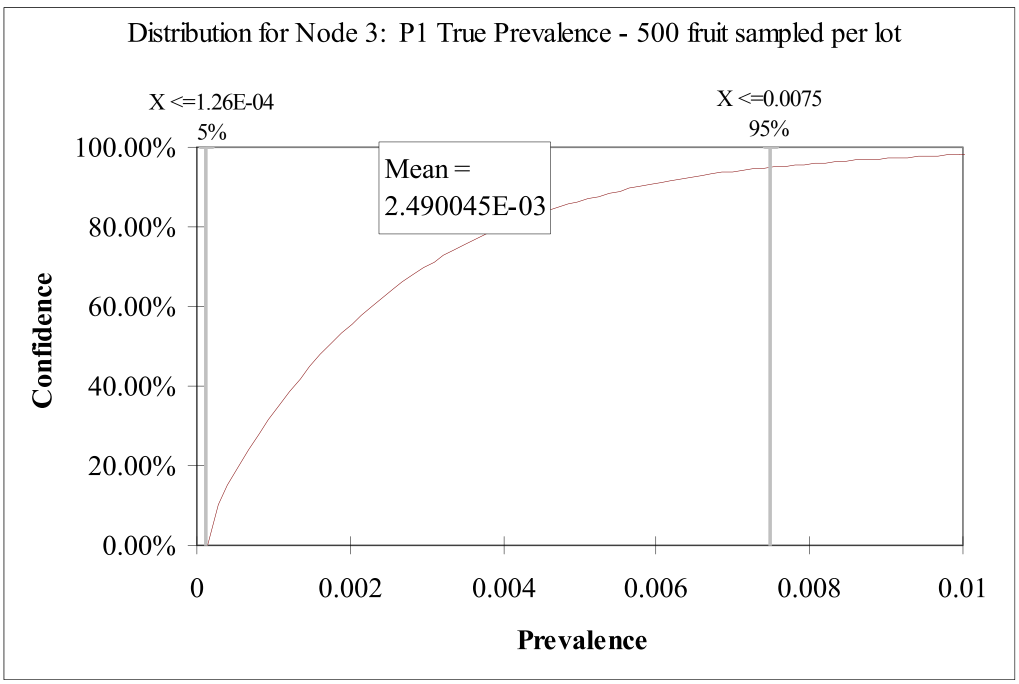


Figure 9. Cumulative probability distribution of the true prevalence of fruit with visible symptoms of Xac in inspected and released lots when a sample size of 1,000 fruit per lot is used

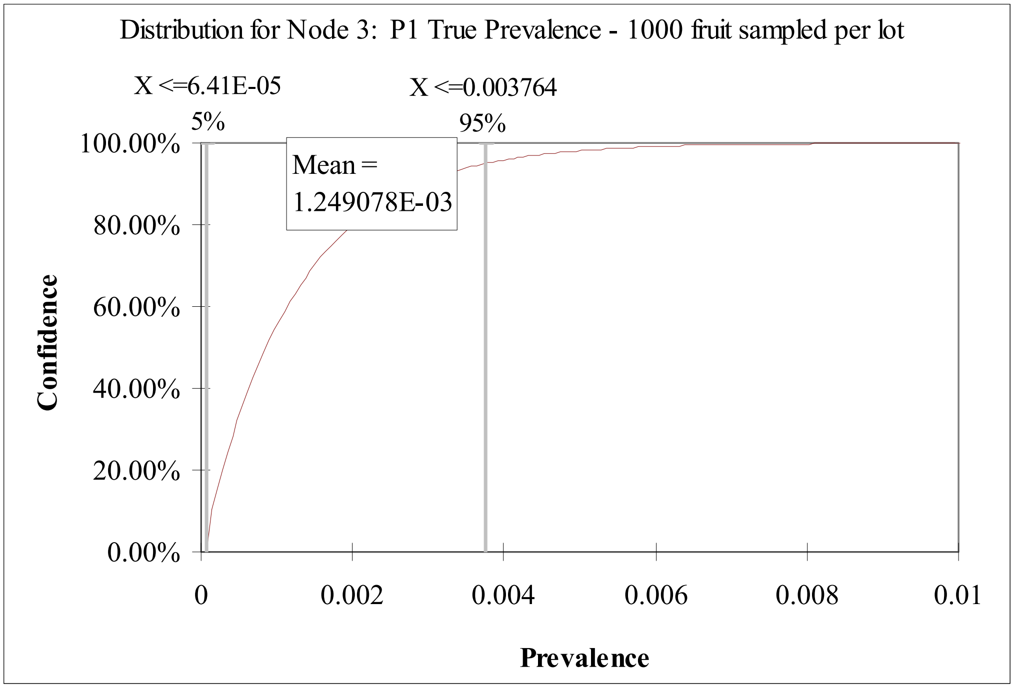
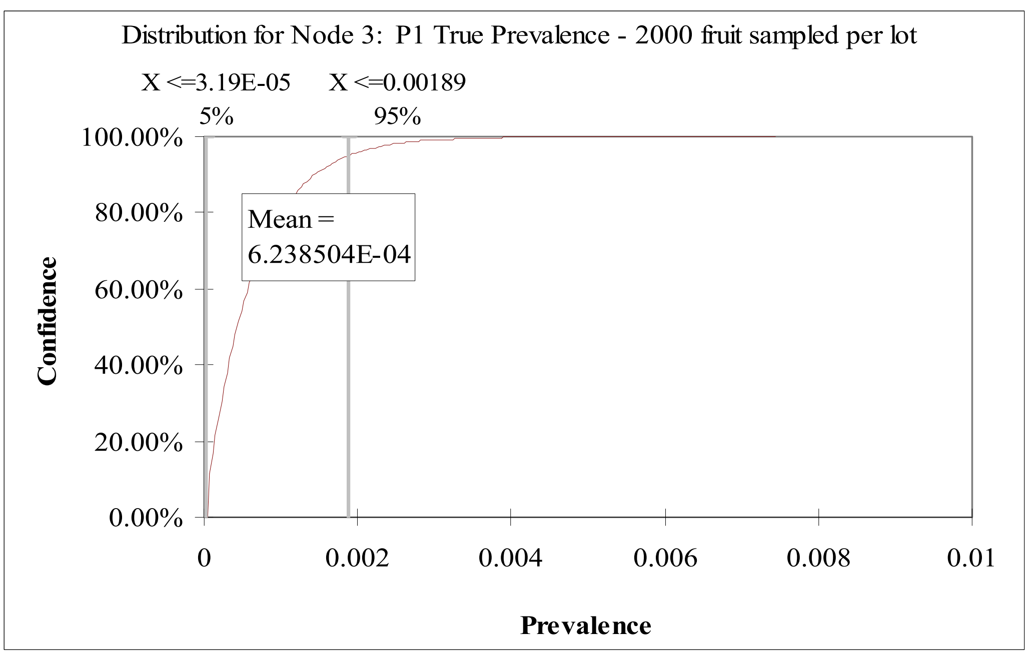


Figure 10. Cumulative probability distribution of the true prevalence of fruit with visible symptoms of Xac in inspected and released lots when a sample size of 2,000 fruit per lot is used



In summary:

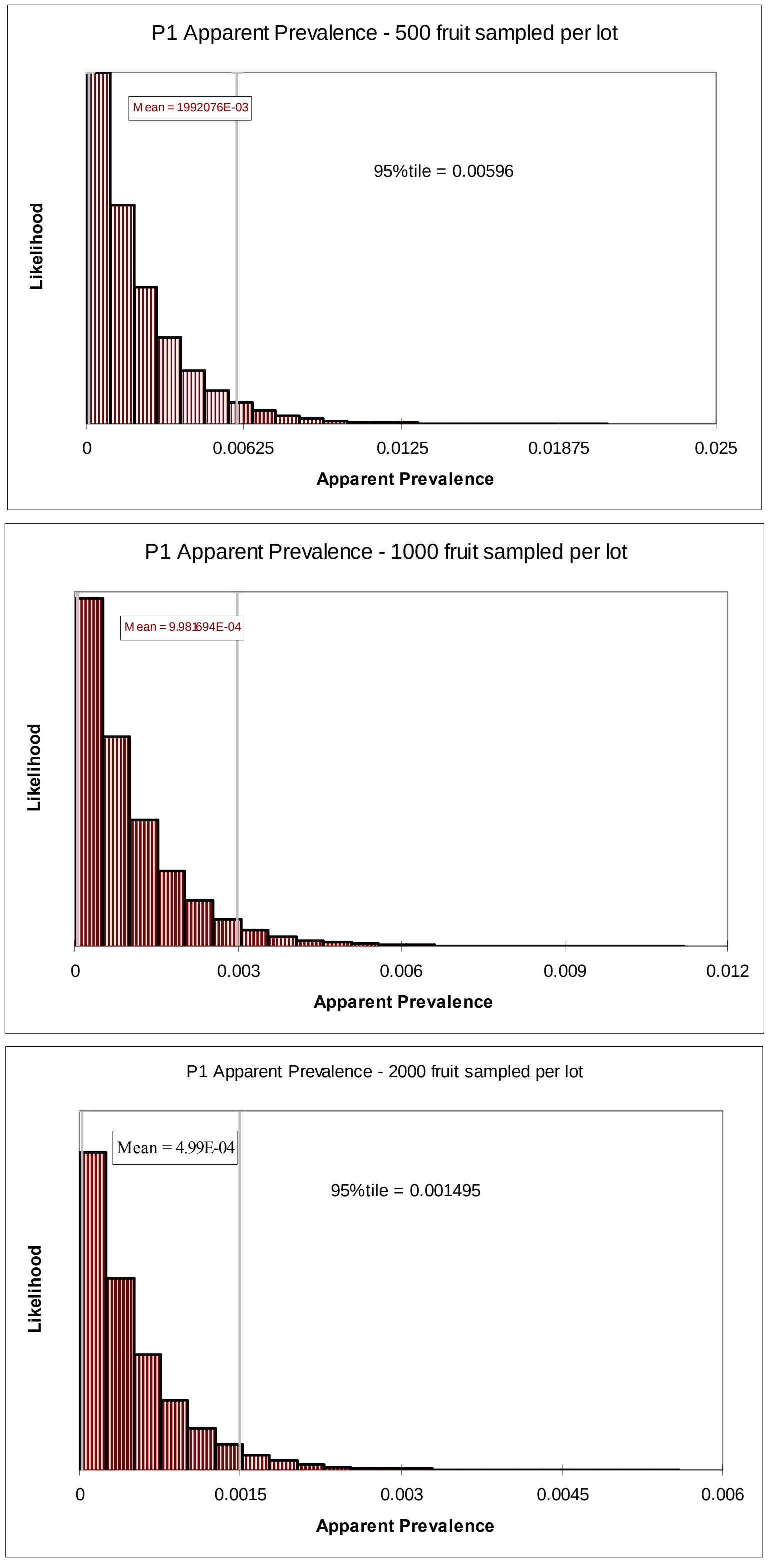
a) If in a random sample of 500 fruit no infected fruit are detected, APHIS is 95% confident that the proportion of infected fruit with visible Xac symptoms in the released lot is no more than 0.75% (748 per 100,000). The mean proportion of fruit with visible symptoms of Xac is 249 per hundred thousand fruit (Figure 8), and the most likely value is 0.
b) If in a random sample of 1000 fruit no infected fruit are detected, APHIS is 95% confident that the proportion of fruit with visible symptoms of Xac in the released lot is no more than 0.38% (376 per 100,000). The mean proportion of fruit with visible symptoms of Xac is 125 per hundred thousand fruit (Figure 9), and the most likely value is 0.
c) If in a random sample of 2000 fruit no infected fruit are detected, APHIS is 95% confident that the proportion of fruit with visible symptoms of Xac in the released lot is no more than 0.19% (189 per 100,000). The mean proportion of fruit with visible symptoms of Xac is 62.4 per hundred thousand fruit (Figure 10), and the most likely value is 0 per million fruit.

9.3.3.3.1 The Beta Distribution

Beta (alpha1, alpha2) specifies a beta distribution using the shape parameters alpha1 and alpha2. These two arguments generate a beta distribution with a minimum value of 0 and a maximum value of 1. The Beta distribution can be used to define the probability of an event, if we know how many times we have observed the event (x), and we know how many times we have tried to observe the event (n). In this case, alpha1 = x+1, and alpha2 = n-x+1. Beta(x+1,n-x) specifies a beta distribution using the number of events observed, x and the number of total observation trials, n.

Designed for binomial processes, the beta distribution allows the calculation of the probability of success on a single trial, given a sampling experiment with x successes in n trials. The Beta distribution is used to determine the apparent prevalence of fruit with visible Xac symptoms (Equation 4) in an APHIS inspected and released lot of fruit, given the size of the sampled population (the fruit actually inspected) and the number of sampled fruit found to be positive (zero for a released lot). Only lots in which no fruit with visible symptoms of Xac are found are allowed to be shipped under management options 2, 3, and 4. The following diagrams present the apparent prevalence under the fruit inspection scenarios of 500, 1000, and 2000 fruit inspected per lot.

Figure 11. Apparent prevalence under the fruit inspection scenarios of 500, 1000, and 2000 fruit inspected per lot



9.3.3.3.2 Why can a constant lot sample size be used for any size of lot?

APHIS is proposing to sample a constant number of fruit from each packed lot in the packing houses, regardless of the size of the lot. This is done for ease of implementation. However, it is important to note the advantages and shortcomings of the approach, and why APHIS believes that a constant sample size can be used for any lot size without compromising the efficacy of the APHIS packinghouse inspection process.

The binomial process of sampling can be modeled in two ways: binomially, involving sampling with replacement; and hypergeometrically, involving sampling without replacement. The beta distribution, as used in equation 6, estimates the apparent prevalence from the number of detections in a given number of fruit inspected. The underlying assumption is that the probability that a fruit has visible symptoms of Xac is the same for every fruit in the lot. This is modeled by sampling with replacement. This means that for a given sample size, the distribution for the prevalence does not change with population size, and therefore the population size does not impact the sample size.

In reality, when the population size is small, the assumption of sampling with replacement does not hold, and the distribution of choice is the hypergeometric distribution, which implements sampling without replacement. In the case where 1000 fruit are sampled per lot, the use of the Beta distribution in equation 6 yields a 95 percent confidence that if no fruit with visible symptoms of Xac are detected in the sample, then the prevalence of fruit with visible symptoms of Xac in the lot is less than 0.38 percent.

For illustrative purposes, the binomial and hypergeometric sample sizes are compared using the following equations:

Binomial sample size determination:

$$n = \log(1\text{-conf})/\log(1\text{-prev*sens})$$

Hypergeometric sample size determination:

$$n = (N - (0.5*N * Prev * Sens) + 0.5) * (1 - (1 - Conf) ^{(1/ (N * Prev * Sens))})$$

Using a confidence (conf) of 95 percent, a prevalence (prev) of 0.38 percent, and a sensitivity (sens) of 80 percent, the population size (N) was varied from 1,000 to 10 million, in increments of 1000, and the binomial and hypergeometric sample sizes were determined and plotted in Figure 12..

Figure 12 shows that in order to have a 95 percent confidence of detecting a prevalence of 0.38 percent or greater in a lot:

- as the number of fruit in the lot increases, the binomially obtained sample size remains constant at 1000

- as the number of fruit in the lot increases, the hypergeometrically obtained sample size approaches the binomially obtained sample size, reaching an asymptote at 1000 when the population is approaching 100,000.

Figure 12. Number of fruit per lot that need to be inspected (sampled) in order to provide a 95 percent confidence that the prevalence is less than 0.38 percent in the lot

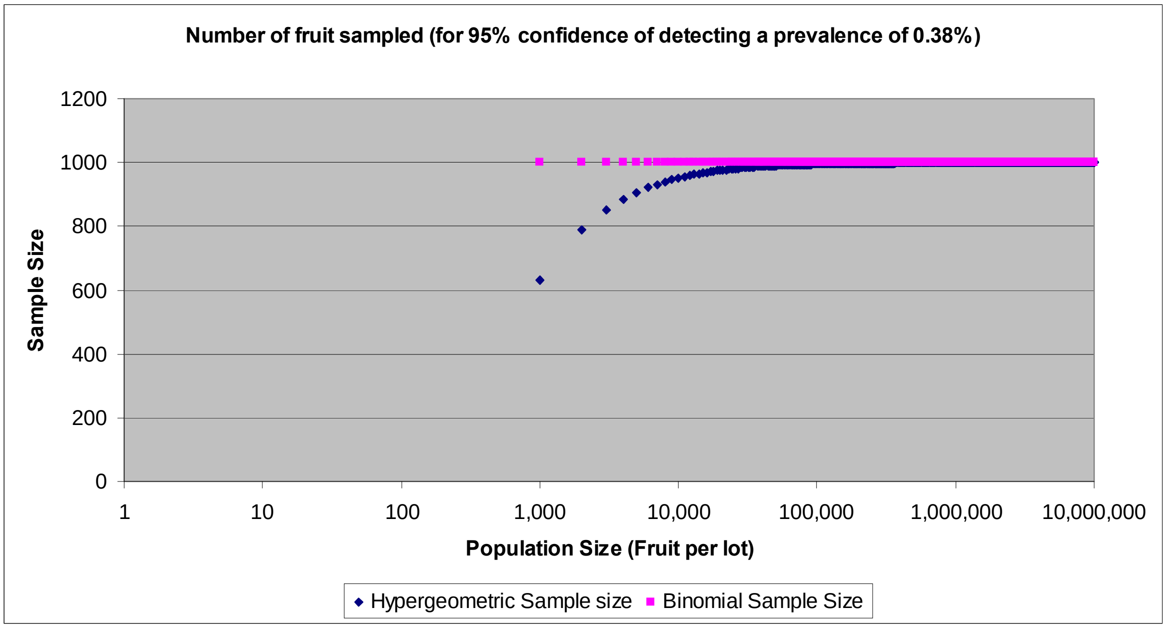


Figure 12 also shows that:

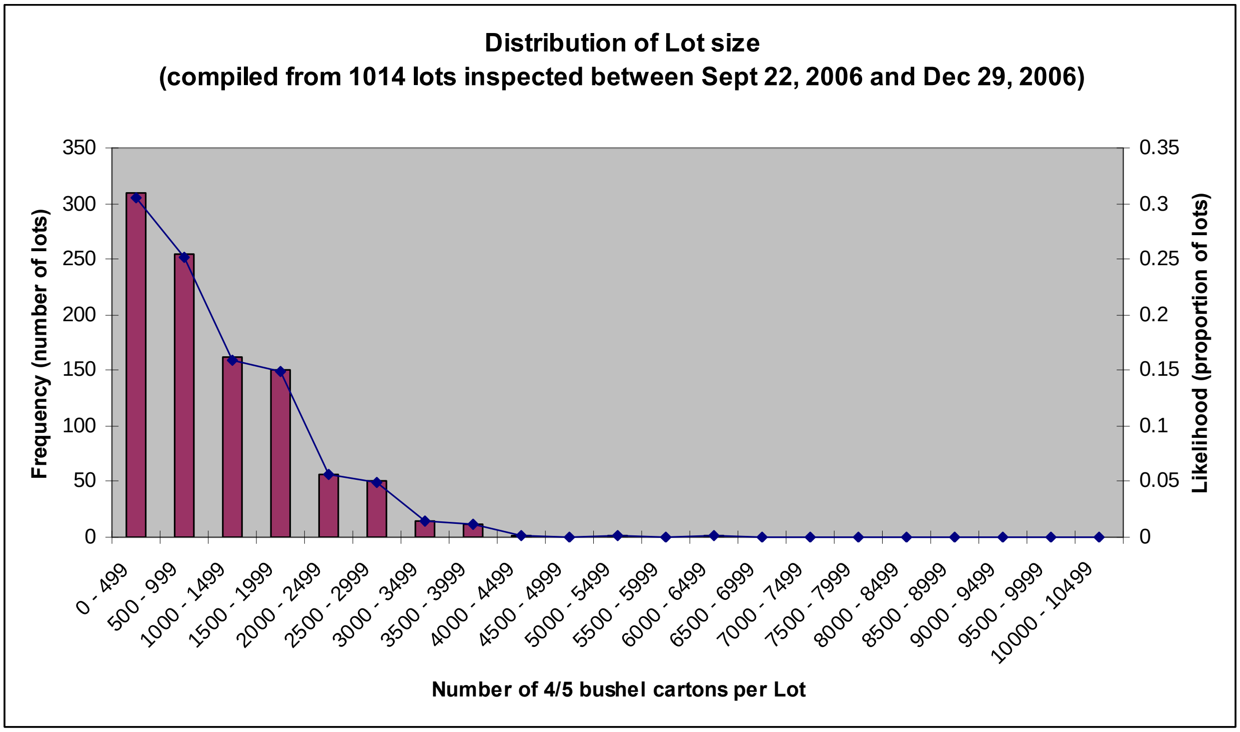
- for lot sizes less than about 50,000 fruit, the hypergeometric sampling algorithm can provide sample sizes of less than 1000 fruit that achieve the same 95% confidence of detecting 0.38 percent prevalence.
- for small lot sizes (less than 10,000 fruit per lot), the binomial sampling algorithm (on which the beta is based) overestimates the threshold prevalence. The same threshold prevalence can be achieved with fewer fruit inspected per lot, using hypergeometric sampling.

