United States Department of Agriculture

# Current Situation, Management, and Economic Impact of Citrus Canker in Florida, US

Timothy Riley

USDA APHIS PPQ
Citrus Health Response Program

# Citrus Canker (CC) *Disease*

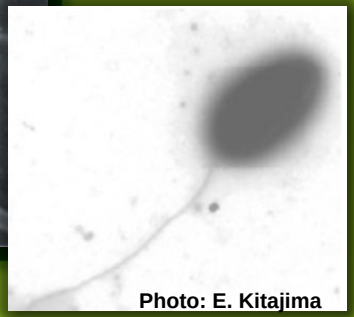
-Caused by the bacterium *Xanthomonas citri* subsp. *citri*
*(syn Xanthomonas axonopodis pv. citri)*

-The Asiatic form (ACC), or A-strain, is the most widespread and severe form

-Host Range: *Citrus* and citrus relatives

# Citrus Canker *Causal pathogen*


Stomata and natural openings are the primary ways for the bacterium to gain access to host tissue




Gram negative, rod shaped, with a single polar flagellum

- Survives on inanimate surfaces for 24- 48 hours therefore;
- Sanitation practices are required to prevent spread through human contact and/or use of equipment and tools in groves and citrus nurseries

# Citrus Canker *Symptoms*

- Variable depending on lesion age and the variety of affected citrus
- All aerial parts of the plant are affected
- Localized lesions only, not systemic in plant


# Citrus Canker *Disease*

## FIRST OUTBREAK

1910 – Canker identified in Florida for the first time

1933 – Canker eradicated

*Other affected States:*

- South Carolina
- Georgia
- Mississippi
- Alabama
- Louisiana
- Texas


*Last infected tree removed in 1927*

## SECOND OUTBREAK

-1986 – New detection in Manatee County 53 years later

-1992 – canker undetectable

-1994 – declared officially eradicated

## THIRD OUTBREAK

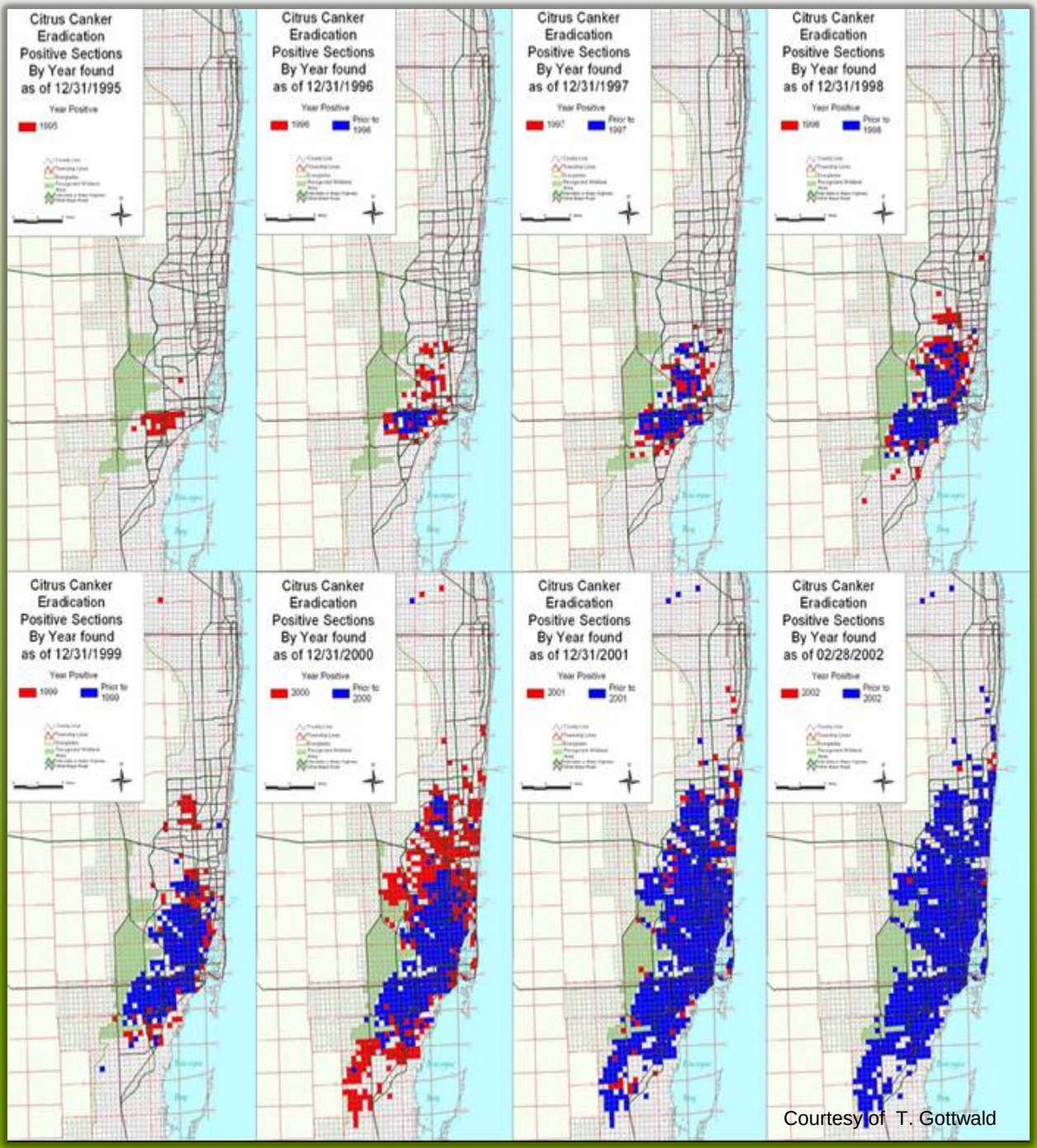
-1995 – Canker detected for a third time near Miami International Airport

# Meteorological events contributed to spread events

- The original 14 $mi^2$ infected area in 1995.
- Storms in 1996 contributed to the development of new infections to the northeast.