The result of keeping a constant sample size of 1000 (or 500, or 2000), is that at lot sizes less than 20,000 fruit, there will be greater than 95 percent confidence of detecting a prevalence of 0.38 percent (or more) in the lot.

Because there are many lots of less than 50,000 fruit, by keeping the sample size fixed, we are understating the reliability of the efficacy of the APHIS packinghouse inspection process.

Figure 13 presents the distribution of the lot sizes in packing houses in one area of Florida. Out of 1,014 lots inspected by APHIS between September 22, 2006 and December 29, 2006, data indicate that the maximum lot size was 11,130 4/5 bushel cartons, and that the average lot size was 1074 cartons (1 truck load is 1,000 cartons). The standard deviation was 923 boxes.

Figure 13. Probability distributions for the number of 4/5 bushel cartons packed per lot and fruit packed per lot in Florida packing houses



The average lot size of 1,074 boxes (1 truck load is 1000 boxes) per lot, equates to between 50,000 and 200,000 fruit per lot (depending on the variety of fruit). This observation indicates that if the future lot sizes (during implementation of the final rule) are similar to those observed in the past, then the actual threshold prevalence will be similar to the true prevalence calculated (based on the assumptions of Beta distribution) using equation 6.

Figure 13 indicates that some lots will exceed one truckload. It should be noted that in such cases, no portion of the lot may leave the premises until the entire lot has been inspected. Commingling of inspected and uninspected or preinspected fruit is unlikely for several reasons:

- physical separation of incoming fruit from the field and packed fruit;
- inspected fruit is packed into boxes specifically labeled for interstate movement; preinspection field fruit is in bins while uninspected intrastate fruit may not be packed in boxes for interstate movement;
- inspected fruit is segregated by loading onto trucks, storage in holding or degreening areas or simply by segregation on the packinghouse floor.

The compliance agreement under which packinghouses will be required to operate will contain provisions ensuring appropriate separation of fruit.

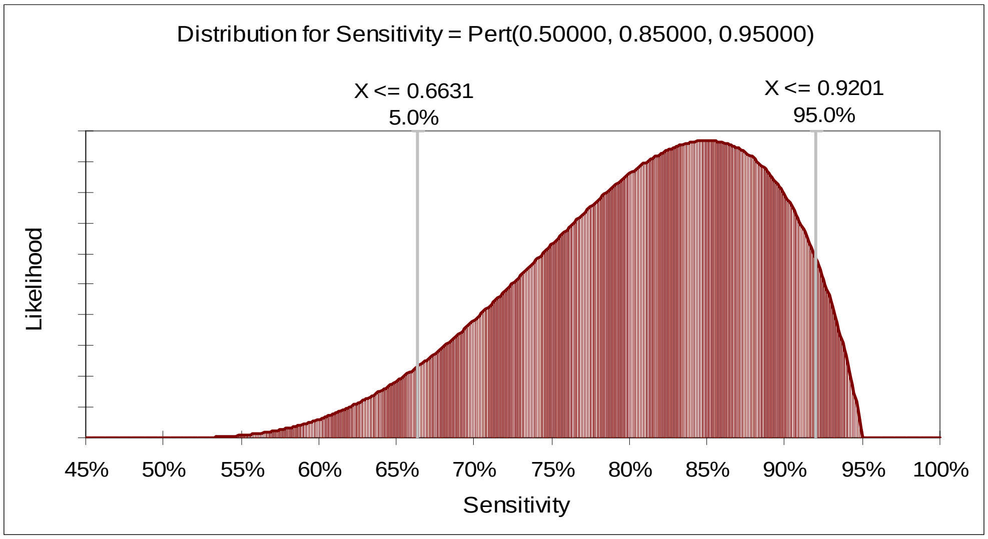
9.3.3.3.3 Inspection sensitivity

APHIS does not assume that inspectors correctly identify every inspected, Xac-infected fruit. The Agency recognizes that even when a Xac-infected fruit is selected for inspection, the symptoms may not be recognized in every case. Inspectors may fail to detect Xac-infected fruit for several reasons. For example, the Xac lesions may be too small to be observed by the naked eye, the lesions may be atypical, the inspectors may fail to observe the entire surface of the fruit, etc. A lesion is visible if it is 1 mm or more in diameter. This analysis focuses on the visible lesions.

"Sensitivity" is the likelihood that a fruit with visible symptoms of Xac will actually be detected by inspection. Sensitivity is defined as the proportion of fruit with visible symptoms of Xac detected by inspection compared to the total number of fruit with visible symptoms of Xac inspected. Sensitivity equal to 1 means that all inspected fruit with visible symptoms of Xac is correctly identified as such; sensitivity equal to 0.75 means that ¾ of inspected fruit with visible symptoms of Xac is correctly identified, etc. APHIS does not know precisely the sensitivity of the fruit inspection process. However, the sensitivity depends on the training of the inspectors, as well as the visibility and distinctiveness of the Xac lesions on fruit. For this reason a distribution was used to represent the uncertainty in the sensitivity estimate.

PPQ inspectors are trained and tested each season for citrus canker disease symptom recognition. APHIS test records indicate that inspectors on average correctly identify over 90 percent of fruit with visible symptoms of Xac. APHIS recognizes, however, that test scores may not reflect actual proficiency under packinghouse conditions. Therefore, APHIS used a Pert probability distribution (Figure 14) to describe the sensitivity of the inspection process and, based on the evidence presented following, estimated the minimum value of sensitivity equal to 0.50, the most likely value equal to 0.85, and the maximum value equal to 0.95.

Figure 14. Probability distribution for the sensitivity of inspection



Inspection sensitivity evidence:

- The size, appearance, and abundance of Xac lesions on fruit entering and exiting the packing line may vary, influencing the ease with which they are detected. Variations observed in lesion appearance are attributed to many factors, including growth stage in which fruit became infected (Civerolo 1984; Graham *et al.* 1992b; Verniere *et al.* 2003; Graham and Leite 2004), susceptibility of the host (Zubrzycki and Zubrzycki 1986; Graham *et al.* 1992b; Gottwald *et al.* 1993), and association with wounds (Koizumi 1972; Sinha *et al.* 1972; Koizumi 1983; Goto 1992; Graham *et al.* 1992b; Verniere *et al.* 2003). Lesions begin as pin point spots, then depending upon the stage at which fruit are infected, may develop to 2 to 10 mm in diameter, becoming corky and crater-like, uniformly brown, approximately circular, and often are surrounded by a water-soaked margin and yellow halo (Gottwald and Graham 2000; Pruvost *et al.* 2002; Timmer *et al.* 2005; University of Florida - IFAS and FDACS-DPI 2006). Lesions on young grapefruit fruit expanded to 1 to 2 mm diameter after 2 to 3 months, enlarging to 9 mm after 200 days (Stall *et al.* 1980), whereas on infected mature fruit, lesions remained as minute (0.1 to 0.15 mm) or small (0.6 to 1.5 mm) greenish spots (Koizumi 1972). The lesions Koizumi observed resulted from a combination of artificial (prick) inoculations and natural infections and therefore provides little information about how the ratio of typical to atypical lesions on fruit varies under natural conditions. Koizumi speculated that the atypical lesions were the result of restricted expansion brought on by physiological changes in the maturing fruit and lower ambient temperatures. As noted by Graham, *et al.* (1992b), the small late season lesions were characterized by a "lack of bacterial proliferation." While other studies have conducted similar inoculation tests on fruit before (Fulton and Bowman 1929) and after (Graham *et al.* 1992b; Verniere *et al.* 2003), Koizumi (1972) remains the only paper to describe this type of lesion. Goto (1969) found in a wound inoculation study that "…latent infections were never observed."

- Training for APHIS phytosanitary inspectors is critical to enable them to detect Xac lesions, and distinguish them from lesions caused by other pathogens (University of Florida - IFAS and FDACS-DPI 2006; USDA-APHIS and FDACS/DPI 2006). Testing of APHIS inspectors occurred two ways.
  - First there is refresher training, followed by testing each year in order to continually improve and measure citrus disease identification skills. A PPQ inspector must score at least 80 percent on a proficiency test. The average test scores for inspectors is 93 percent (Lowe 2007).
  - Second, inspectors were tested as part of an evaluation of ELISA Dip Stick tools. When tested to visually diagnose citrus canker symptoms in culled fruit, PPQ inspectors correctly classified 99% (88 of 89) of the Xac infected fruit as either symptomatic or suspect symptoms. Inspectors also correctly diagnosed 9 out of 10 (90%) of the injured\blemished fruit.
- Training programs for packinghouse and APHIS inspectors focus on distinguishing the overall appearance of typical citrus canker lesions, and it is possible that very small or uncharacteristic lesions may escape detection (University of Florida - IFAS and FDACS-DPI 2006).
- During an evaluation of a diagnostic tool, APHIS plant pathologists collected approximately 75 pieces of fruit eliminated by packinghouse graders for Xac lesions. The average lesion size on these fruit was about 4 mm (Riley 2007).
- APHIS plant pathologists have observed fruit intercepted in final packed cartons with lesions in the 2-3 mm range (Riley 2007). In general, APHIS inspectors do not see smaller lesions (1 mm or less) alone; they occur in association with larger lesions (Riley 2007).
- APHIS plant pathologists have observed that the majority of the symptomatic fruit that APHIS inspectors intercepted after passing through the packing line undetected by graders have only one lesion (Riley 2007).

9.3.3.4. Node 4 (P2): Proportion of fruit with visible symptoms of Xac shipped to citrus-bearing areas (including backyard) in citrus producing States

Unit: *Fruit with visible symptoms of Xac shipped to citrus growing areas of citrus producing States / Fruit with visible symptoms of Xac shipped to citrus producing States*

The model determines the proportion of fruit with visible symptoms of Xac shipped to citrus-growing areas based on the amount of citrus-bearing acreage (including acreage for backyard trees) in each citrus-producing county, the human population in each citrus-producing county and State, and the area of each citrus-producing county. APHIS considered modeling only the quantity of fruit with visible symptoms of Xac shipped to citrus-producing counties within citrus-producing States, basing the model on county population. However, because citrus is produced in almost all counties with citrus-producing States, the result would be little different from simply modeling the quantity of fruit with visible Xac lesions shipped to citrus-producing States. This approach would greatly overestimate the actual risk and was therefore rejected.

As noted above, the model assumes the proportion of fruit with visible symptoms of Xac shipped to citrus-growing areas is the same as the proportion of all citrus consumed in citrus-growing areas (i.e., the proportion of fruit that has visible Xac symptoms and the proportion that is shipped to citrus-producing areas are independent variables).

To determine the quantity of fruit with visible symptoms of Xac that is shipped to citrus-growing areas, the model first determines the quantity of fruit with visible symptoms of Xac that is shipped to citrus-producing counties. This is calculated by multiplying the quantity shipped to citrus-producing States by the fraction of the State population in each county. Recognizing that this result is still a poor indicator of risk (most consumed citrus, even within citrus-producing counties, will not be consumed in reasonably close proximity to Xac host trees), the model adjusts this result based on citrus-producing acreage within citrus-producing counties and using Schubert, *et al.* (2001) data from Florida. Recognizing that citrus canker disease could be introduced into residential backyard citrus as readily as into commercial citrus, APHIS attempted to model backyard citrus acreage. Tables 7 to 13 present the evidence used for this part of the model, the mathematical approach, and the results. The result for each State is calculated as the sum of the results for all citrus-producing areas in the citrus-producing counties of the State.

Table 7. July, 2006 populations in each citrus producing State, projected from the April 2000 census (US Census Bureau 2006)

State	Projected Population for July 2006
Arizona	6,166,318
California	36,457,549
Hawaii	1,285,498
Louisiana	4,287,768
Texas	23,507,783

Considering that about half the homes in Florida's concentrated citrus producing areas have two to three citrus trees (Schubert *et al.* 2001), the overall (for all citrus producing states) average proportion of homes with backyard citrus (q1) is estimated to be 0.25 (one in four), and the average number of citrus trees per home with citrus (q2) is estimated to be 2.

- A1, the number of owner occupied homes (A1) in each citrus bearing county of each citrus producing state is obtained from 2006 projections of the 2000 United States census statistics (U.S. Census Bureau 2006).
- A2, the number of homes with backyard citrus, is calculated by multiplying the number of owner occupied homes (A1) by the average proportion of homes with backyard citrus (q1). The resultant equation is: A2=A1*q1.

- A3, the total number of backyard trees, is calculated by multiplying the number of homes with backyard citrus (A2) by the average number of citrus trees per home with backyard citrus (q2). The equation is: A3=A2*q2.
- A4, the acres of backyard trees, is calculated by dividing the total number of backyard trees (A3) by the number of backyard trees per commercial citrus acre, (q3). The equation is: A4=A3/q3.
- A5, the commercial citrus bearing acreage is obtained from the US Agricultural Census (USDA-NASS 2000). For counties where citrus production was reported but acreage was not available, NASS does report the number of farms in the counties. We have multiplied the number of farms by the mean farm size in the State in each of the counties in which farms were reported to estimate the citrus-producing acreage within each of those counties.
- A6, the total citrus bearing acreage in the county, is the sum of the commercial citrus bearing acreage (A5) and the acres of backyard trees (A4). The equation is: A6=A4+A5.
- A7, the county area in acres, is obtained from the National Agricultural Statistical Service (USDA-NASS 2000).
- A8, the county population is obtained from the U.S. Census Bureau.
- A9, the state population is also obtained from the U.S. Census Bureau.

R1, the proportion of the county area under citrus, is calculated by dividing the total citrus bearing acreage (A6), by the county area (A7). The equation is: R1=A6/A7.

R2, the proportion of citrus consumed in a county, is assumed to be equivalent to the proportion of state residents living in the county. The proportion of the State population residing in the county is calculated by dividing the county population (A8), by the State population (A9). Thus R2=A8/A9.

P2, the proportion of citrus that goes to a State, and is consumed in a citrus growing area of a county, is calculated by multiplying the proportion of the county area under citrus (R1), and the proportion of citrus consumed in citrus growing areas of the county (R2). The representative equation is: P2=R1*R2.

Summing this proportion over all citrus-bearing counties of the State yields the proportion of Florida citrus consumed in citrus bearing areas of a State.

Tables 8, 9, 10, 11 and 12, present the method used to determine (P2) the proportion of fruit with visible Xac symptoms shipped to citrus-growing areas in each citrus-producing county of Arizona, California, Hawaii, Louisiana, and Texas, respectively

Table 8. Proportion of Florida citrus shipped to Arizona and consumed in citrus growing areas of Arizona

ARIZONA	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census. Bureau 2002)	A2= A1*q1[18]	A3= A2*q2[19]	A4 = A3/q3[20]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Graham	7406	1852	3703	37	3	40	2962765	0.001%	33660	6166318	0.546%	0.00001%
Maricopa	764547	191137	382274	3,823	7042	10865	5890010	0.184%	3768123	6166318	61.108%	0.11272%
Mohave**	46218	11555	23109	231	416	647	8519450	0.008%	193035	6166318	3.130%	0.00024%
Pima	213603	53401	106802	1,068	231	1299	5879213	0.022%	946362	6166318	15.347%	0.00339%
Pinal**	47498	11875	23749	237	2682	2919	3436538	0.085%	271059	6166318	4.396%	0.00373%
Yavapai	51519	12880	25760	258	1	259	5198912	0.005%	208014	6166318	3.373%	0.00017%
Yuma**	38911	9728	19456	195	18545	18740	3529018	0.531%	187555	6166318	3.042%	0.01615%
Proportion of Florida citrus to Arizona shipped to citrus growing areas of Arizona (P2)												**0.136%**

**** Counties added as a result of public comment.**

[18] q1 = proportion of homes with citrus = 0.25
[19] q2 = Average number of citrus trees per home with citrus = 2
[20] q3 = number of citrus trees per commercial acreage of citrus = 100

Table 9. Proportion of Florida citrus to California consumed in citrus growing areas of California

California	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census. Bureau 2002)	A2= A1*q1[21]	A3= A2*q2[22]	A4 = A3/q3[23]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Alameda**	286277	71569	143139	1,431	44	1476	472045	0.313%	1457426	36457549	3.998%	0.01250%
Amador**	9629	2407	4815	48	44	93	379501	0.024%	38941	36457549	0.107%	0.00003%
Butte	48336	12084	24168	242	249	491	1049274	0.047%	215881	36457549	0.592%	0.00028%
Colusa**	3853	963	1927	19	44	64	736435	0.009%	21272	36457549	0.058%	0.00001%
El Dorado	44019	11005	22010	220	15	235	1094944	0.021%	178066	36457549	0.488%	0.00010%
Fresno	142795	35699	71398	714	35407	36121	3816147	0.947%	891756	36457549	2.446%	0.02315%
Glenn	5855	1464	2928	29	532	561	841466	0.067%	28061	36457549	0.077%	0.00005%
Imperial	22975	5744	11488	115	4888	5003	2671827	0.187%	160301	36457549	0.440%	0.00082%
Kern	129609	32402	64805	648	54348	54996	5210214	1.056%	780117	36457549	2.140%	0.02259%
Kings**	19253	4813	9627	96	234	330	890234	0.037%	146153	36457549	0.401%	0.00015%
Los Angeles	1499744	374936	749872	7,499	213	7712	2598957	0.297%	9948081	36457549	27.287%	0.08097%
Madera	23934	5984	11967	120	4654	4774	1366950	0.349%	146345	36457549	0.401%	0.00140%
Marin	64024	16006	32012	320	177	498	332672	0.150%	248742	36457549	0.682%	0.00102%
Mariposa**	4615	1154	2308	23	44	67	928717	0.007%	18401	36457549	0.050%	0.00000%
Mendocino**	20383	5096	10192	102	44	146	2245741	0.007%	88109	36457549	0.242%	0.00002%
Merced	37483	9371	18742	187	710	897	1234362	0.073%	245658	36457549	0.674%	0.00049%

[21] q1 = proportion of homes with citrus = 0.25
[22] q2 = Average number of citrus trees per home with citrus = 2
[23] q3 = number of citrus trees per commercial acreage of citrus = 100

California	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census. Bureau 2002)	A2= A1*q1[21]	A3= A2*q2[22]	A4 = A3/q3[23]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Mono**	3084	771	1542	15	44	60	1948416	0.003%	12754	36457549	0.035%	0.00000%
Monterey	66213	16553	33107	331	1020	1351	2126048	0.064%	410206	36457549	1.125%	0.00072%
Napa	29554	7389	14777	148	4	152	482387	0.031%	133522	36457549	0.366%	0.00012%
Nevada**	27958	6990	13979	140	89	229	612870	0.037%	98764	36457549	0.271%	0.00010%
Orange	574456	143614	287228	2,872	493	3365	505216	0.666%	3002048	36457549	8.234%	0.05485%
Placer	68372	17093	34186	342	187	529	898797	0.059%	326242	36457549	0.895%	0.00053%
Riverside	348532	87133	174266	1,743	31942	33685	4612717	0.730%	2026803	36457549	5.559%	0.04060%
Sacramento	263819	65955	131910	1,319	444	1763	618016	0.285%	1374724	36457549	3.771%	0.01075%
San Benito**	10830	2708	5415	54	133	187	888998	0.021%	55842	36457549	0.153%	0.00003%
San Bernardino	340933	85233	170467	1,705	4864	6569	12833600	0.051%	1999332	36457549	5.484%	0.00281%
San Diego	551461	137865	275731	2,757	16216	18973	2687930	0.706%	2941454	36457549	8.068%	0.05695%
San Joaquin	109667	27417	54834	548	444	992	895539	0.111%	673170	36457549	1.846%	0.00205%
San Luis Obispo	57001	14250	28501	285	1826	2111	2114765	0.100%	257005	36457549	0.705%	0.00070%
Santa Barbara	76611	19153	38306	383	2881	3264	1751686	0.186%	400335	36457549	1.098%	0.00205%
Santa Clara**	338661	84665	169331	1,693	355	2048	826042	0.248%	1731281	36457549	4.749%	0.01177%
Santa Cruz	54681	13670	27341	273	14	287	284954	0.101%	249705	36457549	0.685%	0.00069%
Shasta	41910	10478	20955	210	577	786	2422522	0.032%	179951	36457549	0.494%	0.00016%
Solano	84994	21249	42497	425	55	480	530682	0.090%	411680	36457549	1.129%	0.00102%
Sonoma	110475	27619	55238	552	931	1484	1008563	0.147%	466891	36457549	1.281%	0.00188%
Stanislaus	89886	22472	44943	449	1997	2446	956026	0.256%	512138	36457549	1.405%	0.00359%
Sutter	16632	4158	8316	83	36	119	385626	0.031%	91410	36457549	0.251%	0.00008%

California	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census. Bureau 2002)	A2= A1*q1[21]	A3= A2*q2[22]	A4 = A3/q3[23]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Tehama	14214	3554	7107	71	532	603	1888634	0.032%	61686	36457549	0.169%	0.00005%
Tulare	67913	16978	33957	340	110523	110863	3087341	3.591%	419909	36457549	1.152%	0.04136%
Ventura	164380	41095	82190	822	39719	40541	1180992	3.433%	799720	36457549	2.194%	0.07530%
Yolo	31506	7877	15753	158	255	413	648493	0.064%	188085	36457549	0.516%	0.00033%
Yuba	11105	2776	5553	56	798	854	403642	0.212%	70396	36457549	0.193%	0.00041%
		Proportion of Florida citrus shipped to California and consumed in citrus bearing areas of California										0.45247%

**** Counties added as a result of public comment.**

Table 10 Proportion of Florida citrus to Hawaii consumed in citrus growing areas of Hawaii counties

Hawaii	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census. Bureau 2002)	A2= A1*q1 [24]	A3= A2*q2 [25]	A4 = A3/q3 [26]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Hawaii	34175	8544	17088	171	263	434	2577933	0.017%	171191	1285498	13.317%	0.00224%
Honolulu	156290	39073	78145	781	34	816	383853	0.213%	909863	1285498	70.779%	0.15045%
Kauai	12384	3096	6192	62	118	180	398362	0.045%	63004	1285498	4.901%	0.00221%
Maui	25039	6260	12520	125	74	199	741888	0.027%	141320	1285498	10.993%	0.00295%
			Proportion of Florida citrus shipped to Hawaii and consumed in citrus bearing areas of Hawaii									0.15786%

[24] q1 = proportion of homes with citrus = 0.25
[25] q2 = Average number of citrus trees per home with citrus = 2
[26] q3 = number of citrus trees per commercial acreage of citrus = 100

Table 11. Proportion of Florida citrus to Louisiana consumed in citrus growing areas of Louisiana

Louisiana	A1	A2	A3	A4	A5	A6	A7	R1	A8	A9	R2	P2
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	Proportion of County Area under citrus	County POP2003	State Population	Prop of state population in county	Prop of citrus consumed in citrus growing area of county
Reference or Equation	(U.S. Census.Bureau 2002)	A2= A1*q1[27]	A3= A2*q2[28]	A4 = A3/q3[29]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	R1 = A6/A7	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	R2 = A8/A9	(P2 = R1*R2)
Allen**	6162	1541	3081	31	15	46	489280	0.009%	25447	4287768	0.593%	0.00006%
Ascension**	21955	5489	10978	110	15	125	186579	0.067%	97335	4287768	2.270%	0.00152%
Beauregard	9661	2415	4831	48	2	50	742458	0.007%	35130	4287768	0.819%	0.00006%
Calcasieu**	49106	12277	24553	246	0	246	685517	0.036%	184524	4287768	4.303%	0.00154%
Iberia**	18635	4659	9318	93	8	101	368083	0.027%	75509	4287768	1.761%	0.00048%
Jackson**	4698	1175	2349	23	0	23	364640	0.006%	15202	4287768	0.355%	0.00002%
Lafayette	47798	11950	23899	239	38	277	172691	0.161%	203091	4287768	4.737%	0.00760%
Lafourche	24998	6250	12499	125	42	167	694195	0.024%	93554	4287768	2.182%	0.00052%
Lincoln**	9134	2284	4567	46	0	46	301683	0.015%	41857	4287768	0.976%	0.00015%
Plaquemines	7117	1779	3559	36	921	957	540518	0.177%	22512	4287768	0.525%	0.00093%
Rapides**	32057	8014	16029	160	15	176	846426	0.021%	130201	4287768	3.037%	0.00063%
Red River**	2605	651	1303	13	8	21	249146	0.008%	9438	4287768	0.220%	0.00002%
St. Bernard**	18753	4688	9377	94	15	109	297626	0.037%	15514	4287768	0.362%	0.00013%
St. Charles**	13374	3344	6687	67	8	75	181530	0.041%	52761	4287768	1.231%	0.00051%
St. John the Baptist	11573	2893	5787	58	1	59	140096	0.042%	48537	4287768	1.132%	0.00048%
St. Landry**	22865	5716	11433	114	23	137	594336	0.023%	91528	4287768	2.135%	0.00049%
St. Martin	14024	3506	7012	70	52	122	473504	0.026%	51341	4287768	1.197%	0.00031%
St. Mary**	14279	3570	7140	71	15	87	392186	0.022%	51867	4287768	1.210%	0.00027%
St. Tammany**	55719	13930	27860	279	8	286	546656	0.052%	230605	4287768	5.378%	0.00282%
Tangipahoa	26800	6700	13400	134	3	137	505754	0.027%	113137	4287768	2.639%	0.00071%
Terrebonne**	27212	6803	13606	136	58	194	803155	0.024%	109348	4287768	2.550%	0.00062%
Vermilion**	15283	3821	7642	76	15	92	751219	0.012%	56021	4287768	1.307%	0.00016%
		Proportion of Florida citrus shipped to Louisiana and consumed in citrus bearing areas of Loouisiana										**0.02002%**

27 q1 = proportion of homes with citrus = 0.25

28 q2 = Average number of citrus trees per home with citrus = 2

29 q3 = number of citrus trees per commercial acreage of citrus = 100

Table 12. Proportion of Florida citrus to Texas consumed in citrus growing areas of Texas**.**

Texas	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census.Bureau 2002)	A2= A1*q1[30]	A3= A2*q2[31]	A4 = A3/q3[32]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Austin**	6754	1689	3377	34	30	63	417658	0.015%	26407	23507783	0.112%	0.00002%
Bastrop**	16158	4040	8079	81	30	110	568544	0.019%	71684	23507783	0.305%	0.00006%
Brazoria	60674	15169	30337	303	207	510	887296	0.057%	287898	23507783	1.225%	0.00070%
Brooks**	1980	495	990	10	59	69	603699	0.011%	7731	23507783	0.033%	0.00000%
Cameron	65875	16469	32938	329	3141	3470	579686	0.599%	387717	23507783	1.649%	0.00987%
Colorado**	5857	1464	2929	29	0	29	616288	0.005%	20824	23507783	0.089%	0.00000%
Dimmit**	2444	611	1222	12	118	130	851782	0.015%	10385	23507783	0.044%	0.00001%
Ellis**	28218	7055	14109	141	0	141	601542	0.023%	139300	23507783	0.593%	0.00014%
Galveston**	62742	15686	31371	314	59	373	255021	0.146%	283551	23507783	1.206%	0.00176%
Goliad**	2116	529	1058	11	0	11	546253	0.002%	7192	23507783	0.031%	0.00000%
Hidalgo	114580	28645	57290	573	25497	26070	1004640	2.595%	700634	23507783	2.980%	0.07734%
Jefferson**	61274	15319	30637	306	118	425	578272	0.073%	243914	23507783	1.038%	0.00076%
Jim Wells**	9921	2480	4961	50	30	79	553293	0.014%	41131	23507783	0.175%	0.00003%
La Salle**	1274	319	637	6	59	65	952864	0.007%	5969	23507783	0.025%	0.00000%
Liberty	18356	4589	9178	92	118	210	742195	0.028%	75685	23507783	0.322%	0.00009%
Matagorda**	1750	438	875	9	0	9	713254	0.001%	37824	23507783	0.161%	0.00000%
Medina**	10279	2570	5140	51	59	110	849766	0.013%	43913	23507783	0.187%	0.00002%
Milam**	6717	1679	3359	34	59	93	650694	0.014%	25286	23507783	0.108%	0.00002%
Newton**	4718	1180	2359	24	59	83	596922	0.014%	14090	23507783	0.060%	0.00001%

[30] q1 = proportion of homes with citrus = 0.25
[31] q2 = Average number of citrus trees per home with citrus = 2
[32] q3 = number of citrus trees per commercial acreage of citrus = 100

Texas	A1	A2	A3	A4	A5	A6	A7	**R1**	A8	A9	**R2**	**P2**
Citrus bearing counties	# owner occupied Homes	# homes with back-yard trees	Total back-yard trees	Acres of back-yard trees	Commercial Citrus bearing acreage	Total citrus Bearing Acreage	County Area in Acres	**Proportion of County Area under citrus**	County POP2003	State Population	**Prop of state population in county**	**Prop of citrus consumed in citrus growing area of county**
Reference or Equation	(U.S. Census.Bureau 2002)	A2= A1*q1[30]	A3= A2*q2[31]	A4 = A3/q3[32]	(USDA-NASS 2000)	A6 = A4+A5	(USDA-NASS 2000)	**R1 = A6/A7**	(U.S. Census Bureau 2006)	(U.S. Census Bureau 2006)	**R2 = A8/A9**	**(P2 = R1*R2)**
Orange**	24424	6106	12212	122	4	126	228096	0.055%	84243	23507783	0.358%	0.00020%
Sabine**	3866	967	1933	19	0	19	313773	0.006%	10457	23507783	0.044%	0.00000%
Starr	11450	2863	5725	57	118	175	782733	0.022%	61780	23507783	0.263%	0.00006%
Waller**	7650	1913	3825	38	59	97	328723	0.030%	35185	23507783	0.150%	0.00004%
Willacy	4316	1079	2158	22	184	206	381875	0.054%	20645	23507783	0.088%	0.00005%
Williamson**	64380	16095	32190	322	0	322	718573	0.045%	353830	23507783	1.505%	0.00067%
			Proportion of Florida citrus shipped to Texas and consumed in citrus bearing areas of Texas									0.09187%

** Counties added as a result of public comment.

Table 13 Proportion of Florida citrus shipped to and consumed in growing areas of Arizona, California, Hawaii, Louisiana and Texas.

	State	**Proportion of Florida citrus shipped and consumed in growing counties of a state**	**Proportion of Florida citrus shipped to a state and consumed in growing areas of a state = P2[33]**
Proportion of Florida citrus shipped to state and consumed	**Arizona**	90.94%	0.14%
	California	91.91%	0.45%
	Hawaii	99.99%	0.16%
	Louisiana	40.92%	0.02%
	Texas	12.75%	0.09%

[33] P2, the proportion of fruit with visible Xax lesions shipped to citrus growing areas of a citrus producing state, is equal to the proportion of Florida citrus shipped to the state and consumed in growing areas of a state

9.3.4. Performing Calculations

Using the input parameters (nodes) described in the previous section, the quantitative model computes a number of output values. These are now described, and an equation relating the output variable to the input parameters is also presented:

a) **Q1,** is the amount of fruit (grapefruit, oranges, temples, tangelos, honey tangerines, or other tangerines) from released lots that will move interstate from Florida. This is a function of the number of 4/5-bushel containers (cartons) shipped per growing season (N1), and the number of fruit per carton (N2). The quantity Q1 represents the total number of fruit shipped per season to citrus producing States summed over all shipped cartons. In a given year, the number of cartons exported (N1) would be fixed, however, the number of fruit per carton (N2) varies among cartons of differing fruit size. Therefore the number of fruit shipped to citrus producing States in a particular shipping season is simply the sum of the products of $N1_i$ and $N2_i$., where *i* is the fruit size Therefore,

$$Q1 = \sum_{i=1}^{i=10} N1_i * N2_i \qquad (5)$$

For example, from Table 18 in Appendix 2: In 2005-2006 the following numbers of bushels of seedless pink grapefruit (variety 104) was shipped to California:

N1 = 0, 0, 3867, 13847, 10736, 11536, 14770, 7839, 1484, and 0 cartons respectively for each of the ten fruit sizes.

From Table 17 in Appendix 2, we see that the number of fruit per 4/5 bushel carton of grapefruit, for the various fruit sizes are:

N2 = 14, 18, 23, 27, 32, 36, 40, 48, 36, and 64 fruit per 4/5 bushel carton respectively.

By multiplying the number of cartons of grapefruit in each fruit size, by the number of grapefruit per carton for that fruit size, and summing all the products, yields the total number of seedless pink grapefruit shipped to California in the 2005-2006 shipping season.

Therefore Q1 = 0 + 0 + 88941 + 373869 + 343552 + 415296 + 590800 + 376272 + 53424 + 0

Q1 = 2,242,154

Similarly, using Tables 17 and 18 in Appendix 2, the numbers of fruit of each variety of citrus shipped to each citrus producing State are computed for each of the shipping seasons from 2001-2002 to 2005-2006.

b) **Q2**, is the number of undetected fruit with visible symptoms of Xac shipped interstate. This is determined for each variety of citrus and for each citrus-producing State, and is a function of Q1, the amount of Florida fruit released for interstate movement to citrus producing States, and P1, the undetected proportion of fruit with visible Xac symptoms in released interstate shipments. Assuming Q2 is a binomially distributed random variable, Q2 can be represented as: Q2=Binomial(Q1, P1). However, because Q1 is too large to be used in an @Risk binomial distribution the binomial distribution cannot be used, and an alternative approximation is sought. Because Q1 is very large and P1 is very small, the Poisson distribution is used to approximate the binomial (Vose 2000). This can be simulated using @Risk. Therefore

$$Q2 \sim Poisson(Q1*P1). \qquad (6)$$

c) **Q3**, is the number of undetected fruit with visible symptoms of Xac consumed in citrus growing areas of citrus producing states. Q3 is determined for each citrus producing State, and is a function of the number of fruit with visible symptoms of Xac shipped to each State (Q2), and the proportion of fruit with visible symptoms of Xac consumed in citrus growing areas in that State (P2). Like Q2, Q3 is assumed to be a binomially distributed random variable., and can be represented as: Q3 = Binomial(Q2, P2). Because Q2 is too large, the binomial distribution cannot be used, and the Poisson distribution is used to approximate the binomial (Vose 2000). Therefore

$$Q3 \sim Poisson(Q2*P2). \qquad \mathbf{(7)}$$

Table 14. Calculated values, and the equations used in their calculation

OUTPUT PARAMETER & DESCRIPTION		UNITS	EQUATION
Q1	# fruit shipped to citrus producing states (per shipping-season)	fruit shipped to citrus producing states / shipping-season	Q1 = N1*N2
Q2	# fruit with visible symptoms of Xac shipped to citrus producing states (per shipping-season)	fruit with visible symptoms of Xac shipped to citrus producing states / shipping-season	**Q2~Poisson(Q1*P1)**
Q3	# fruit with visible symptoms of Xac shipped to citrus growing areas in citrus producing counties of citrus producing states (per shipping-season)	fruit with visible symptoms of Xac shipped to citrus growing areas in citrus producing counties of citrus producing states / shipping-season	**Q3~Poisson(Q2*P2)**

A stochastic model (based on the aforementioned parameters and calculations) was constructed and 20,000 Monte Carlo iterations (with a fixed seed value of 100) were carried out using MS- Excel[34], and @RISK[35].

The model evaluates three inspection options: inspection of 500 fruit per lot, inspection of 1000 fruit per lot, and inspection of 2000 fruit per lot.