# Major factors associated with the spread of citrus canker

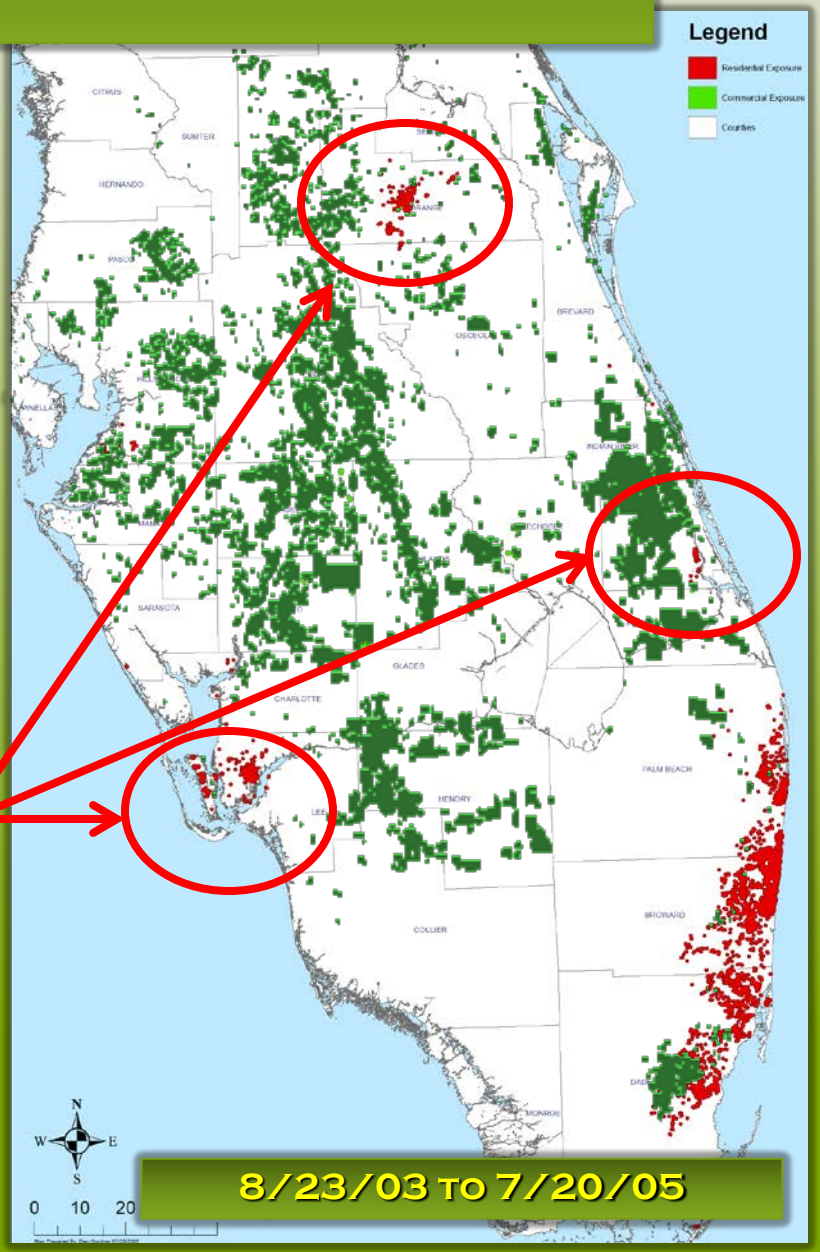
- Spatio-Temporal increase of citrus canker in the South Florida Counties of Miami-Dade and Broward
- Additional outbreaks across the state were attributed to the large inoculum source found in this area.



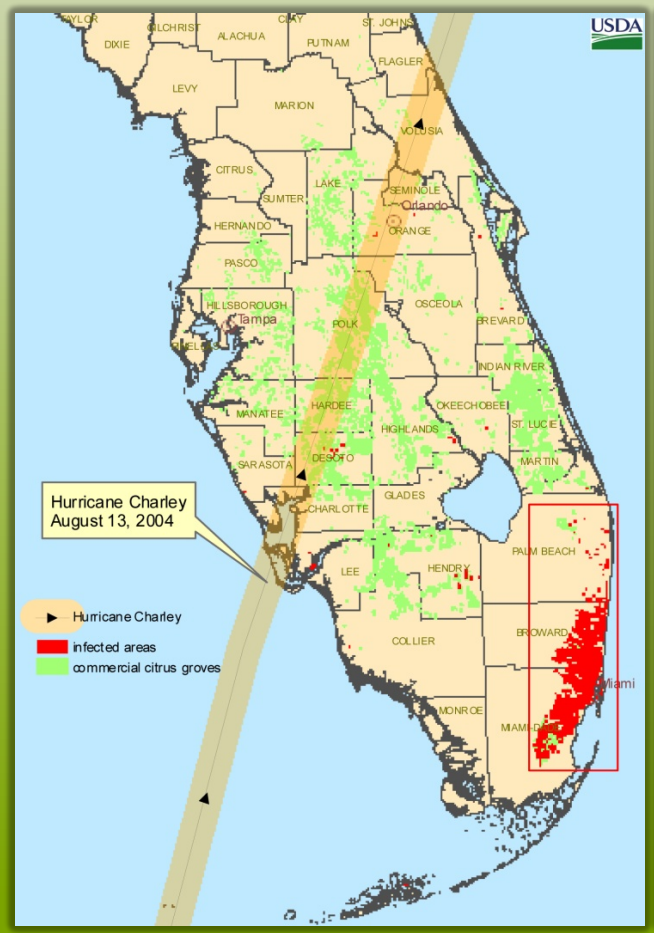
# Major factors associated with the spread of citrus canker

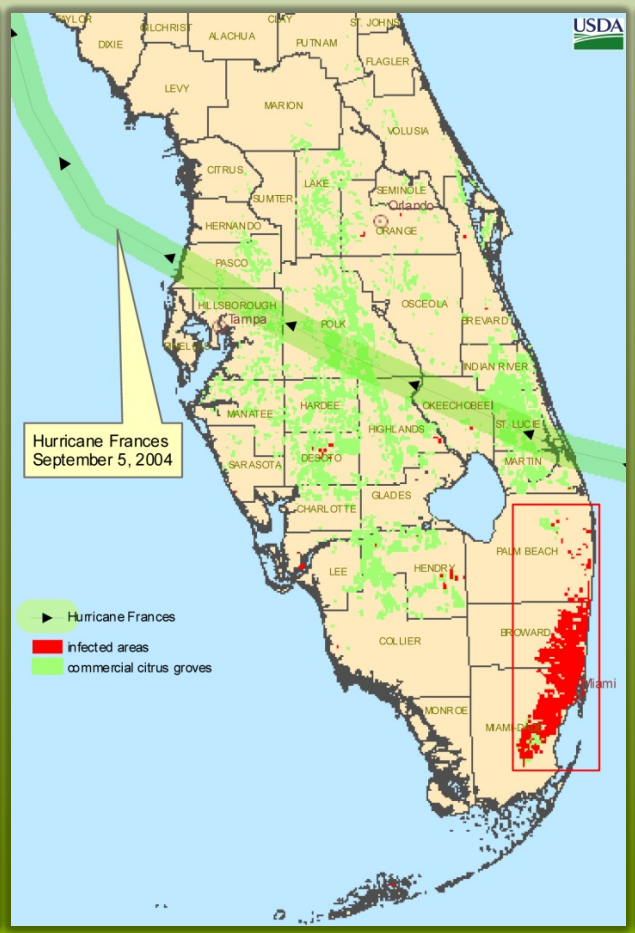
- Human-assisted plant material movement
- Wind-driven rain events
  - Wind speeds greater than 18 mph (8m / sec)

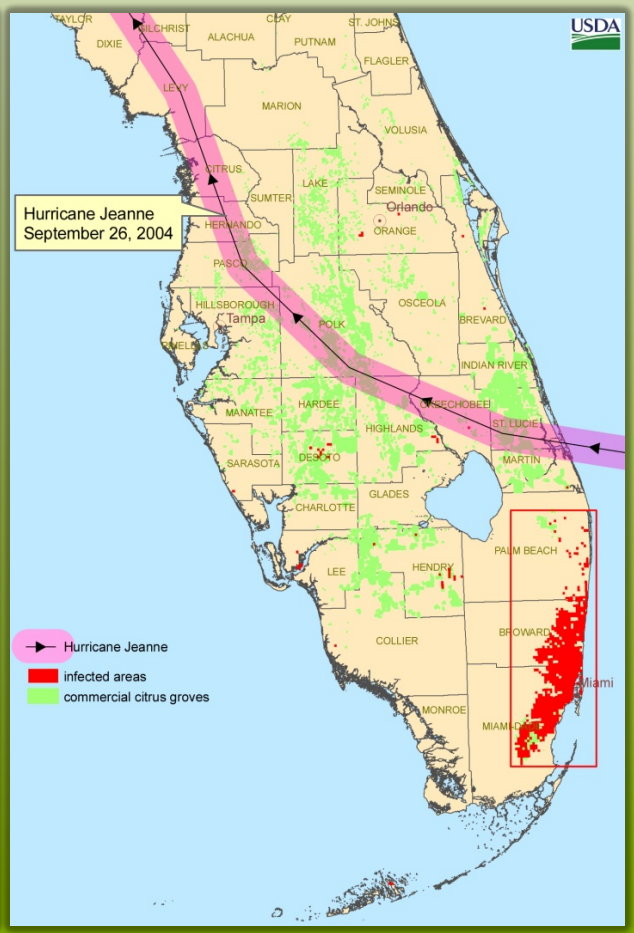
- Confirmed movement of plant material to new areas of the state originating from South Florida
- Individual properties identified



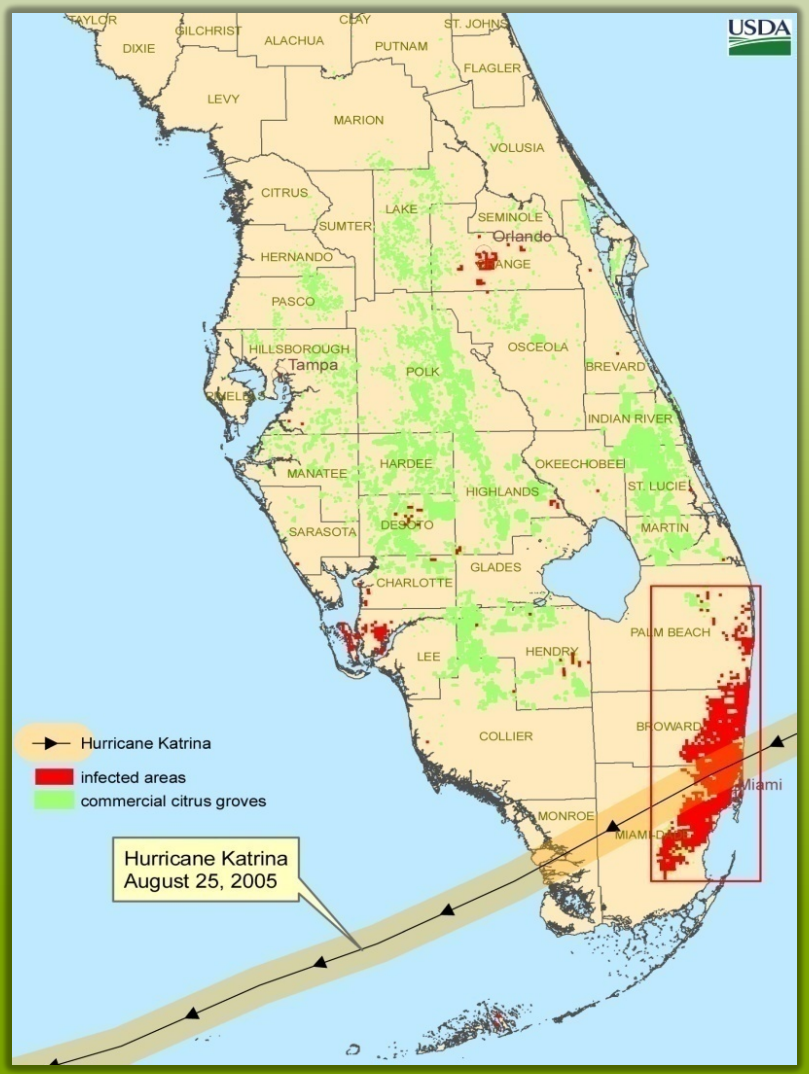
# Major factors associated with the spread of citrus canker 2004