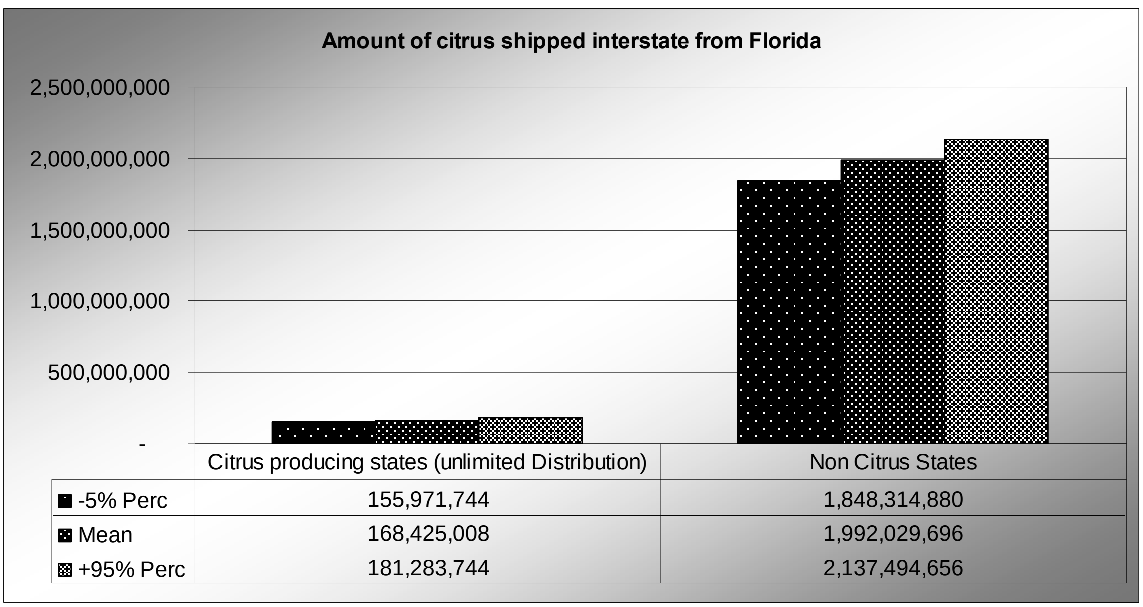
These output parameter results are now presented.

9.4. Results

Q1 Results: The model first calculates Q1, the number of citrus fruit shipped interstate from Florida each shipping season. Under unlimited distribution (option 2) the simulation results indicate:

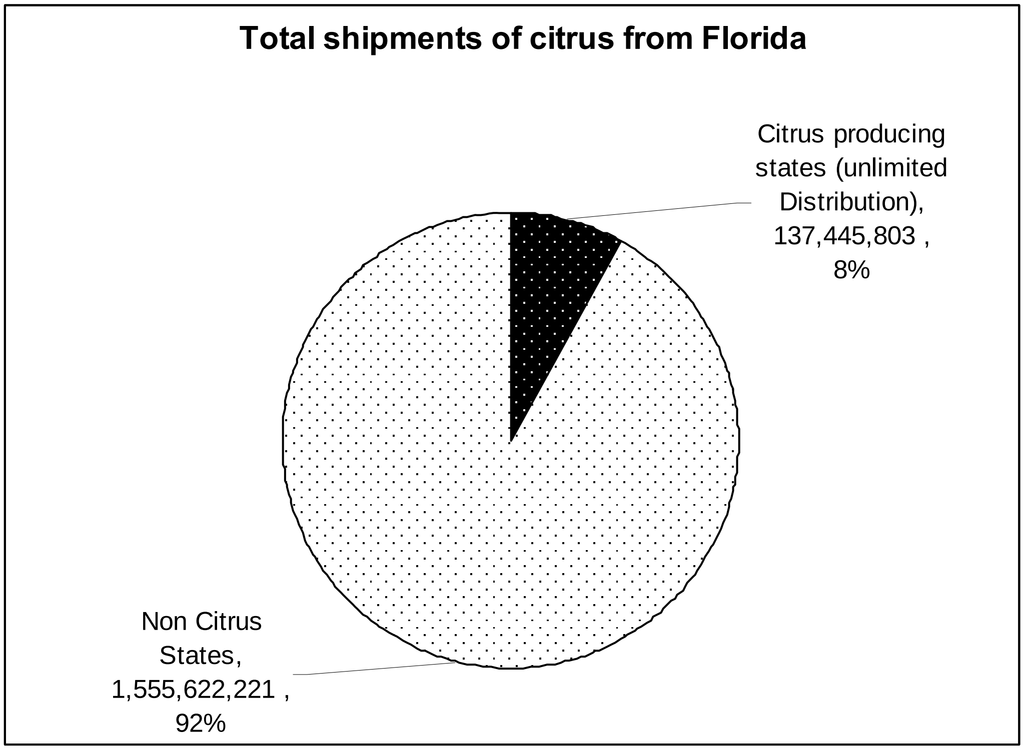
- The mean and 95 percentile quantities of citrus shipped from Florida to citrus producing States are 168,425,008 and 181,283,744 respectively (Figure 15).
- On average, only 8 percent of the fruit shipped interstate from Florida is shipped to citrus producing States (Figure 16).

Figure 15. Amount of citrus shipped interstate from Florida



[34] Copyright © 1985-2003 Microsoft Corporation
[35] Version 4.5.2 Professional Edition, Copyright © 2002 Palisade Corporation

Figure 16. Mean proportion of Florida citrus shipped interstate.



- On average, 73 percent of the fruit shipped to citrus producing States, is shipped to California, 14 percent to Texas, 12 percent to Louisiana, and only 0.12 percent to Arizona and 0.04 percent to Hawaii (Figures 17, 18, and 19).

Figure 17. Number of citrus fruit shipped to citrus producing States

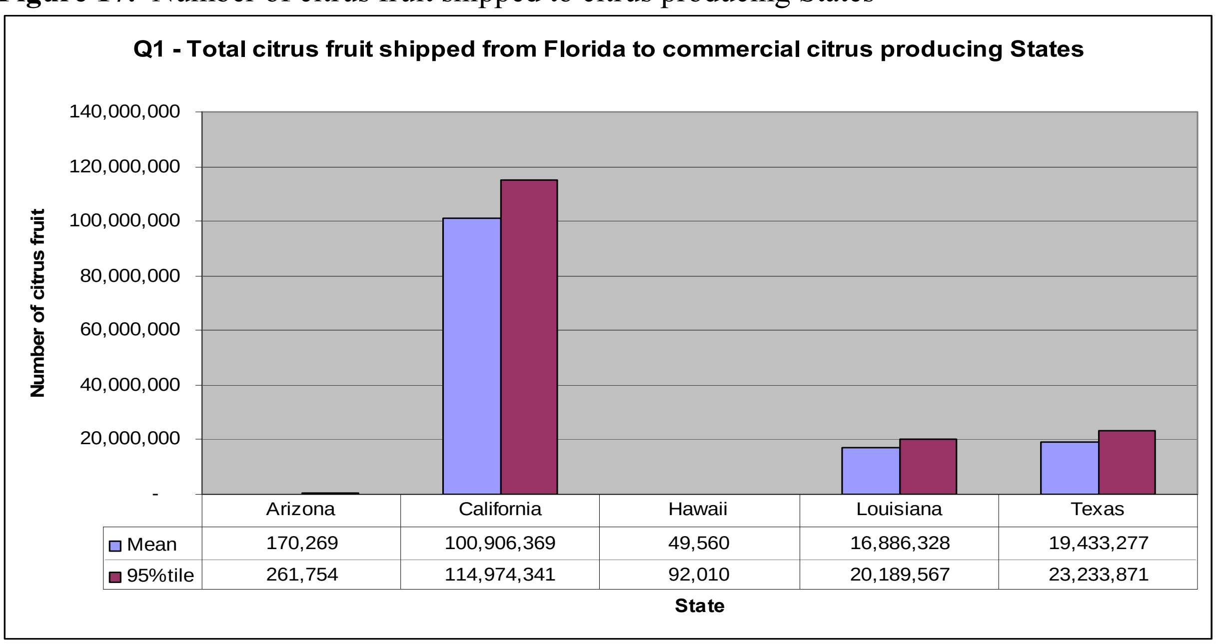


Figure 18. Mean percentage of citrus fruit shipped from Florida to selected citrus producing States

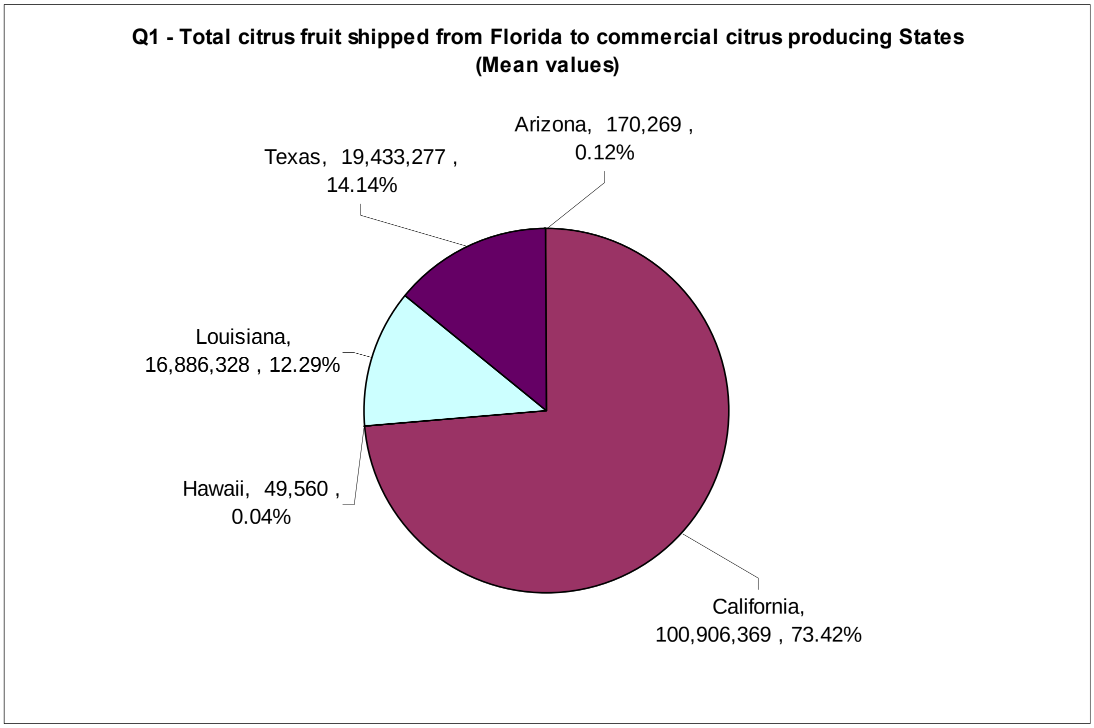
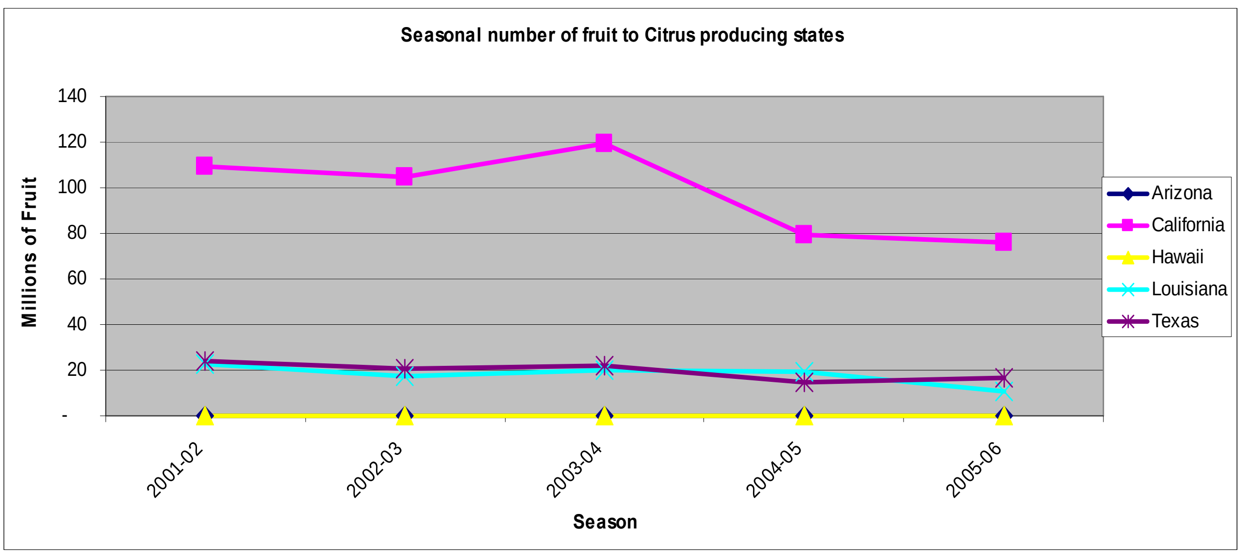


Figure 19. Annual amount of Florida citrus fruit, shipped to selected citrus producing States



On average, 81 percent of the fruit shipped to citrus producing States are tangerines (tangerines and other tangerines), 14 percent are oranges, 4 percent are grapefruit, and only 0.6 percent are tangelos, and 0.3 percent are temples (Figures 20).

Figure 20. Mean proportion of Florida citrus fruit, by variety, shipped to citrus producing States

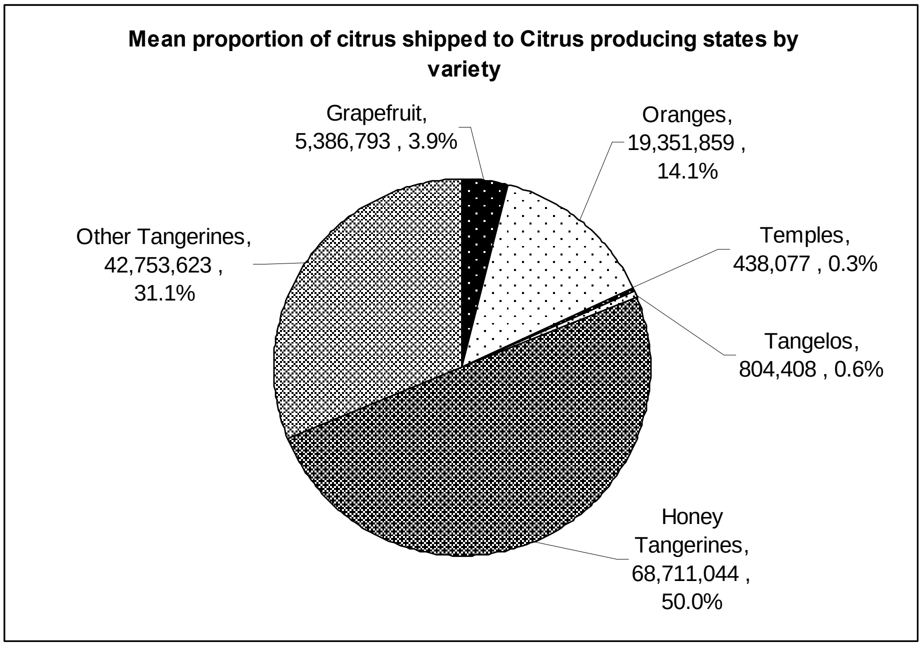
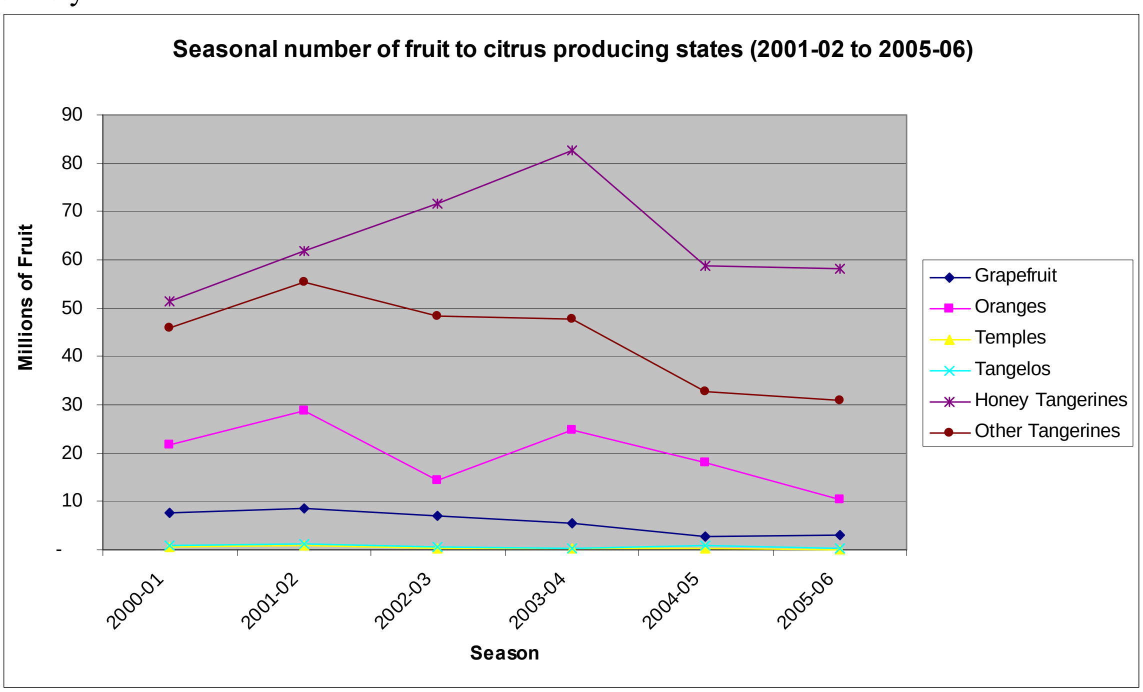


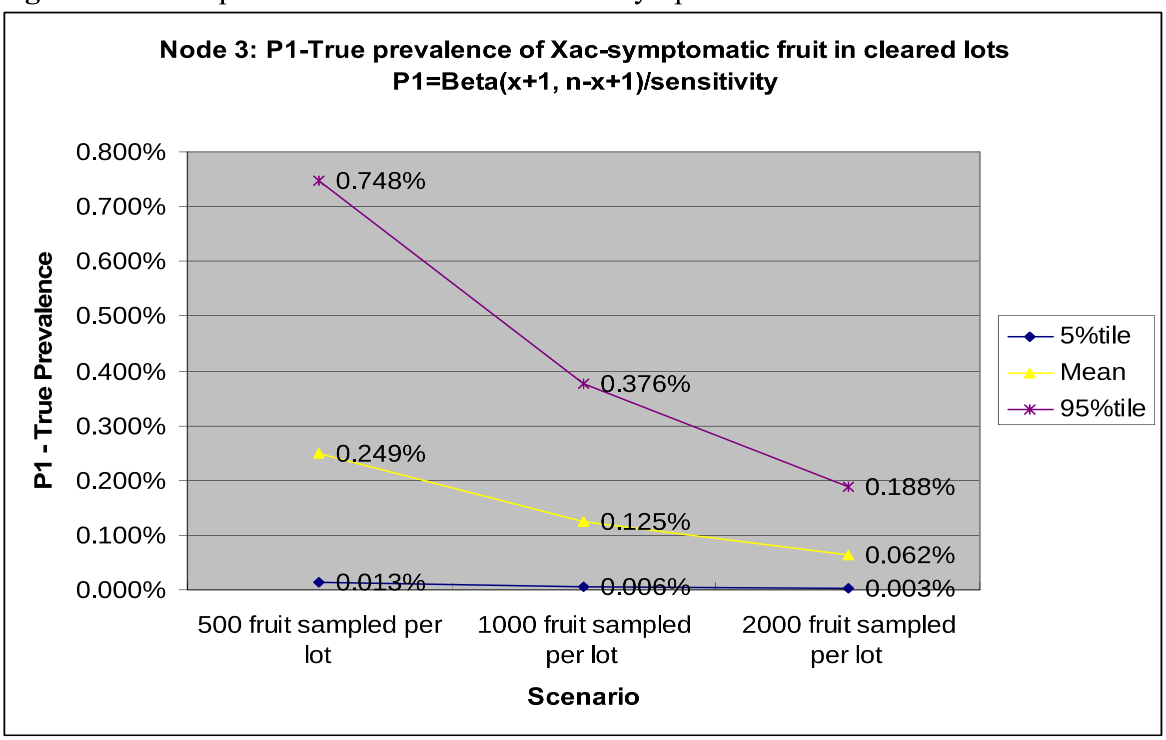
Figure 21. Annual amount of Florida citrus fruit shipped to citrus producing States by variety