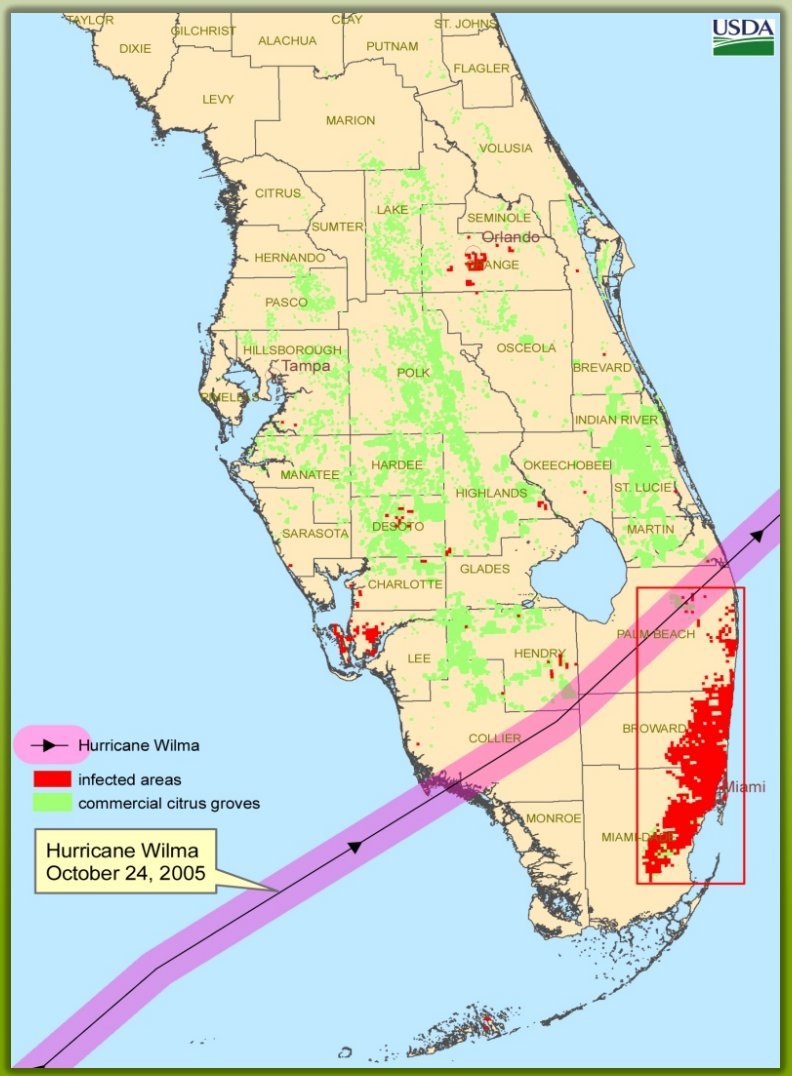


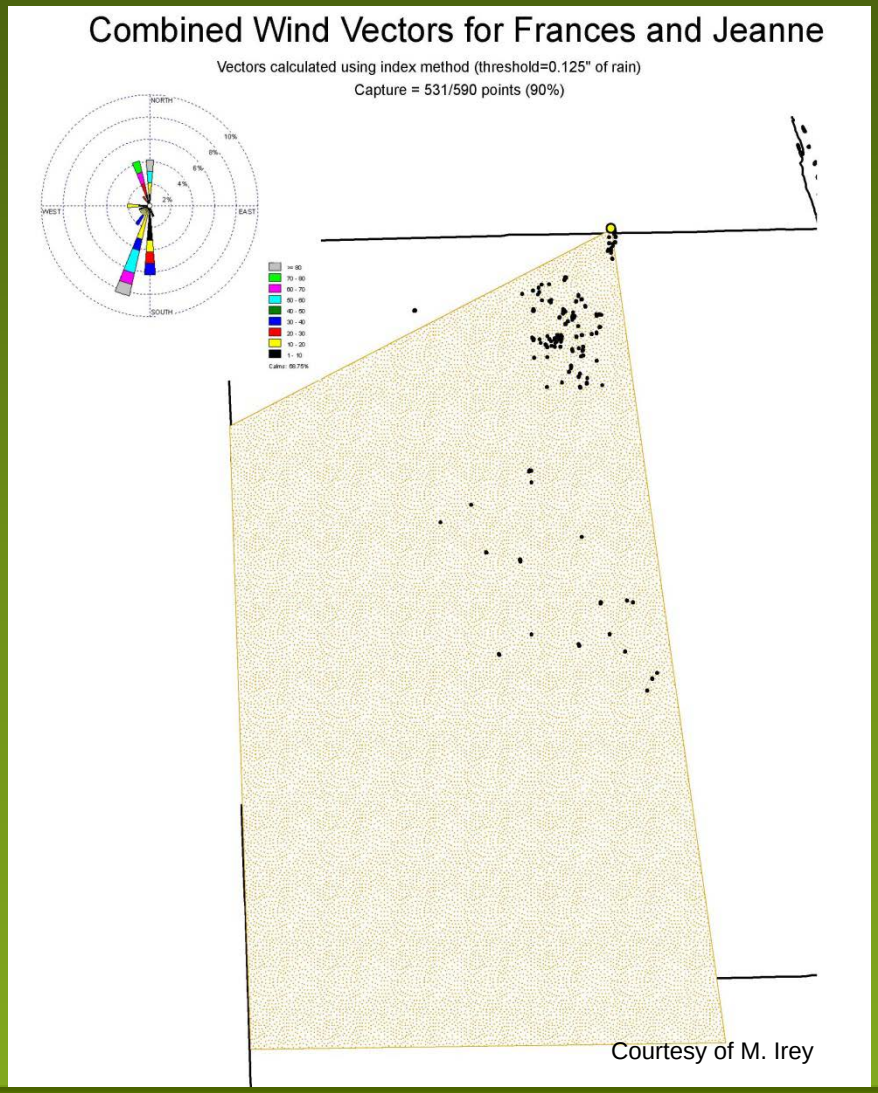
# Major factors associated with the spread of citrus canker 2005