P1 Results: The model then calculates P1, the true prevalence of fruit with visible symptoms of Xac in APHIS released lots. This is the proportion of fruit with visible symptoms of Xac in interstate shipments of Florida citrus. This is calculated for lot sample sizes of 500, 1000 and 2000, and the results are as follows:

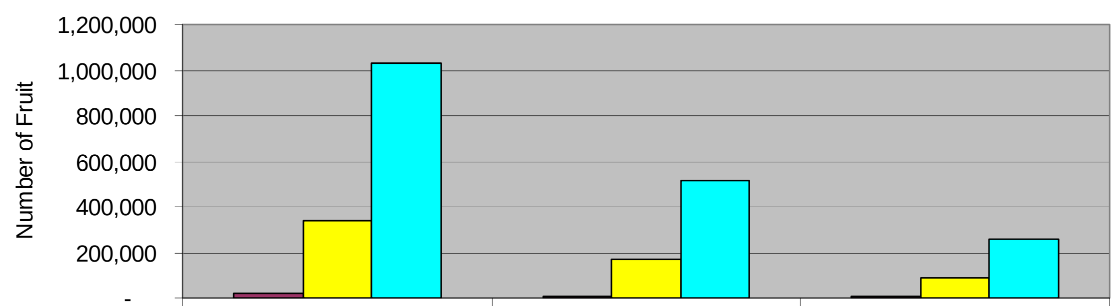
a) If in a random sample of 500 fruit no infected fruit are detected, APHIS is 95 pecent confident that the proportion of infected fruit with visible Xac symptoms in the released lot is no more than 0.75 percent (748 per 100,000). The mean value is 249 per hundred thousand fruit, and the most likely value is 0 per million fruit. (Figure 22)
b) If in a random sample of 1000 fruit no infected fruit are detected, APHIS is 95 percent confident that the proportion of infected fruit with visible Xac symptoms in the released lot is no more than 0.38 percent (376 per 100,000). The mean value is 125 per hundred thousand fruit, and the most likely value is 0 per million fruit. (Figure 22)
c) If in a random sample of 2000 fruit no infected fruit are detected, APHIS is 95 percent confident that the proportion of infected fruit with visible Xac symptoms in the released lot is no more than 0.19 percent (188 per 100,000). The mean value is 63 per hundred thousand fruit, and the most likely value is 0 per million fruit. (Figure 22)

Figure 22. True prevalence of fruit with visible symptoms of Xac in released lots



Q2 Results: The model then calculates Q2, the number of fruit with visible symptoms of Xac that reach citrus producing states.

Figure 23. 5th percentile, Mean, and 95th percentile number of fruit with visible symptoms of Xac shipped from Florida per shipping season



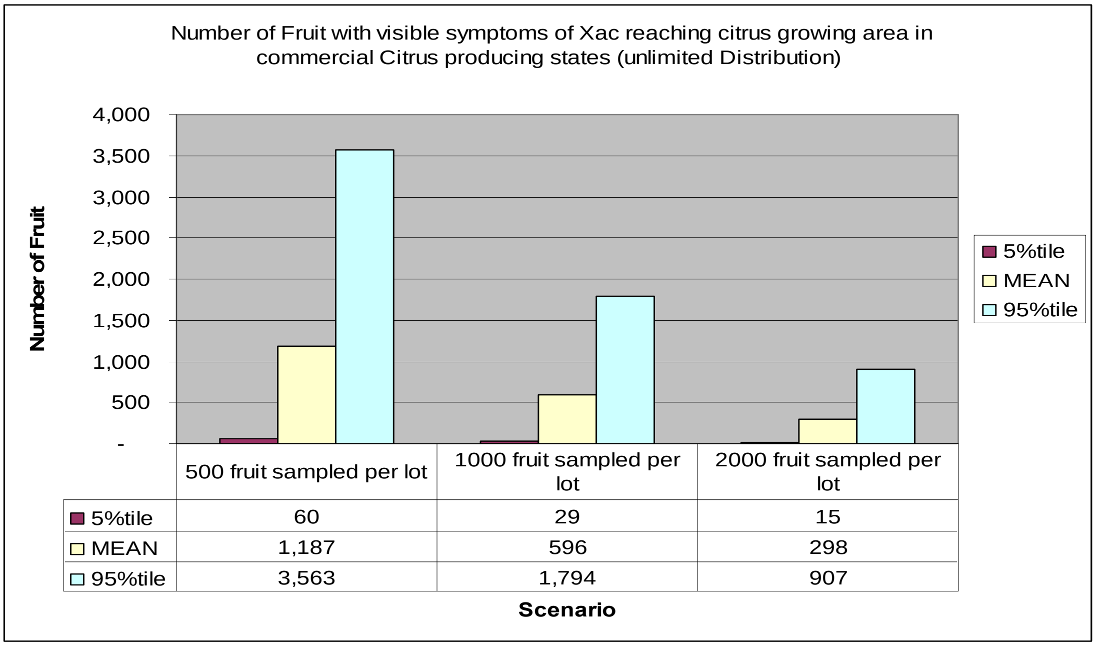
	500 fruit sampled per lot	1000 fruit sampled per lot	2000 fruit sampled per lot
5%tile	17,578	8,647	4,369
MEAN	340,781	171,526	85,670
95%tile	1,033,575	517,709	256,473

Based on the simulation runs, the 5 percentile, mean and 95 percentile number of fruit with symptoms of Xac that reach citrus producing states, at the 1000 fruit inspection level is 8647, 171526, and 517709 respectively.

Q3 Results:

The model then calculates Q3, the number of fruit with visible symptoms of Xac that reach citrus growing areas within citrus producing States.

Figure 24. Number of fruit with visible symptoms of Xac reaching citrus growing areas within citrus producing States per shipping season.



Result Summary:
For the three scenarios of inspection, the results were as follows:

Scenario 1: **500 fruit** sampled per lot
The distribution outputs for the model (based on sampling 500 fruit) predict that the mean (average) and 95th percentile ("worst case") values for the total number of fruit with visible symptoms of Xac shipped to citrus producing States is 341,669 and 1,024,892 respectively. The predicted number of those fruit to reach citrus growing areas in citrus producing States is 1,187 (mean) and, 3,563 (95th percentile)

Scenario 2: **1000 fruit** sampled per lot
The distribution outputs for the model (based on sampling 1,000 fruit) predict that the mean (average) and 95th percentile ("worst case") values for the total number of fruit with visible symptoms of Xac shipped to citrus producing States is 171,474 and 519,178, respectively. The predicted number of those fruit to reach citrus growing areas in citrus producing States is 596 (mean) and, 1,974 (95th percentile).

Scenario 3: **2000 fruit** sampled per lot
The distribution outputs for the model (based on sampling 2,000 fruit) predict a mean (average) of , mode (most likely) and values for the total number of fruit

with visible symptoms of Xac shipped to citrus producing States is 85,864 and a 95th percentile ("worst case") of 260,221, respectively. The predicted number of those fruit to reach citrus growing areas in citrus producing States is 298 (mean), and 907 (95th percentile).

These values reflect the likelihood that, under management Options 2, fruit with visible symptoms of Xac reach citrus-producing States, and citrus growing areas within those States, and **not** the likelihood of Xac establishment in these states.

Table 15. Summary of results.

	Scenario 1		**Scenario 2**		**Scenario 3**	
	500 fruit sampled per lot		1000 fruit sampled per lot		2000 fruit sampled per lot	
	mean	95%tile	mean	95%tile	mean	95%tile
Q1 -Number of fruit shipped to citrus producing states per shipping season	137,445,797	152,234,658	137,445,797	152,234,658	137,445,797	152,234,658
Q2-Number of fruit with visible symptoms of Xac reaching citrus producing states per shipping season	341,669	1,024,892	171,474	519,178	85,864	260,221
Q3-Number of fruit with visible symptoms of Xac reaching citrus growing areas in citrus producing states per shipping season	1,187	3,563	596	1,794	298	907

If fruit with visible symptoms of Xac reach citrus-producing States, and citrus growing areas within those States, under any management option, in order for an outbreak to occur:

a. the fruit must be discarded in such a way that Xac, in sufficient amounts to cause infection exists, and
b. the Xac must encounter an environment with a temperature, relative humidity, and rain events conducive to infection, and
c. the Xac must encounter plant tissue of a host that is either at a susceptible growing stage or is wounded, and
d. viable Xac, in sufficient numbers to incite infection, need to successfully enter this susceptible/wounded tissue.

These series of events is not likely, and is discussed elsewhere in this document.

Management option 4 prohibits distribution of all types and varieties of citrus fruit, including tangerines, to citrus-producing States. Fruit can, however, be illegally moved, intentionally or unintentionally, to prohibited States, even though fruit boxes are labeled to prevent such movement. USDA-APHIS-PPQ-Smuggling Interdiction and Trade Compliance staff report six known interceptions of Florida citrus fruit since 2006 in citrus-producing States out of an estimated 12,400 shipments.

APHIS staff have no information with which to estimate the frequency of unreported illegal movement of Florida citrus to citrus-producing States or the proportion of reported illegal movement to total illegal movement. Since Option 4 would maintain the current prohibition on movement of citrus fruit to citrus-producing States, APHIS expects that the rate of intentional or unintentional movement of Florida citrus fruit to prohibited States will not change under this option. Therefore, the number of fruit with visible symptoms of Xac reaching citrus growing areas in citrus producing states per shipping season would be expected to be close to zero.

To compensate for uncertainty in the rate of illegal fruit movement and ensure compliance with the distribution restrictions included in Option 4, APHIS will routinely monitor wholesalers and fresh fruit markets in commercial citrus-producing States and distribution routes bound for commercial citrus-producing States to ensure that Florida citrus fruit does not unlawfully enter U.S. commercial citrus producing States. This monitoring will be conducted primarily by APHIS' Smuggling Interdiction and Trade Compliance (SITC) program, which works with Federal, State and local cooperators to interdict smugglers, close illegal pathways, and prevent the unlawful entry and distribution of prohibited agricultural products that may harbor harmful, exotic plant and animal pests, disease, or invasive species. The packinghouse measures of disinfection and APHIS inspection ensure that even if a given shipment were illegally moved to a prohibited State, the shipment would have a low likelihood of containing fruit with the potential to cause an outbreak of citrus canker disease.

9.4.1 Uncertainty

What APHIS can and cannot estimate reasonably accurately (based on the proposed measures):

- **APHIS cannot** estimate the prevalence of Xac infected groves. The proportion of groves infested, and the levels of fruit infestation within groves, will depend entirely on the grove management practices, and will vary tremendously between groves. The proximity of the groves to Xac sources, and the incidence of hurricanes and conducive climate will also add to the variability and uncertainty in the Xac infestation levels in the groves, trees, and fruit. As a result, APHIS cannot estimate the prevalence of Xac infection in the fruit in groves, or entering the packing houses. This uncertainty will be reduced somewhat over the next few years, as the packinghouse fruit inspection program gathers data.

- **APHIS cannot** estimate (with any degree of certainty) the efficacy of the packinghouse culling process in removing Xac infected citrus. The efficacy of the packinghouse culling could be estimated by measuring the difference between the prevalence in fruit with visible symptoms of Xac entering the packinghouse (from the groves), and that leaving the packinghouse (in boxes), This requires sampling and inspection of fruit pre culling, and post culling.
- **APHIS can** estimate the proportion of Xac infected fruit with visible[36] symptoms of Xac in each inspected lot, based on the results of a required pre-shipment APHIS inspection of each lot. Even though this is probably an overestimate[37] at present, it is a reliable way to determine the potential proportion of fruit with visible symptoms of Xac that survive the commercial culling, treatment, and inspection process, that is intended to remove them, and get shipped out of Florida.

[36] Lesion size 1mm and greater
[37] This estimate assumes that nothing is known about the prevalence of fruit with visible Xac symptoms in packinghouse finished fruit that is ready for inspection.

10 Appendix 2. Data from Florida Department of Citrus

This appendix was received in a personal communication in August, 2007 via email containing a Microsoft Excel spreadsheet (Florida Department of Citrus -2007 Florida fresh domestic shipments of citrus and to the citrus producing States of Arizona, California, Hawaii, Louisiana and Texas, for the 1996-97 through 2006-07 shipping seasons, from Carolyn Brown, Database Analyst, Economic and Market Research, Florida Department of Citrus. Table 15 contains the Florida citrus variety codes, Table 16 contains the average number of fruit per 4/5 bushel carton by category, Table 17 contains the average number of fruit per 4/5 bushel carton by citrus variety, and Table 18 contains the seasonal numbers of 4/5 bushels of all varieties of citrus shipped from Florida to citrus producing states.

In a personal communication via email on August 21, 2007, Carolyn Brown sent an email containing an explanation of the data she had sent to APHIS. She communicated that:
"There is a list at the bottom which defines the variety codes. The headings at the top tell the average number of fruit per 4/5 bushel carton. If the variety is 103 (white seedless grapefruit) and there are 1000 boxes listed under the column titled GFT 14 that means those cartons each held 14 grapefruit. If the variety had been 203 (navel oranges) in that same column the second title – ORG 48-50 would apply. Each carton would hold 48 to 50 oranges. Varieties in the 100 range would use the GFT sizes; 200 range would use ORG sizes; and 300 range would use SPEC sizes."

Table 16. Florida citrus variety codes

CODE	Varieties…
101	Seedy white grapefruit
102	Seedy pink grapefruit
103	Seedless white grapefruit
104	Seedless pink grapefruit
119	other grapefruit
203	Navel oranges
205	Early oranges
206	Midseason oranges
207	Late oranges
220	Other oranges
202	K-early oranges
208	Temple oranges
209	Tangelo
210	Ambersweet orange
303	Honey tangerine
309	Dancy tangerine
321	Other tangerine
302	Robinson tangerine
304	Sunburst tangerine
305	Fallglo tangerine

Table 17. Average number of fruit per 4/5 bushel carton of Florida Fresh citrus by category

		GFT 14	GFT 18	GFT 23	GFT 27	GFT 32	GFT 36	GFT 40	GFT 48	GFT 56	GFT 64
		ORG 48-50	ORG 56	ORG 64	ORG 72-80	ORG 100	ORG 120	ORG 125	ORG 150	ORG 156	ORG 163
	Category	SPEC 64+	SPEC 64	SPEC 80	SPEC 100	SPEC 120	SPEC 150	SPEC 176	SPEC 210	SPEC 246	SPEC 294
	Grapefruit	14	18	23	27	32	36	40	48	36	64
	Oranges	49	56	64	76	100	120	125	150	156	163
	Specialty fruit	64	64	80	100	120	150	176	210	246	294

Table 18. Average number of fruit per 4/5 bushel carton of Florida Fresh citrus by variety

Variety code	**Variety Name**	**Average Number of fruit per 4/5 Bushel carton**									
Variety code	**Variety Name**										
101	Seedy white grapefruit	14	18	23	27	32	36	40	48	36	64
102	Seedy pink grapefruit	14	18	23	27	32	36	40	48	36	64
103	Seedless white grapefruit	14	18	23	27	32	36	40	48	36	64
104	Seedless pink grapefruit	14	18	23	27	32	36	40	48	36	64
119	other grapefruit	14	18	23	27	32	36	40	48	36	64
202	K-early oranges	49	56	64	76	100	120	125	150	156	163
203	Navel oranges	49	56	64	76	100	120	125	150	156	163
205	Early oranges	49	56	64	76	100	120	125	150	156	163
206	Midseason oranges	49	56	64	76	100	120	125	150	156	163
207	Late oranges	49	56	64	76	100	120	125	150	156	163
208	Temple oranges	49	56	64	76	100	120	125	150	156	163
209	Tangelo	49	56	64	76	100	120	125	150	156	163
210	Ambersweet orange	49	56	64	76	100	120	125	150	156	163
220	Other oranges	49	56	64	76	100	120	125	150	156	163

Variety code	Variety Name	Average Number of fruit per 4/5 Bushel carton									
Variety code	Variety Name										
302	Robinson tangerine	64	64	80	100	120	150	176	210	246	294
303	Honey tangerine	64	64	80	100	120	150	176	210	246	294
304	Sunburst tangerine	64	64	80	100	120	150	176	210	246	294
305	Fallglo tangerine	64	64	80	100	120	150	176	210	246	294
309	Dancy tangerine	64	64	80	100	120	150	176	210	246	294
321	Other tangerine	64	64	80	100	120	150	176	210	246	294

NB. This table is derived from information from the FDOC and Tables 1 and 2.