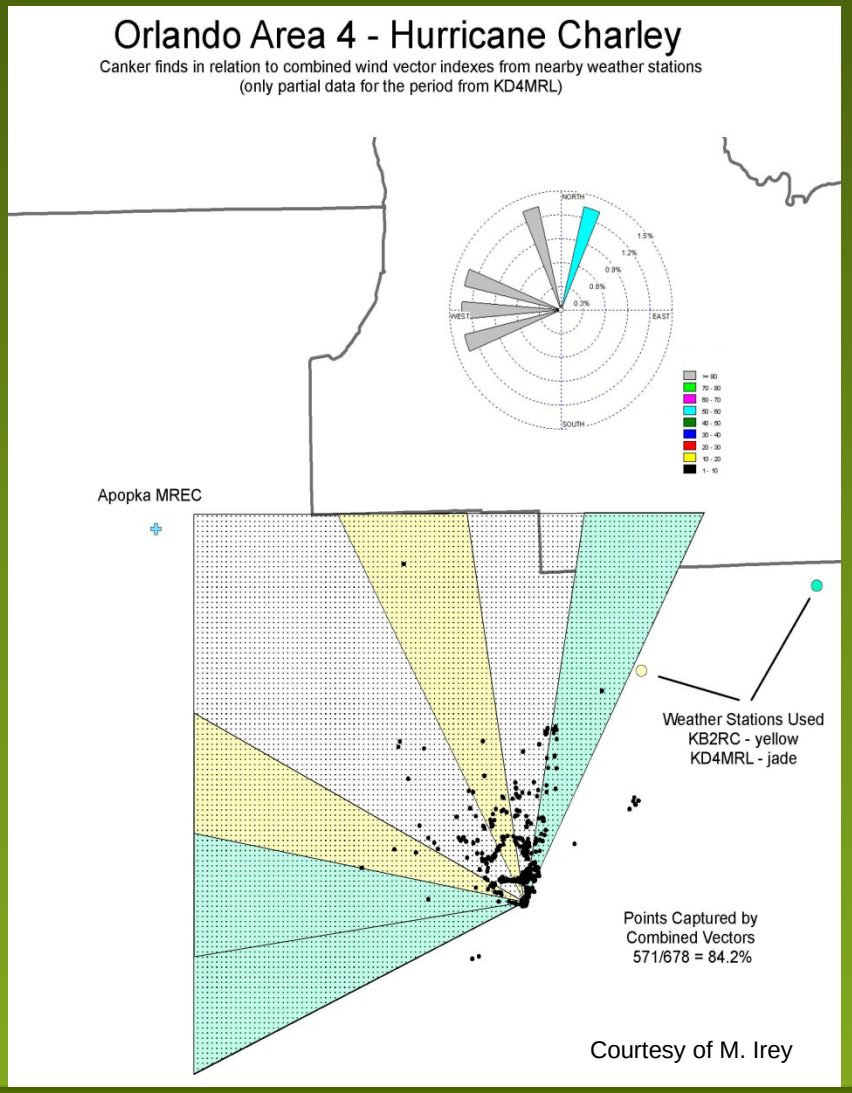


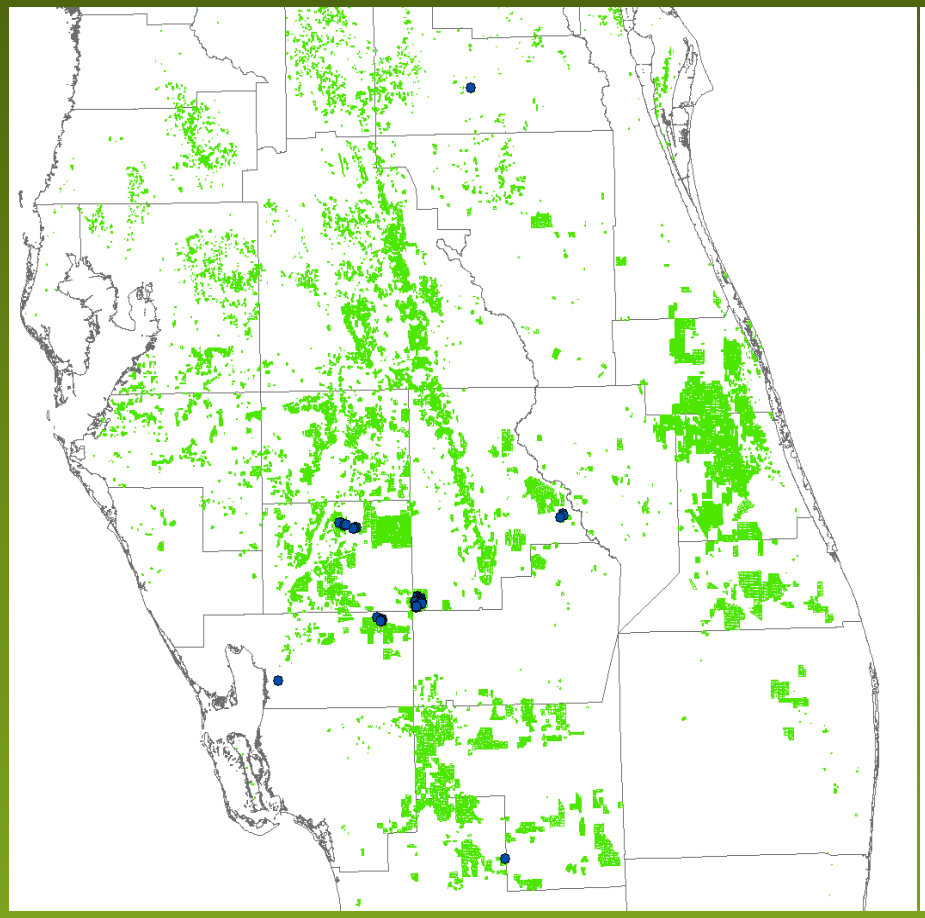
# Major factors associated with the spread of citrus canker