Table 19. Florida Fresh shipments to U.S. commercial citrus producing States

Florida fresh citrus shipments to AZ, CA, LA, TX & HI												
Season	State	Variety	GFT 14	GFT 18	GFT 23	GFT 27	GFT 32	GFT 36	GFT 40	GFT 48	GFT 56	GFT 64
			ORG 48-50	ORG 56	ORG 64	ORG 72-80	ORG 100	ORG 120	ORG 125	ORG 150	ORG 156	ORG 163
			SPEC 64+	SPEC 64	SPEC 80	SPEC 100	SPEC 120	SPEC 150	SPEC 176	SPEC 210	SPEC 246	SPEC 294
			4/5 bu ctns									
2006-07	DOMEXFL	101	80	0	0	0	0	1	0	0	0	0
2006-07	DOMEXFL	103	0	35	67990	53859	34541	39832	46036	6122	37	0
2006-07	DOMEXFL	104	292	2907	298411	788200	844033	1139257	1325117	703259	289201	1699
2006-07	DOMEXFL	203	673798	423304	890962	400659	101114	0	13628	0	0	0
2006-07	DOMEXFL	205	571	7364	63942	210670	468372	0	278591	0	0	0
2006-07	DOMEXFL	206	2240	22772	108650	188244	265140	0	87720	0	0	0
2006-07	DOMEXFL	207	11399	112335	549869	811649	671329	126	145166	0	0	0
2006-07	DOMEXFL	208	227	7137	61158	98996	72106	0	24882	0	0	0
2006-07	DOMEXFL	209	8584	15437	60252	158363	131776	60	66211	0	0	0
2006-07	DOMEXFL	210	252	11509	44034	60646	42259	0	13459	0	0	0
2006-07	DOMEXFL	220	0	0	181	1041	992	0	752	0	0	0
2006-07	DOMEXFL	302	0	31	573	2053	5047	1560	430	0	0	0
2006-07	DOMEXFL	303	28385	205362	515865	459636	488454	171042	36178	0	0	0
2006-07	DOMEXFL	304	2847	41656	195377	380981	570176	390143	74772	0	0	0
2006-07	DOMEXFL	305	1821	37381	162473	268061	211176	59653	2693	0	0	0
2006-07	DOMEXFL	321	22	0	151	78	0	0	0	0	0	0
2005-06	AZ	104	0	0	0	0	1371	0	264	0	0	0
2005-06	CA	103	0	861	11712	7627	672	46	55	64	0	0

2005-06	CA	104	0	0	3867	13847	10736	11536	14770	7839	1484	0
2005-06	CA	203	2962	3705	7055	818	100	0	0	0	0	0
2005-06	CA	207	99	2132	8456	28519	20872	0	0	0	0	0
2005-06	CA	209	0	0	0	0	54	0	0	0	0	0
2005-06	CA	220	0	0	61	403	631	525	0	0	0	0
2005-06	CA	303	6716	29313	130110	144116	146291	11218	972	0	0	0
2005-06	CA	304	3	1060	16608	40815	41047	7691	441	0	0	0
2005-06	CA	305	0	5719	25689	31251	26272	2242	238	0	0	0
2005-06	LA	104	0	0	0	189	1585	1101	1594	1684	245	0
2005-06	LA	203	1530	3692	3640	3235	3387	0	317	0	0	0
2005-06	LA	205	0	0	33	252	2437	0	2646	0	0	0
2005-06	LA	206	0	0	42	150	1117	0	3637	0	0	0
2005-06	LA	207	0	0	93	1890	2749	0	4549	0	0	0
2005-06	LA	208	0	0	81	108	108	0	163	0	0	0
2005-06	LA	209	0	0	0	623	916	0	1216	0	0	0
2005-06	LA	210	0	0	614	166	472	0	378	0	0	0
2005-06	LA	303	0	0	290	4305	8621	8525	95	0	0	0
2005-06	LA	304	800	0	10	1112	10390	4553	503	0	0	0
2005-06	LA	305	0	0	216	4060	4768	2740	243	0	0	0
2005-06	TX	103	0	0	39	8	0	0	63	63	0	0
2005-06	TX	104	0	0	139	100	3	9	0	232	0	0
2005-06	TX	203	216	1565	10050	998	0	0	0	0	0	0
2005-06	TX	205	0	0	0	0	110	0	0	0	0	0
2005-06	TX	206	0	0	0	0	0	0	1016	0	0	0
2005-06	TX	207	0	0	0	0	1	0	0	0	0	0
2005-06	TX	303	949	1781	2867	11278	20440	31373	956	0	0	0
2005-06	TX	304	0	0	316	4698	5058	4262	216	0	0	0
2005-06	TX	305	9	700	1492	11941	18658	7886	0	0	0	0
2005-06	DOMEXFL	103	0	1677	55269	52550	28030	32615	56824	16721	0	0

2005-06	DOMEXFL	104	0	5032	187510	386470	534630	829238	981726	593681	212227	2121
2005-06	DOMEXFL	203	480842	600803	1062128	694253	196341	0	30540	0	0	0
2005-06	DOMEXFL	205	1094	646	8327	79966	341526	0	321271	0	0	0
2005-06	DOMEXFL	206	63	2968	23215	122707	289115	0	179421	0	0	0
2005-06	DOMEXFL	207	514	38462	173164	522875	846791	174	325998	0	0	0
2005-06	DOMEXFL	208	22	824	31678	95187	85053	0	22779	0	0	0
2005-06	DOMEXFL	209	4058	7866	34772	131326	197978	153	103637	0	0	0
2005-06	DOMEXFL	210	1483	7002	39626	73355	37347	0	10913	0	0	0
2005-06	DOMEXFL	220	5	55	1384	4878	13069	5263	3150	1739	0	0
2005-06	DOMEXFL	302	0	0	0	1532	11735	9705	4741	0	0	0
2005-06	DOMEXFL	303	15967	102512	428260	685375	756474	362498	64707	0	0	0
2005-06	DOMEXFL	304	1452	17517	169811	388809	805768	568338	140766	0	0	0
2005-06	DOMEXFL	305	2017	35215	125252	247174	260379	102597	11112	0	0	0
2005-06	DOMEXFL	309	0	0	40	208	772	497	0	0	0	0
2004-05	AZ	104	0	0	0	0	93	214	435	0	54	0
2004-05	AZ	303	20	205	200	601	0	0	0	0	0	0
2004-05	AZ	305	0	0	702	216	0	0	0	0	0	0
2004-05	CA	103	0	0	4247	8188	736	4392	0	0	0	0
2004-05	CA	104	0	0	6924	15778	6395	10095	973	7182	508	0
2004-05	CA	203	3058	6219	4540	2411	300	0	0	0	0	0
2004-05	CA	205	0	0	0	0	783	0	491	0	0	0
2004-05	CA	206	0	0	108	378	540	0	0	0	0	0
2004-05	CA	207	0	5974	24736	40159	23035	0	460	0	0	0
2004-05	CA	303	2261	41161	140166	149246	136587	22362	239	0	0	0
2004-05	CA	304	0	249	15461	29458	28071	8330	0	0	0	0
2004-05	CA	305	293	7626	50523	32943	23791	1813	0	0	0	0
2004-05	LA	104	0	0	27	211	353	2655	5922	3549	470	0
2004-05	LA	203	461	3682	2009	2834	3937	0	811	0	0	0

2004-05	LA	205	0	0	0	1547	4364	0	14476	0	0	0
2004-05	LA	206	0	0	109	2092	4365	0	7072	0	0	0
2004-05	LA	207	0	378	395	9288	12913	0	14490	0	0	0
2004-05	LA	208	0	0	108	108	1053	0	575	0	0	0
2004-05	LA	209	0	0	0	1234	2582	0	2095	0	0	0
2004-05	LA	210	0	91	27	1137	303	0	299	0	0	0
2004-05	LA	302	0	0	0	356	462	408	135	0	0	0
2004-05	LA	303	0	108	69	4584	19371	8897	1770	0	0	0
2004-05	LA	304	0	0	45	1985	16283	6681	982	0	0	0
2004-05	LA	305	0	80	1374	2203	6249	423	0	0	0	0
2004-05	TX	103	0	0	212	84	0	0	0	0	0	0
2004-05	TX	104	0	0	253	493	3	209	14	0	0	0
2004-05	TX	203	2134	2205	1946	16	0	0	0	0	0	0
2004-05	TX	205	0	0	0	0	0	0	540	0	0	0
2004-05	TX	206	0	0	0	0	0	0	937	0	0	0
2004-05	TX	207	0	0	0	0	0	0	432	0	0	0
2004-05	TX	303	62	1807	3896	11611	18248	10841	0	0	0	0
2004-05	TX	304	0	0	216	4669	15165	2631	0	0	0	0
2004-05	TX	305	40	948	5192	9266	31454	3242	0	0	0	0
2004-05	DOMEXFL	103	0	0	34260	38506	27011	37716	46806	6104	36	0
2004-05	DOMEXFL	104	21	5044	160841	398239	442168	870506	1187188	641710	225180	0
2004-05	DOMEXFL	202	0	264	558	982	2171	0	0	0	0	0
2004-05	DOMEXFL	203	412648	425223	714374	425226	140859	0	12800	0	0	0
2004-05	DOMEXFL	205	74	365	24469	151668	580408	0	436999	0	0	0
2004-05	DOMEXFL	206	210	718	49210	185078	428036	0	211958	0	0	0
2004-05	DOMEXFL	207	6461	71093	310827	872361	1109460	0	336254	0	0	0
2004-05	DOMEXFL	208	1693	2349	45646	100723	84444	0	19784	0	0	0
2004-05	DOMEXFL	209	1531	3470	32513	101431	184664	43	127912	0	0	0
2004-05	DOMEXFL	210	465	6751	34848	54768	53742	40	11978	0	0	0

2004-05	DOMEXFL	220	45	731	5025	3764	2652	108	1249	0	0	0
2004-05	DOMEXFL	302	0	84	1070	2227	29888	18667	9851	0	0	0
2004-05	DOMEXFL	303	5006	101475	409497	605819	646234	347429	53770	0	0	0
2004-05	DOMEXFL	304	1250	9343	138279	376014	730653	544249	118428	280	0	0
2004-05	DOMEXFL	305	2760	60186	210039	258552	286734	42309	1810	0	0	0
2004-05	DOMEXFL	309	0	0	44	146	557	21	0	0	0	0
2004-05	DOMEXFL	321	0	0	21	372	0	0	40	0	0	0
2003-04	CA	103	0	0	9472	11375	1896	1787	0	0	0	0
2003-04	CA	104	0	0	13470	44811	20660	20004	5496	13423	2614	0
2003-04	CA	203	4080	4475	3492	289	0	0	0	0	0	0
2003-04	CA	205	0	0	0	54	553	0	486	0	0	0
2003-04	CA	206	0	0	0	0	0	0	330	0	0	0
2003-04	CA	207	38	3362	49087	57063	48737	0	648	0	0	0
2003-04	CA	208	0	0	0	230	0	0	0	0	0	0
2003-04	CA	209	0	6	0	68	86	0	0	0	0	0
2003-04	CA	220	0	0	770	110	0	0	0	0	0	0
2003-04	CA	302	0	0	0	400	490	0	0	0	0	0
2003-04	CA	303	15363	91213	271085	178618	156234	25428	3	0	0	0
2003-04	CA	304	144	2052	29152	62107	78533	29576	0	0	0	0
2003-04	CA	305	26	6508	39535	31508	23589	2520	0	0	0	0
2003-04	HI	104	0	0	0	0	0	20	0	0	0	0
2003-04	HI	203	0	0	0	0	40	0	0	0	0	0
2003-04	HI	303	0	0	1155	20	0	0	0	0	0	0
2003-04	LA	103	0	0	0	9	9	0	0	27	0	0
2003-04	LA	104	0	0	275	3070	1545	3726	10701	4016	788	0
2003-04	LA	203	1711	3589	8410	4862	1863	0	210	0	0	0
2003-04	LA	205	0	0	1270	967	4347	0	15607	0	0	0
2003-04	LA	206	0	0	18	307	1381	0	7466	0	0	0

2003-04	LA	207	0	504	787	8375	7469	0	15244	0	0	0
2003-04	LA	208	0	0	299	1242	410	0	462	0	0	0
2003-04	LA	209	0	1	185	495	108	0	708	0	0	0
2003-04	LA	210	0	84	684	0	0	0	0	0	0	0
2003-04	LA	220	0	0	110	0	0	0	0	0	0	0
2003-04	LA	302	0	0	0	442	1072	610	0	0	0	0
2003-04	LA	303	0	0	378	10122	17623	8966	437	0	0	0
2003-04	LA	304	0	0	0	11188	15802	6595	976	0	0	0
2003-04	LA	305	0	60	1243	3158	3947	390	0	0	0	0
2003-04	TX	103	0	0	359	302	0	0	0	0	0	0
2003-04	TX	104	0	0	1434	390	12	1041	267	189	0	0
2003-04	TX	203	1529	4532	4862	392	0	0	0	0	0	0
2003-04	TX	205	0	0	0	0	0	0	1026	0	0	0
2003-04	TX	206	0	0	0	363	2783	0	1105	0	0	0
2003-04	TX	207	0	0	0	19629	108	0	1283	0	0	0
2003-04	TX	208	0	0	193	60	0	0	0	0	0	0
2003-04	TX	209	0	0	289	259	0	0	0	0	0	0
2003-04	TX	302	0	0	0	360	880	0	0	0	0	0
2003-04	TX	303	865	2724	10726	18131	43151	6133	0	0	0	0
2003-04	TX	304	0	2	2211	11686	31356	1860	0	0	0	0
2003-04	TX	305	0	912	3627	7522	25192	1042	0	0	0	0
2003-04	DOMEXFL	101	0	0	0	18	0	0	0	0	0	0
2003-04	DOMEXFL	103	0	550	72598	83124	63135	87147	106558	12256	1	0
2003-04	DOMEXFL	104	0	5965	315779	974759	1016267	2089871	2064591	833020	199933	15
2003-04	DOMEXFL	203	698392	670357	1233534	575514	102262	210	4692	0	0	0
2003-04	DOMEXFL	205	107	1269	41760	261510	703317	0	475811	0	0	0
2003-04	DOMEXFL	206	250	7650	44760	148235	296889	0	187252	0	0	0
2003-04	DOMEXFL	207	9196	118002	493357	1252003	1197683	0	363117	0	0	0
2003-04	DOMEXFL	208	656	8293	108013	189386	133538	0	22696	0	0	0

2003-04	DOMEXFL	209	6104	21058	95634	210153	106031	59	38902	0	0	0
2003-04	DOMEXFL	210	340	16060	45403	37996	12196	0	1745	0	0	0
2003-04	DOMEXFL	220	1136	5669	12644	5699	623	205	0	0	0	0
2003-04	DOMEXFL	302	0	0	264	6322	15157	19002	3351	0	0	0
2003-04	DOMEXFL	303	39035	265885	803104	842908	730704	321926	50539	0	0	0
2003-04	DOMEXFL	304	221	20521	250080	646076	1119363	666980	147231	0	0	0
2003-04	DOMEXFL	305	1135	51133	234230	261444	209984	30961	1010	0	0	0
2003-04	DOMEXFL	321	0	466	1800	1434	531	126	0	0	0	0
2002-03	AZ	104	0	0	0	0	0	0	38	0	0	0
2002-03	AZ	203	71	0	0	157	0	0	0	0	0	0
2002-03	AZ	205	0	0	0	0	3	0	0	0	0	0
2002-03	AZ	207	0	0	0	0	0	0	54	0	0	0
2002-03	AZ	209	0	0	0	9	0	0	0	0	0	0
2002-03	AZ	305	0	0	540	0	0	0	0	0	0	0
2002-03	CA	103	0	0	12685	16456	2127	558	179	0	0	0
2002-03	CA	104	0	66	23580	54634	28505	23289	14485	15117	56	0
2002-03	CA	203	5709	10855	10043	2029	0	0	0	0	0	0
2002-03	CA	205	0	0	0	0	382	0	446	0	0	0
2002-03	CA	206	0	0	0	0	108	0	39	0	0	0
2002-03	CA	207	308	4824	23232	25775	12561	0	54	0	0	0
2002-03	CA	208	0	0	0	0	166	0	0	0	0	0
2002-03	CA	209	0	0	0	54	0	0	0	0	0	0
2002-03	CA	303	15029	106637	222153	153253	115186	35222	3	0	0	0
2002-03	CA	304	117	6869	53540	47301	63651	19255	410	0	0	0
2002-03	CA	305	2805	15195	40995	28295	30351	4472	0	0	0	0
2002-03	LA	103	0	0	0	663	96	293	394	0	0	0
2002-03	LA	104	0	0	0	3844	613	4270	6492	2256	120	0
2002-03	LA	203	4176	7634	8268	7773	2174	0	735	0	0	0

2002-03	LA	205	0	0	1490	2262	7856	0	11836	0	0	0
2002-03	LA	206	0	0	180	954	622	0	1940	0	0	0
2002-03	LA	207	0	1905	1911	6526	1710	0	1126	0	0	0
2002-03	LA	208	0	0	171	2648	378	0	538	0	0	0
2002-03	LA	209	0	0	0	726	1574	0	980	0	0	0
2002-03	LA	210	0	108	779	1162	232	0	789	0	0	0
2002-03	LA	302	0	0	105	90	656	84	54	0	0	0
2002-03	LA	303	0	42	2198	10061	13080	9040	489	0	0	0
2002-03	LA	304	0	18	1336	7690	12689	7573	477	0	0	0
2002-03	LA	305	0	3462	4214	3983	4241	1867	81	0	0	0
2002-03	TX	103	0	0	956	2282	110	0	0	0	0	0
2002-03	TX	104	0	0	1753	1444	432	774	1366	366	252	0
2002-03	TX	203	2360	9153	6091	752	0	0	0	0	0	0
2002-03	TX	205	0	0	0	0	70	0	1566	0	0	0
2002-03	TX	206	0	0	0	0	105	0	0	0	0	0
2002-03	TX	207	0	0	0	307	0	0	0	0	0	0
2002-03	TX	208	0	0	0	351	0	0	0	0	0	0
2002-03	TX	209	0	0	152	338	51	0	0	0	0	0
2002-03	TX	303	0	1134	6479	17249	34477	7374	0	0	0	0
2002-03	TX	304	0	0	4275	9755	27323	6411	450	0	0	0
2002-03	TX	305	256	610	13365	9616	24820	4217	0	0	0	0
2002-03	DOMEXFL	101	0	0	59	13	15	55	0	0	0	0
2002-03	DOMEXFL	102	0	0	0	0	0	108	0	0	0	0
2002-03	DOMEXFL	103	0	260	106361	107791	61175	91121	113342	10022	243	0
2002-03	DOMEXFL	104	2	35285	529348	1365637	1214198	2229040	1904050	740406	209299	1047
2002-03	DOMEXFL	203	862627	895274	1592805	847524	181687	0	18234	0	0	0
2002-03	DOMEXFL	205	98	851	73679	323221	790624	82	436341	0	0	0
2002-03	DOMEXFL	206	113	3503	70268	161006	237804	0	77812	0	0	0
2002-03	DOMEXFL	207	17875	166608	546967	1025464	699950	0	127240	0	0	0

2002-03	DOMEXFL	208	614	17421	133494	147138	76313	0	21926	0	0	0
2002-03	DOMEXFL	209	8912	18637	89366	223834	199416	286	79211	0	0	0
2002-03	DOMEXFL	210	2373	24865	64805	96477	70878	0	16656	0	0	0
2002-03	DOMEXFL	220	34	27	269	40	81	0	6	0	0	0
2002-03	DOMEXFL	302	0	130	387	1539	1367	1476	1062	0	0	0
2002-03	DOMEXFL	303	48500	254531	615502	694106	598577	303475	47443	0	0	0
2002-03	DOMEXFL	304	867	48878	369995	531279	866990	605823	90986	0	0	0
2002-03	DOMEXFL	305	6384	93699	251317	239150	219065	52043	5100	0	0	0
2002-03	DOMEXFL	309	0	8	100	96	267	117	27	0	0	0
2002-03	DOMEXFL	321	0	54	216	267	87	0	0	0	0	0
2001-02	AZ	104	0	0	0	831	935	0	2288	0	0	0
2001-02	AZ	305	0	0	0	828	0	0	0	0	0	0
2001-02	CA	103	0	0	1846	12989	7070	628	496	1	0	0
2001-02	CA	104	0	0	13606	36405	40734	48231	26660	19798	245	0
2001-02	CA	203	5745	7849	9310	4409	0	0	0	0	0	0
2001-02	CA	205	0	0	0	0	1352	0	918	0	0	0
2001-02	CA	206	0	0	0	0	2052	0	2052	0	0	0
2001-02	CA	207	506	18359	40867	54130	58429	0	865	0	0	0
2001-02	CA	220	0	716	2064	2153	1521	0	0	0	0	0
2001-02	CA	302	0	0	226	1033	2284	412	0	0	0	0
2001-02	CA	303	13583	58804	177810	134663	100192	42532	110	0	0	0
2001-02	CA	304	1	1103	26720	65848	58227	40108	287	0	0	0
2001-02	CA	305	15	1819	31609	47548	30569	10200	0	0	0	0
2001-02	LA	103	0	0	0	488	330	66	1231	92	0	0
2001-02	LA	104	0	0	144	2371	3559	5401	7894	2748	698	0
2001-02	LA	203	7630	4997	13015	13056	3540	0	799	0	0	0
2001-02	LA	205	0	0	0	1531	7255	0	10866	0	0	0
2001-02	LA	206	0	38	633	2107	2817	0	5147	0	0	0

2001-02	LA	207	0	752	839	6355	8282	0	8346	0	0	0
2001-02	LA	208	0	0	162	1737	3228	0	2578	0	0	0
2001-02	LA	209	6	0	448	621	1574	0	1189	0	0	0
2001-02	LA	210	0	786	581	1339	1687	0	286	0	0	0
2001-02	LA	302	0	0	0	115	283	434	0	0	0	0
2001-02	LA	303	0	17	1626	5954	15110	8801	2118	0	0	0
2001-02	LA	304	0	0	984	4377	22352	13366	2199	0	0	0
2001-02	LA	305	0	0	383	5103	4503	2542	135	0	0	0
2001-02	LA	309	0	0	0	0	216	0	0	0	0	0
2001-02	TX	103	0	0	102	55	0	194	137	0	0	0
2001-02	TX	104	0	0	171	55	76	5749	865	1734	2	0
2001-02	TX	203	5930	8076	19891	4644	0	0	0	0	0	0
2001-02	TX	205	0	0	0	13	0	0	1711	0	0	0
2001-02	TX	206	0	0	54	0	0	0	0	0	0	0
2001-02	TX	207	0	0	380	1069	2	0	1787	0	0	0
2001-02	TX	208	0	0	19	12	0	0	0	0	0	0
2001-02	TX	209	0	0	34	5838	0	0	0	0	0	0
2001-02	TX	210	0	0	0	972	0	0	0	0	0	0
2001-02	TX	302	0	0	0	1498	3708	1134	0	0	0	0
2001-02	TX	303	454	425	2125	12792	30789	10302	475	0	0	0
2001-02	TX	304	0	175	1572	9108	51968	3696	110	0	0	0
2001-02	TX	305	0	0	1746	7254	26908	4092	0	0	0	0
2001-02	DOMEXFL	101	0	0	24	3	9	7	0	0	0	0
2001-02	DOMEXFL	103	262	704	60886	76435	74653	103610	150473	16855	518	0
2001-02	DOMEXFL	104	5	11427	322617	1025463	1278635	2611036	2508847	1057816	292605	397
2001-02	DOMEXFL	202	0	0	141	673	2398	0	0	0	0	0
2001-02	DOMEXFL	203	905558	819138	1640511	953270	244243	58	21057	343	0	0
2001-02	DOMEXFL	205	55	1820	50759	239691	712518	37	456875	0	0	0
2001-02	DOMEXFL	206	436	7683	45463	175547	355864	0	163684	0	0	0

2001-02	DOMEXFL	207	17110	117147	467773	1113610	1260150	94	347907	0	0	0
2001-02	DOMEXFL	208	148	2777	76882	166884	201250	0	54401	0	0	0
2001-02	DOMEXFL	209	9472	20428	113259	266089	220272	0	99536	0	0	0
2001-02	DOMEXFL	210	764	21721	50321	118656	115543	0	24012	0	0	0
2001-02	DOMEXFL	220	938	3441	5579	7230	6014	1200	426	0	0	0
2001-02	DOMEXFL	302	0	53	1885	17997	53569	20617	10099	0	0	0
2001-02	DOMEXFL	303	28016	136907	483140	532908	522677	300261	69521	42	0	0
2001-02	DOMEXFL	304	314	12538	213159	708708	1249269	1020382	271877	33	0	0
2001-02	DOMEXFL	305	150	19193	173735	290999	324219	107834	5481	0	0	0
2001-02	DOMEXFL	309	0	0	93	172	3229	1358	657	0	0	0
2001-02	DOMEXFL	321	0	587	1721	1957	1262	312	52	0	0	0
2000-01	AZ	104	0	0	0	0	0	306	85	0	0	0
2000-01	AZ	203	108	0	328	145	0	0	0	0	0	0
2000-01	AZ	205	0	0	0	0	840	0	0	0	0	0
2000-01	AZ	207	0	0	0	0	972	0	0	0	0	0
2000-01	AZ	209	0	0	198	215	0	0	0	0	0	0
2000-01	AZ	303	0	0	0	108	864	0	0	0	0	0
2000-01	AZ	305	0	0	0	450	0	0	0	0	0	0
2000-01	CA	103	0	0	9436	8710	4200	226	424	71	0	0
2000-01	CA	104	0	1134	16428	34880	27406	70909	6870	20009	550	0
2000-01	CA	203	2733	3375	4179	1570	0	0	0	0	0	0
2000-01	CA	205	0	0	0	0	108	0	108	0	0	0
2000-01	CA	207	1054	12593	34918	43571	21167	0	1004	0	0	0
2000-01	CA	208	0	0	168	0	168	0	0	0	0	0
2000-01	CA	209	0	0	10	45	0	0	20	0	0	0
2000-01	CA	302	0	1	72	404	279	0	0	0	0	0
2000-01	CA	303	11	37691	111489	141896	89143	47577	884	0	0	0
2000-01	CA	304	0	454	15854	47979	35802	36870	0	0	0	0

2000-01	CA	305	0	3820	30235	61224	29018	2274	0	0	0	0
2000-01	LA	103	0	0	0	1812	0	906	1169	0	0	0
2000-01	LA	104	0	27	81	7410	697	4012	9878	2462	6	0
2000-01	LA	202	0	0	0	21	0	0	21	0	0	0
2000-01	LA	203	2862	4460	15398	11538	5172	0	1306	0	0	0
2000-01	LA	205	0	0	205	911	2330	0	12113	0	0	0
2000-01	LA	206	0	0	1177	1675	2268	0	7643	0	0	0
2000-01	LA	207	0	484	3709	9297	6697	0	8972	0	0	0
2000-01	LA	208	0	58	317	2947	1185	0	2113	0	0	0
2000-01	LA	209	0	0	0	1239	2641	0	1177	0	0	0
2000-01	LA	210	0	878	321	666	520	0	593	0	0	0
2000-01	LA	302	0	0	0	40	1281	1405	135	0	0	0
2000-01	LA	303	0	0	535	2074	12694	5474	1882	0	0	0
2000-01	LA	304	0	0	233	2642	9778	9982	678	0	0	0
2000-01	LA	305	0	0	97	4181	2508	1363	21	0	0	0
2000-01	LA	309	0	0	0	0	108	63	0	0	0	0
2000-01	TX	103	0	0	165	0	218	42	55	0	0	0
2000-01	TX	104	0	0	35	412	28	1270	204	89	0	0
2000-01	TX	203	3987	3541	5575	5183	0	0	0	0	0	0
2000-01	TX	205	0	0	0	606	83	0	1079	0	0	0
2000-01	TX	206	0	0	0	2164	0	0	1296	0	0	0
2000-01	TX	207	153	657	756	3987	9126	0	1134	0	0	0
2000-01	TX	208	0	0	324	0	0	0	0	0	0	0
2000-01	TX	209	0	14	1	708	74	0	138	0	0	0
2000-01	TX	302	0	0	3	5374	11666	972	0	0	0	0
2000-01	TX	303	0	1974	3830	13438	19246	4635	0	0	0	0
2000-01	TX	304	0	220	1579	21493	29297	4883	537	0	0	0
2000-01	TX	305	0	189	2789	9417	22913	577	0	0	0	0
2000-01	DOMEXFL	101	0	0	0	0	9	0	0	0	0	0

2000-01	DOMEXFL	103	0	826	78270	72134	82876	109255	173145	27842	290	0
2000-01	DOMEXFL	104	2	19943	322137	981598	1247041	2757884	2799582	1024181	274056	2336
2000-01	DOMEXFL	202	0	170	994	5061	8952	0	2238	0	0	0
2000-01	DOMEXFL	203	729593	684179	1524604	895947	208928	0	22711	0	0	0
2000-01	DOMEXFL	205	326	2461	27957	140474	540304	182	375390	0	0	0
2000-01	DOMEXFL	206	801	3890	83510	235979	444776	0	246618	0	0	0
2000-01	DOMEXFL	207	27037	100766	456676	999158	1276270	165	325006	0	0	0
2000-01	DOMEXFL	208	594	1244	79849	177360	162290	126	49144	0	0	0
2000-01	DOMEXFL	209	18184	13168	86369	265810	285174	106	108203	0	0	0
2000-01	DOMEXFL	210	1331	20985	61993	177302	93074	163	18646	0	0	0
2000-01	DOMEXFL	220	2586	2292	13348	7369	3345	270	283	0	0	0
2000-01	DOMEXFL	302	0	976	1717	23331	71134	38296	12052	0	0	0
2000-01	DOMEXFL	303	35	95510	342530	503182	494708	324211	60567	0	0	0
2000-01	DOMEXFL	304	467	12673	187389	587710	1028664	873313	149663	60	0	0
2000-01	DOMEXFL	305	304	20671	185515	337249	238119	59867	1738	291	0	0
2000-01	DOMEXFL	309	0	0	569	2590	5433	9856	1575	0	0	0
2000-01	DOMEXFL	321	0	68	531	469	817	207	6	0	0	0
1999-00	AZ	103	0	0	0	0	0	201	30	0	0	0
1999-00	AZ	104	0	0	0	40	100	2239	1218	3144	0	0
1999-00	AZ	203	20	20	100	60	0	0	0	0	0	0
1999-00	AZ	205	0	0	0	0	462	0	0	0	0	0
1999-00	AZ	207	0	0	0	420	0	0	0	0	0	0
1999-00	AZ	209	0	0	0	54	0	0	0	0	0	0
1999-00	AZ	303	0	0	0	1080	0	42	0	0	0	0
1999-00	CA	103	0	274	11496	8575	2955	1697	889	0	0	0
1999-00	CA	104	0	552	18213	53060	41621	103288	34181	20200	385	0
1999-00	CA	203	7866	6819	9145	1176	565	0	201	0	0	0
1999-00	CA	205	0	0	168	0	417	0	108	0	0	0

1999-00	CA	206	0	0	0	0	54	0	246	0	0	0
1999-00	CA	207	4460	19477	46632	34589	30726	0	373	0	0	0
1999-00	CA	208	0	0	0	486	378	0	0	0	0	0
1999-00	CA	209	0	71	409	384	195	0	0	0	0	0
1999-00	CA	302	0	66	927	1105	144	0	0	0	0	0
1999-00	CA	303	0	22122	127097	224195	148907	64008	0	0	0	0
1999-00	CA	304	0	2814	32760	68601	65256	8918	98	0	0	0
1999-00	CA	305	0	19468	71313	70258	22095	4119	135	0	0	0
1999-00	CA	309	0	1	5	33	58	18	22	0	0	0
1999-00	LA	103	0	0	0	1387	0	0	54	0	0	0
1999-00	LA	104	0	206	187	6743	2583	9286	17278	3073	81	595
1999-00	LA	202	0	0	0	0	54	0	124	0	0	0
1999-00	LA	203	10414	3911	11794	2578	764	0	1342	0	0	0
1999-00	LA	205	0	0	39	2713	10170	0	18868	0	0	0
1999-00	LA	206	0	0	0	2866	7777	0	4021	0	0	0
1999-00	LA	207	0	235	2798	13491	6204	0	2806	0	0	0
1999-00	LA	208	49	0	108	459	330	0	1097	0	0	0
1999-00	LA	209	7	0	65	165	583	0	1186	0	0	0
1999-00	LA	210	0	162	91	126	437	0	317	0	0	0
1999-00	LA	302	0	0	104	145	1359	784	36	53	0	0
1999-00	LA	303	0	53	1139	9664	10490	6146	2014	0	0	0
1999-00	LA	304	0	0	0	2449	9988	6876	1578	0	0	0
1999-00	LA	305	0	216	486	990	6672	2465	0	0	0	0
1999-00	LA	309	0	0	0	0	54	310	27	0	0	0
1999-00	TX	103	0	0	117	2	2	55	0	0	0	0
1999-00	TX	104	0	775	436	778	216	667	2833	1711	54	320
1999-00	TX	203	4691	4362	2960	378	539	0	654	0	0	0
1999-00	TX	205	42	8	0	1242	218	0	1215	0	0	0
1999-00	TX	206	0	0	650	76	630	0	805	0	0	0

1999-00	TX	207	0	495	337	5130	3274	0	338	0	0	0
1999-00	TX	208	147	0	0	2112	504	0	0	0	0	0
1999-00	TX	209	201	0	4	1	0	0	108	0	0	0
1999-00	TX	210	0	0	320	67	0	0	0	0	0	0
1999-00	TX	302	0	0	0	1785	9755	0	0	0	0	0
1999-00	TX	303	0	613	571	8366	38912	2916	0	0	0	0
1999-00	TX	304	0	552	4833	8887	7132	672	0	140	0	0
1999-00	TX	305	0	950	2735	7233	10552	802	0	0	0	0
1999-00	TX	309	0	0	0	0	0	54	0	0	0	0
1999-00	DOMEXFL	101	0	0	5	15	0	0	0	0	0	0
1999-00	DOMEXFL	103	0	3354	70321	84781	89407	146780	178981	24654	698	0
1999-00	DOMEXFL	104	1	99750	576548	1303124	1654879	2947412	2896594	1006926	229434	19125
1999-00	DOMEXFL	202	0	336	2064	4213	4971	0	869	0	0	0
1999-00	DOMEXFL	203	1194920	767781	1201789	766490	120051	55	42851	0	0	0
1999-00	DOMEXFL	205	5100	4327	112087	450346	1119691	431	562814	0	0	0
1999-00	DOMEXFL	206	722	3402	70846	223084	403502	317	140851	0	0	0
1999-00	DOMEXFL	207	32791	135207	474855	1034246	947845	110	197440	0	0	0
1999-00	DOMEXFL	208	32800	2020	77708	223523	195556	0	40693	0	0	0
1999-00	DOMEXFL	209	42558	16052	115881	243793	284409	348	109912	0	0	0
1999-00	DOMEXFL	210	15367	31689	73785	88677	44844	0	8100	0	0	0
1999-00	DOMEXFL	220	741	1280	1563	3069	3316	0	1004	0	0	0
1999-00	DOMEXFL	302	0	3559	10039	28338	66691	25320	10830	2060	0	0
1999-00	DOMEXFL	303	40	79626	401149	821985	706680	500050	67588	294	0	0
1999-00	DOMEXFL	304	11	25991	309173	681898	887574	989433	181929	24927	0	0
1999-00	DOMEXFL	305	281	85837	303733	326716	224734	82288	3711	7	0	0
1999-00	DOMEXFL	309	0	44	429	3081	12163	10741	2971	1431	0	0
1999-00	AZ	103	0	0	0	0	0	201	30	0	0	0
1999-00	AZ	104	0	0	0	40	100	2239	1218	3144	0	0

1999-00	AZ	203	20	20	100	60	0	0	0	0	0	0
1999-00	AZ	205	0	0	0	0	462	0	0	0	0	0
1999-00	AZ	207	0	0	0	420	0	0	0	0	0	0
1999-00	AZ	209	0	0	0	54	0	0	0	0	0	0
1999-00	AZ	303	0	0	0	1080	0	42	0	0	0	0
1999-00	CA	103	0	274	11496	8575	2955	1697	889	0	0	0
1999-00	CA	104	0	552	18213	53060	41621	103288	34181	20200	385	0
1999-00	CA	203	7866	6819	9145	1176	565	0	201	0	0	0
1999-00	CA	205	0	0	168	0	417	0	108	0	0	0
1999-00	CA	206	0	0	0	0	54	0	246	0	0	0
1999-00	CA	207	4460	19477	46632	34589	30726	0	373	0	0	0
1999-00	CA	208	0	0	0	486	378	0	0	0	0	0
1999-00	CA	209	0	71	409	384	195	0	0	0	0	0
1999-00	CA	302	0	66	927	1105	144	0	0	0	0	0
1999-00	CA	303	0	22122	127097	224195	148907	64008	0	0	0	0
1999-00	CA	304	0	2814	32760	68601	65256	8918	98	0	0	0
1999-00	CA	305	0	19468	71313	70258	22095	4119	135	0	0	0
1999-00	CA	309	0	1	5	33	58	18	22	0	0	0
1999-00	LA	103	0	0	0	1387	0	0	54	0	0	0
1999-00	LA	104	0	206	187	6743	2583	9286	17278	3073	81	595
1999-00	LA	202	0	0	0	0	54	0	124	0	0	0
1999-00	LA	203	10414	3911	11794	2578	764	0	1342	0	0	0
1999-00	LA	205	0	0	39	2713	10170	0	18868	0	0	0
1999-00	LA	206	0	0	0	2866	7777	0	4021	0	0	0
1999-00	LA	207	0	235	2798	13491	6204	0	2806	0	0	0
1999-00	LA	208	49	0	108	459	330	0	1097	0	0	0
1999-00	LA	209	7	0	65	165	583	0	1186	0	0	0
1999-00	LA	210	0	162	91	126	437	0	317	0	0	0
1999-00	LA	302	0	0	104	145	1359	784	36	53	0	0

1999-00	LA	303	0	53	1139	9664	10490	6146	2014	0	0	0
1999-00	LA	304	0	0	0	2449	9988	6876	1578	0	0	0
1999-00	LA	305	0	216	486	990	6672	2465	0	0	0	0
1999-00	LA	309	0	0	0	0	54	310	27	0	0	0
1999-00	TX	103	0	0	117	2	2	55	0	0	0	0
1999-00	TX	104	0	775	436	778	216	667	2833	1711	54	320
1999-00	TX	203	4691	4362	2960	378	539	0	654	0	0	0
1999-00	TX	205	42	8	0	1242	218	0	1215	0	0	0
1999-00	TX	206	0	0	650	76	630	0	805	0	0	0
1999-00	TX	207	0	495	337	5130	3274	0	338	0	0	0
1999-00	TX	208	147	0	0	2112	504	0	0	0	0	0
1999-00	TX	209	201	0	4	1	0	0	108	0	0	0
1999-00	TX	210	0	0	320	67	0	0	0	0	0	0
1999-00	TX	302	0	0	0	1785	9755	0	0	0	0	0
1999-00	TX	303	0	613	571	8366	38912	2916	0	0	0	0
1999-00	TX	304	0	552	4833	8887	7132	672	0	140	0	0
1999-00	TX	305	0	950	2735	7233	10552	802	0	0	0	0
1999-00	TX	309	0	0	0	0	0	54	0	0	0	0
1999-00	DOMEXFL	101	0	0	5	15	0	0	0	0	0	0
1999-00	DOMEXFL	103	0	3354	70321	84781	89407	146780	178981	24654	698	0
1999-00	DOMEXFL	104	1	99750	576548	1303124	1654879	2947412	2896594	1006926	229434	19125
1999-00	DOMEXFL	202	0	336	2064	4213	4971	0	869	0	0	0
1999-00	DOMEXFL	203	1194920	767781	1201789	766490	120051	55	42851	0	0	0
1999-00	DOMEXFL	205	5100	4327	112087	450346	1119691	431	562814	0	0	0
1999-00	DOMEXFL	206	722	3402	70846	223084	403502	317	140851	0	0	0
1999-00	DOMEXFL	207	32791	135207	474855	1034246	947845	110	197440	0	0	0
1999-00	DOMEXFL	208	32800	2020	77708	223523	195556	0	40693	0	0	0
1999-00	DOMEXFL	209	42558	16052	115881	243793	284409	348	109912	0	0	0
1999-00	DOMEXFL	210	15367	31689	73785	88677	44844	0	8100	0	0	0