## *Residential outbreaks*

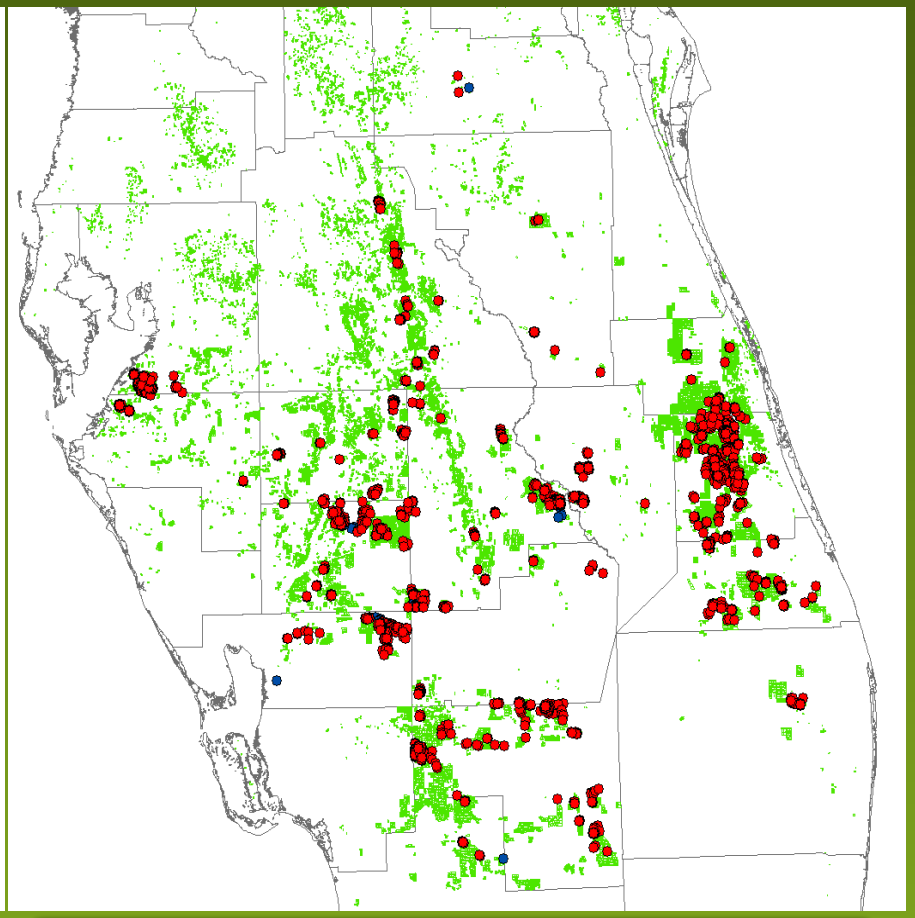


# Major factors associated with the spread of citrus canker



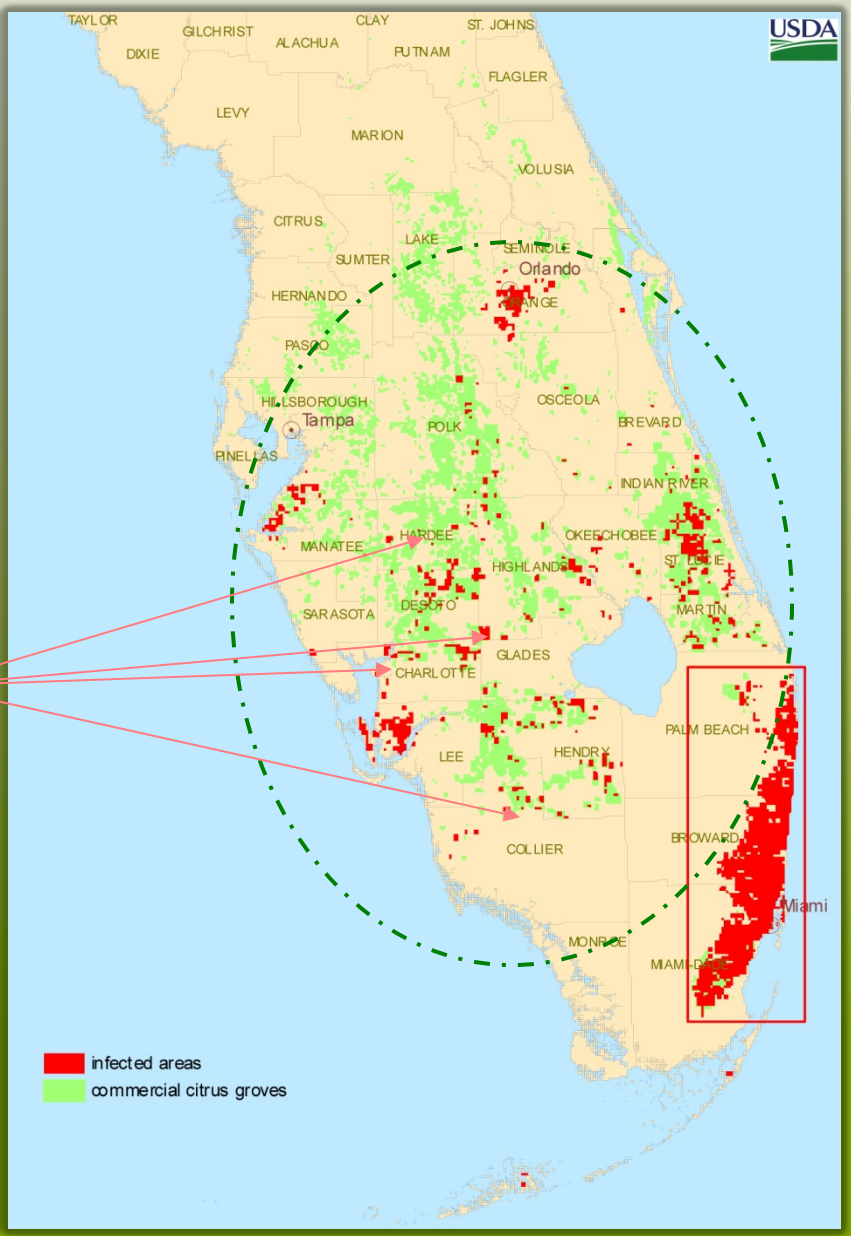
Prior to 2004 hurricane season



Post 2004 hurricane season

# By the end of 2005

- After all surveys completed to determine the extent of spread due to hurricanes…
- Total of **1,624** square-mile sections positive for citrus canker
- Including many detections throughout the commercial growing areas
- And, for the first time, canker was found in citrus production nurseries
- 1st HLB detection in Florida in August 2005



# Major Regulatory events post eradication program

- January 2006 Citrus Canker Eradication Program ends
- 2006 Citrus Health Response Program established
  - Interstate movement of citrus products and nursery stock prohibited
- August 2006 entire state of Florida under citrus canker quarantine

# Major Regulatory events post eradication program

- 2007 Interstate movement of asymptomatic commercially packed fruit permitted to non citrus-producing states only
  - Grove inspections required prior to shipping
    - Field (pre-harvest inspections)
  - Packinghouse
- Continued to 2009

# Regulatory Rule Changed

A team of 15 International scientists representing Florida, Texas, California, Brazil, Argentina, and Europe were assembled to conduct numerous research experiments which clearly showed that symptomatic fruit is not a pathway to spread canker

Crop Protection 28 (2009) 508–524

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

## The epidemiological significance of post-packinghouse survival of *Xanthomonas citri* subsp. *citri* for dissemination of Asiatic citrus canker via infected fruit

T. Gottwald [a,*], J. Graham [b], C. Bock [a,b], G. Bonn [c], E. Civerolo [d], M. Irey [e], R. Leite [f], G. McCollum [a], P. Parker [g], J. Ramallo [h], T. Riley [i], T. Schubert [c], B. Stein [h], E. Taylor [a]

[a] *Agricultural Research Service, US Department of Agriculture, US Horticultural Research Laboratory, 2001 South Rock Road, Fort Pierce, FL 34945, USA*
[b] *Citrus Research and Education Center, University of Florida, Lake Alfred, FL 33850, USA*
[c] *Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL 32611, USA*
[d] *Agricultural Research Service, US Department of Agriculture, San Joaquin Valley Agricultural Sciences Center, Parlier, CA 93648, USA*
[e] *Southern Gardens Citrus, US Sugar Corporation, 1820 County Road, 833 Clewiston, FL 33440, USA*
[f] *Área de Proteção de Plantas, IAPAR, CP 481, 86047-902 Londrina, Brazil*
[g] *US Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Edinburg, TX 78541, USA*
[h] *Estación Experimental Agroindustrial-Obispo Colombres, Las Talitas, Tucumán, Argentina*
[i] *US Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Citrus Health Response Program, Orlando, FL 32824, USA*