1999-00	DOMEXFL	220	741	1280	1563	3069	3316	0	1004	0	0	0
1999-00	DOMEXFL	302	0	3559	10039	28338	66691	25320	10830	2060	0	0
1999-00	DOMEXFL	303	40	79626	401149	821985	706680	500050	67588	294	0	0
1999-00	DOMEXFL	304	11	25991	309173	681898	887574	989433	181929	24927	0	0
1999-00	DOMEXFL	305	281	85837	303733	326716	224734	82288	3711	7	0	0
1999-00	DOMEXFL	309	0	44	429	3081	12163	10741	2971	1431	0	0
1998-99	AZ	103	0	0	63	381	295	42	1026	0	0	0
1998-99	AZ	104	0	51	485	8851	927	2979	4655	13850	230	0
1998-99	AZ	206	0	0	0	0	4242	0	0	0	0	0
1998-99	AZ	208	0	0	0	0	7614	0	0	0	0	0
1998-99	AZ	303	0	0	762	2484	540	0	0	0	0	0
1998-99	AZ	304	0	0	0	1207	330	0	0	0	0	0
1998-99	AZ	305	0	0	795	1358	0	0	0	0	0	0
1998-99	CA	103	0	0	7646	10415	1475	1741	4092	309	0	0
1998-99	CA	104	0	1822	14616	44185	35379	101354	101675	35436	363	0
1998-99	CA	203	5705	7270	8475	12155	1808	0	66	0	0	0
1998-99	CA	205	0	0	270	582	1134	0	744	0	0	0
1998-99	CA	206	0	0	0	0	1026	0	0	0	0	0
1998-99	CA	207	1816	10273	107256	199665	208830	0	23920	0	0	0
1998-99	CA	208	0	2	37	3875	1364	0	838	0	0	0
1998-99	CA	209	92	34	260	166	108	0	77	0	0	0
1998-99	CA	303	19	57073	150130	247522	94277	16183	0	0	0	0
1998-99	CA	304	0	319	18196	28512	72185	6643	837	0	0	0
1998-99	CA	305	0	6980	45081	32340	4718	273	825	0	0	0
1998-99	LA	103	0	0	0	1830	0	27	0	0	0	0
1998-99	LA	104	0	759	122	7537	3046	5790	22032	10603	139	558
1998-99	LA	202	0	0	0	15	285	0	82	0	0	0
1998-99	LA	203	3947	4622	15172	6230	4641	0	2855	0	0	0

1998-99	LA	205	0	0	108	3144	8295	0	20695	0	0	0
1998-99	LA	206	423	0	104	1368	7425	0	7254	0	0	0
1998-99	LA	207	0	891	7717	15738	38279	0	21279	0	0	0
1998-99	LA	208	11	0	201	2594	374	0	3638	0	0	0
1998-99	LA	209	392	0	274	94	1296	0	2067	0	0	0
1998-99	LA	210	0	373	199	584	63	0	526	0	0	0
1998-99	LA	302	0	2	0	79	612	1006	0	0	0	0
1998-99	LA	303	0	547	2647	9278	13111	2621	267	0	0	0
1998-99	LA	304	0	171	530	4702	6702	7478	1418	144	0	0
1998-99	LA	305	0	905	1983	4254	5428	1409	41	0	0	0
1998-99	LA	309	0	0	5	79	1515	108	0	0	0	0
1998-99	TX	101	0	0	0	8	0	0	0	0	0	0
1998-99	TX	103	0	0	112	22	454	1	486	461	0	0
1998-99	TX	104	0	1604	130	238	1449	1767	258	1557	0	91
1998-99	TX	203	2995	1737	6848	757	0	0	110	0	0	0
1998-99	TX	205	0	0	0	0	0	0	258	0	0	0
1998-99	TX	206	0	0	270	1026	0	0	2648	0	0	0
1998-99	TX	207	15	257	1031	13377	3084	0	13502	0	0	0
1998-99	TX	208	107	0	33	2967	2058	0	0	0	0	0
1998-99	TX	209	323	216	126	152	174	0	329	0	0	0
1998-99	TX	210	0	0	0	1894	0	0	0	0	0	0
1998-99	TX	302	0	61	0	0	0	0	0	0	0	0
1998-99	TX	303	0	816	7118	8841	38379	1724	0	79	0	0
1998-99	TX	304	0	55	378	324	16808	9113	0	0	0	0
1998-99	TX	305	0	432	4188	7113	13934	1198	0	0	0	0
1998-99	TX	309	0	0	0	0	378	66	0	0	0	0
1998-99	DOMEXFL	101	0	0	14	320	266	194	80	0	0	0
1998-99	DOMEXFL	103	0	1674	88978	84304	121761	178030	274397	50899	879	0
1998-99	DOMEXFL	104	0	111690	455222	1085326	1756640	3299917	3914085	1632179	407990	17983

1998-99	DOMEXFL	202	0	507	1007	8892	8878	108	2809	0	0	0
1998-99	DOMEXFL	203	810147	640521	1361639	1122082	349372	10486	94391	0	0	0
1998-99	DOMEXFL	205	769	3132	57832	263857	810787	2578	562561	0	0	0
1998-99	DOMEXFL	206	962	3792	44433	166171	407949	52	183216	0	0	0
1998-99	DOMEXFL	207	32067	159013	740243	1649350	2044525	175	677389	0	0	0
1998-99	DOMEXFL	208	26951	4139	67964	335193	314667	0	67755	0	0	0
1998-99	DOMEXFL	209	47243	22882	100261	230727	303377	494	204204	0	0	0
1998-99	DOMEXFL	210	4777	24653	75514	157690	109067	0	12215	0	0	0
1998-99	DOMEXFL	220	28	40	1811	2576	3219	1470	1878	239	0	0
1998-99	DOMEXFL	302	142	961	2945	9834	35277	54474	23018	4421	0	0
1998-99	DOMEXFL	303	711	124518	426523	665760	556751	254488	34673	498	0	0
1998-99	DOMEXFL	304	159	12277	151683	402165	825225	848321	208822	30999	0	0
1998-99	DOMEXFL	305	971	37806	212059	295443	182588	63288	4674	187	0	0
1998-99	DOMEXFL	309	0	135	1468	13019	23418	29379	6264	844	0	0
1998-99	DOMEXFL	321	0	712	1581	1773	1052	1023	496	87	0	0
1997-98	AZ	103	0	0	0	0	0	336	120	0	0	0
1997-98	AZ	104	0	0	0	1618	6436	136	0	0	0	0
1997-98	AZ	203	0	0	984	1806	0	0	0	0	0	0
1997-98	AZ	205	0	0	0	0	978	0	546	0	0	0
1997-98	AZ	207	0	0	0	891	0	0	918	0	0	0
1997-98	AZ	210	0	0	420	1428	0	0	0	0	0	0
1997-98	AZ	304	0	0	0	0	312	2747	0	0	0	0
1997-98	AZ	305	0	0	54	0	0	0	0	0	0	0
1997-98	CA	103	0	192	10987	11055	5194	7719	4504	478	31	0
1997-98	CA	104	0	468	45201	85386	93077	183106	64457	47777	2590	0
1997-98	CA	203	9079	6172	8065	5067	368	0	19	0	0	0
1997-98	CA	205	0	0	97	670	2324	0	1756	0	0	0
1997-98	CA	206	0	0	0	918	756	0	0	0	0	0

1997-98	CA	207	939	6496	25083	32558	50929	0	4086	0	0	0
1997-98	CA	208	0	0	1026	0	0	0	255	0	0	0
1997-98	CA	209	0	0	307	30	756	0	0	0	0	0
1997-98	CA	210	0	0	180	1074	441	0	0	0	0	0
1997-98	CA	302	0	0	0	231	1061	996	0	0	0	0
1997-98	CA	303	3811	53222	182945	199617	81633	1356	39	0	0	0
1997-98	CA	304	0	1023	12623	39549	44427	4854	218	67	0	0
1997-98	CA	305	0	2916	22744	53188	26991	2263	0	0	0	0
1997-98	CA	309	0	0	486	540	0	0	0	0	0	0
1997-98	LA	103	0	0	1674	2010	566	175	510	0	0	0
1997-98	LA	104	0	475	11065	7150	6580	10717	15943	13557	10613	0
1997-98	LA	202	0	0	0	0	96	0	20	0	0	0
1997-98	LA	203	22980	22903	10307	28285	4435	0	1798	0	0	0
1997-98	LA	205	111	109	100	1530	11148	0	35428	0	0	0
1997-98	LA	206	0	0	190	3293	7416	0	7886	0	0	0
1997-98	LA	207	0	628	5607	30071	16512	0	8981	0	0	0
1997-98	LA	208	8	0	288	2598	998	0	1510	0	0	0
1997-98	LA	209	93	37	1400	1128	1160	0	2961	0	0	0
1997-98	LA	210	0	0	1458	2059	1829	0	3024	0	0	0
1997-98	LA	302	0	0	0	27	2224	5069	423	30	0	0
1997-98	LA	303	0	1404	5620	9474	13910	8079	2032	0	0	0
1997-98	LA	304	0	166	549	2753	10348	4650	1112	54	0	0
1997-98	LA	305	0	253	617	4748	6982	2567	113	0	0	0
1997-98	LA	309	0	110	110	0	0	0	0	0	0	0
1997-98	TX	101	0	0	24	150	15	0	0	0	0	0
1997-98	TX	103	0	0	0	55	28	0	63	0	0	0
1997-98	TX	104	0	604	244	385	819	2932	937	1036	188	0
1997-98	TX	202	0	0	0	0	56	0	0	0	0	0
1997-98	TX	203	2049	1084	2874	116	131	0	0	0	0	0

1997-98	TX	205	120	0	0	435	580	0	362	0	0	0
1997-98	TX	206	0	0	0	0	216	0	27	0	0	0
1997-98	TX	207	100	1411	14980	10026	6492	0	1939	0	0	0
1997-98	TX	208	0	0	326	0	0	0	0	0	0	0
1997-98	TX	209	370	0	1228	519	414	0	187	0	0	0
1997-98	TX	210	0	0	0	0	0	0	79	0	0	0
1997-98	TX	302	0	0	0	486	596	0	0	0	0	0
1997-98	TX	303	0	2206	1443	9914	28461	3238	0	0	0	0
1997-98	TX	304	0	18	648	4300	24110	2776	0	0	0	0
1997-98	TX	305	0	54	3897	3052	12835	742	0	0	0	0
1997-98	TX	309	0	1	0	154	1500	0	0	0	0	0
1997-98	DOMEXFL	101	0	12	638	856	616	302	80	0	0	0
1997-98	DOMEXFL	103	0	4249	205801	173702	168205	262580	292153	67738	1634	0
1997-98	DOMEXFL	104	0	116086	853130	1859274	2413797	4033815	3710240	1481190	378659	9527
1997-98	DOMEXFL	202	19	715	3330	17628	15992	0	5868	0	0	0
1997-98	DOMEXFL	203	1202339	930636	1691924	1107257	257379	0	48952	0	0	0
1997-98	DOMEXFL	205	4023	12736	81574	366244	1097832	433	691525	0	0	0
1997-98	DOMEXFL	206	2568	3122	56618	225996	519667	0	211184	0	0	0
1997-98	DOMEXFL	207	20015	127601	689699	1675254	1397697	222	339267	0	0	0
1997-98	DOMEXFL	208	15867	39510	104799	302033	219671	365	43235	0	0	0
1997-98	DOMEXFL	209	38123	20690	153312	368839	363004	11557	126738	0	0	0
1997-98	DOMEXFL	210	913	15668	85153	230660	230305	655	66186	0	0	0
1997-98	DOMEXFL	220	45	209	899	2133	2591	198	1156	0	0	0
1997-98	DOMEXFL	302	0	501	2868	23456	82643	95095	29368	5151	0	0
1997-98	DOMEXFL	303	4351	133505	484916	658113	497753	201649	48826	743	0	0
1997-98	DOMEXFL	304	1671	9202	179523	489786	737279	630142	161162	30631	0	0
1997-98	DOMEXFL	305	415	14264	142612	271800	228456	75463	12134	453	0	0
1997-98	DOMEXFL	309	0	483	4699	14084	30421	19007	5635	1643	0	0
1997-98	DOMEXFL	321	0	21	144	107	0	0	0	0	0	0

1996-97	AZ	103	0	0	0	0	54	42	84	0	0	0
1996-97	AZ	104	0	288	54	216	54	1282	1532	0	0	31
1996-97	AZ	203	0	0	0	619	0	0	58	0	0	0
1996-97	AZ	205	0	0	0	168	270	0	0	0	0	0
1996-97	AZ	207	0	0	0	840	1188	0	0	0	0	0
1996-97	AZ	304	0	0	0	0	108	0	0	0	0	0
1996-97	AZ	309	0	0	0	0	0	0	0	43	0	0
1996-97	CA	103	0	0	7942	5521	4309	3901	2313	1310	0	0
1996-97	CA	104	0	3060	23878	75457	49839	202408	60555	40776	6088	0
1996-97	CA	203	6410	7581	14048	14896	500	0	169	0	0	0
1996-97	CA	205	0	0	216	6787	1410	0	1125	0	0	0
1996-97	CA	206	0	0	66	981	6776	0	3090	0	0	0
1996-97	CA	207	2938	5390	20622	36760	71606	0	8899	0	0	0
1996-97	CA	208	0	20	176	3553	5547	0	1501	0	0	0
1996-97	CA	209	0	40	240	881	165	0	777	0	0	0
1996-97	CA	210	30	423	901	2296	598	0	42	0	0	0
1996-97	CA	302	0	0	70	1858	2600	904	0	0	0	0
1996-97	CA	303	49	9221	83471	149836	64043	2887	34	176	0	0
1996-97	CA	304	0	32	7128	28030	91261	4445	57	0	0	0
1996-97	CA	305	0	6553	49771	28996	9127	400	5	0	0	0
1996-97	CA	309	0	0	0	0	0	270	0	0	0	0
1996-97	LA	103	0	0	0	0	9	2635	78	1512	0	0
1996-97	LA	104	0	1362	4143	5125	12232	22026	22700	13752	301	125
1996-97	LA	202	0	0	0	0	263	0	1587	0	0	0
1996-97	LA	203	26200	34081	12762	10050	6235	0	1884	0	0	0
1996-97	LA	205	188	131	27	6898	27580	0	47685	0	0	0
1996-97	LA	206	0	0	0	5207	19081	0	8012	0	0	0
1996-97	LA	207	0	483	10589	37807	23171	0	7238	0	0	0

1996-97	LA	208	0	0	1247	2113	1338	0	1624	0	0	0
1996-97	LA	209	185	0	33	862	3228	0	2768	0	0	0
1996-97	LA	210	22	3082	3668	3494	1927	0	868	0	0	0
1996-97	LA	302	0	0	31	526	2074	1622	654	81	0	0
1996-97	LA	303	0	333	1342	5646	15679	5727	1077	0	0	0
1996-97	LA	304	0	109	1896	6829	16830	21364	4804	0	0	0
1996-97	LA	305	0	596	2120	3638	4449	1618	92	0	0	0
1996-97	LA	309	0	23	0	0	0	0	39	0	0	0
1996-97	TX	103	0	6	560	170	27	52	34	17	0	0
1996-97	TX	104	0	485	216	92	700	1485	981	927	569	165
1996-97	TX	203	3367	1672	2755	805	502	0	0	0	0	0
1996-97	TX	205	0	0	0	450	1016	0	973	0	0	0
1996-97	TX	206	0	0	0	243	693	0	351	0	0	0
1996-97	TX	207	1052	159	756	1606	1222	0	221	0	0	0
1996-97	TX	208	0	0	146	465	122	0	86	0	0	0
1996-97	TX	209	0	0	54	1026	459	0	594	0	0	0
1996-97	TX	210	0	0	28	378	0	0	0	0	0	0
1996-97	TX	302	0	0	0	0	1296	1902	211	0	0	0
1996-97	TX	303	0	342	5075	4205	13908	7251	540	0	0	0
1996-97	TX	304	0	9	972	1026	22149	5585	2798	0	0	0
1996-97	TX	305	0	0	2339	4447	9518	1045	0	0	0	0
1996-97	TX	309	0	1	0	0	0	48	0	0	0	0
1996-97	TX	321	0	0	0	162	0	0	0	0	0	0
1996-97	DOMEXFL	101	0	0	11	124	200	390	176	0	0	0
1996-97	DOMEXFL	103	0	2306	165292	134931	143175	227191	352381	111942	1625	0
1996-97	DOMEXFL	104	0	120475	822154	1706507	2148571	3857629	4317608	2012541	491016	10073
1996-97	DOMEXFL	202	0	733	8701	35219	45363	110	18279	0	0	0
1996-97	DOMEXFL	203	1390247	1009918	1705173	1147149	231473	164	57932	0	0	0
1996-97	DOMEXFL	205	5053	11999	108797	497085	1382340	54	962874	0	0	0

1996-97	DOMEXFL	206	702	2346	50383	189543	372655	0	172587	0	0	0
1996-97	DOMEXFL	207	29681	151602	642860	1642172	1355669	0	423796	42	0	0
1996-97	DOMEXFL	208	18933	17040	73366	260576	302763	0	69453	0	0	0
1996-97	DOMEXFL	209	42447	11798	107276	351667	517116	279	223392	0	0	0
1996-97	DOMEXFL	210	9566	32464	130923	179756	88886	0	19961	0	0	0
1996-97	DOMEXFL	220	0	25	1685	4299	5246	10	2414	0	0	0
1996-97	DOMEXFL	302	0	80	3865	24909	118727	118393	53930	11395	0	0
1996-97	DOMEXFL	303	286	45491	299608	508575	439110	200294	35243	588	0	0
1996-97	DOMEXFL	304	468	6197	154903	501103	1205800	1141407	358316	35113	0	0
1996-97	DOMEXFL	305	1073	49255	225269	202262	156432	43570	5640	225	0	0
1996-97	DOMEXFL	309	0	2602	2170	7735	12009	12223	3048	1122	0	0
1996-97	DOMEXFL	321	0	383	232	1522	1156	1364	758	705	0	0