# Regulatory Rule Changed

## USDA Key Findings For Canker Rule Change

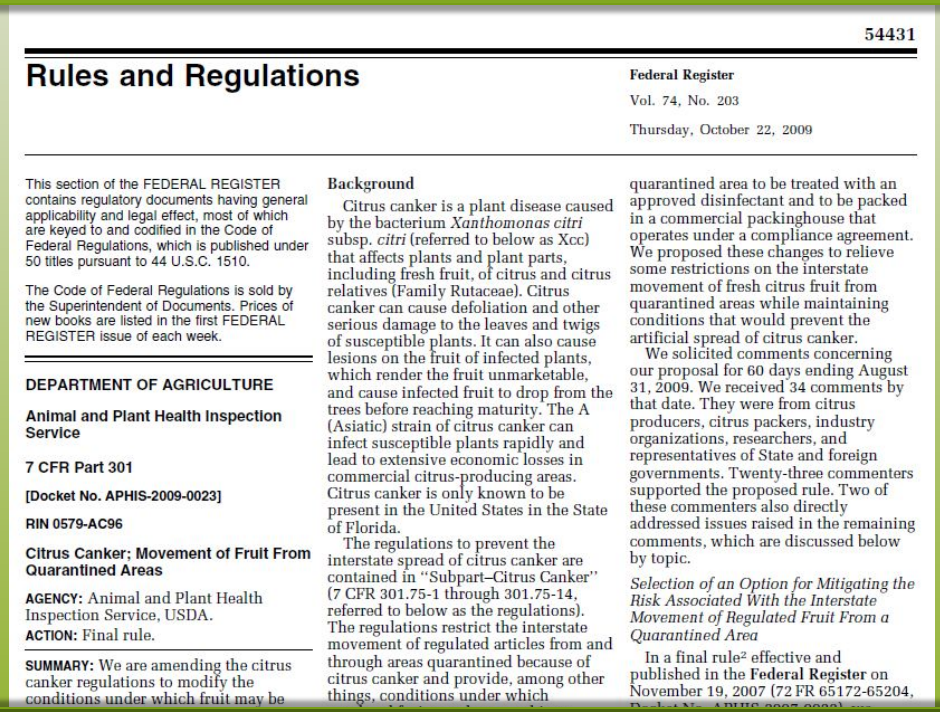
- Postharvest treatments reduce the viability of bacteria on fruit.
- The viability of bacteria on fruit diminishes after harvest and shipment
- Rinds of infected fruit are unlikely to provide inoculum for disease if they have been discarded in the field at least eight days.
- Fruit parts, even those that are in direct contact with susceptible trees, are unlikely to spread the disease.
- Citrus canker disease development between harvest and packinghouse, via wounding, is not likely.

# Regulatory requirements for interstate shipment of fruit

## New Rule

- 2009 Interstate movement of all fruit permitted as long as the following conditions are met:
  - The fruit must originate in a grove operating under a compliance agreement. (Florida Department of Agriculture and Consumer Services – Division of Plant Industry FDACS-DPI)
  - The fruit must be packed in a commercial packinghouse whose owner or operator has entered into a compliance agreement with USDA APHIS PPQ.
  - The fruit must be found to be free of leaves and other regulated plant material.
  - The fruit must be washed, brushed, and surface disinfested with approved treatment).
    - (1) Sodium Hypochlorite or
    - (2) Sodium O-Phenyl Phenate (SOPP) or
    - (3) Peroxyacetic Acid (PAA).
  - The fruit must be waxed.

# Federal Regulations governing citrus fruit movement



54431

**Rules and Regulations**

Federal Register
Vol. 74, No. 203
Thursday, October 22, 2009

This section of the FEDERAL REGISTER contains regulatory documents having general applicability and legal effect, most of which are keyed to and codified in the Code of Federal Regulations, which is published under 50 titles pursuant to 44 U.S.C. 1510.

The Code of Federal Regulations is sold by the Superintendent of Documents. Prices of new books are listed in the first FEDERAL REGISTER issue of each week.

DEPARTMENT OF AGRICULTURE

Animal and Plant Health Inspection Service

7 CFR Part 301

[Docket No. APHIS-2009-0023]

RIN 0579-AC96

Citrus Canker; Movement of Fruit From Quarantined Areas

AGENCY: Animal and Plant Health Inspection Service, USDA.

ACTION: Final rule.

SUMMARY: We are amending the citrus canker regulations to modify the conditions under which fruit may be

Background

Citrus canker is a plant disease caused by the bacterium *Xanthomonas citri* subsp. *citri* (referred to below as Xcc) that affects plants and plant parts, including fresh fruit, of citrus and citrus relatives (Family Rutaceae). Citrus canker can cause defoliation and other serious damage to the leaves and twigs of susceptible plants. It can also cause lesions on the fruit of infected plants, which render the fruit unmarketable, and cause infected fruit to drop from the trees before reaching maturity. The A (Asiatic) strain of citrus canker can infect susceptible plants rapidly and lead to extensive economic losses in commercial citrus-producing areas. Citrus canker is only known to be present in the United States in the State of Florida.

The regulations to prevent the interstate spread of citrus canker are contained in "Subpart–Citrus Canker" (7 CFR 301.75-1 through 301.75-14, referred to below as the regulations). The regulations restrict the interstate movement of regulated articles from and through areas quarantined because of citrus canker and provide, among other things, conditions under which

quarantined area to be treated with an approved disinfectant and to be packed in a commercial packinghouse that operates under a compliance agreement. We proposed these changes to relieve some restrictions on the interstate movement of fresh citrus fruit from quarantined areas while maintaining conditions that would prevent the artificial spread of citrus canker.

We solicited comments concerning our proposal for 60 days ending August 31, 2009. We received 34 comments by that date. They were from citrus producers, citrus packers, industry organizations, researchers, and representatives of State and foreign governments. Twenty-three commenters supported the proposed rule. Two of these commenters also directly addressed issues raised in the remaining comments, which are discussed below by topic.

*Selection of an Option for Mitigating the Risk Associated With the Interstate Movement of Regulated Fruit From a Quarantined Area*

In a final rule[2] effective and published in the **Federal Register** on November 19, 2007 (72 FR 65172-65204,

Code of Federal Regulations, CFR 301.75 Subpart-Citrus Canker;

Federal Domestic Quarantine Order, *Guignardia citricarpa,* Causal Agent of Citrus Black Spot (CBS), DA-2011-29; and

Federal Domestic Quarantine Order, *Elsinoë australis* Bitanc. & Jenkins, Causal Agent of Sweet Orange Scab (SOS), DA-2011-22.

# Regulatory requirements for interstate shipment of fruit
## ( Current )

- 2013 Interstate movement of all fruit permitted as long as the following added measures are included to previous list of requirements:
  - Added measures include a fungicide treatment at the time of packing:
    - As a result of sweet orange scab *Elsinoë australis*
      - fruit must be treated with label rates of one of the following fungicides: imazalil, thiabendazole or a combination of fludioxonil plus azoxystrobin
    - As a result of citrus black spot *Guignardia citricarpa*
      - fruit must be treated with label rates of imazalil and/or thiabendazole

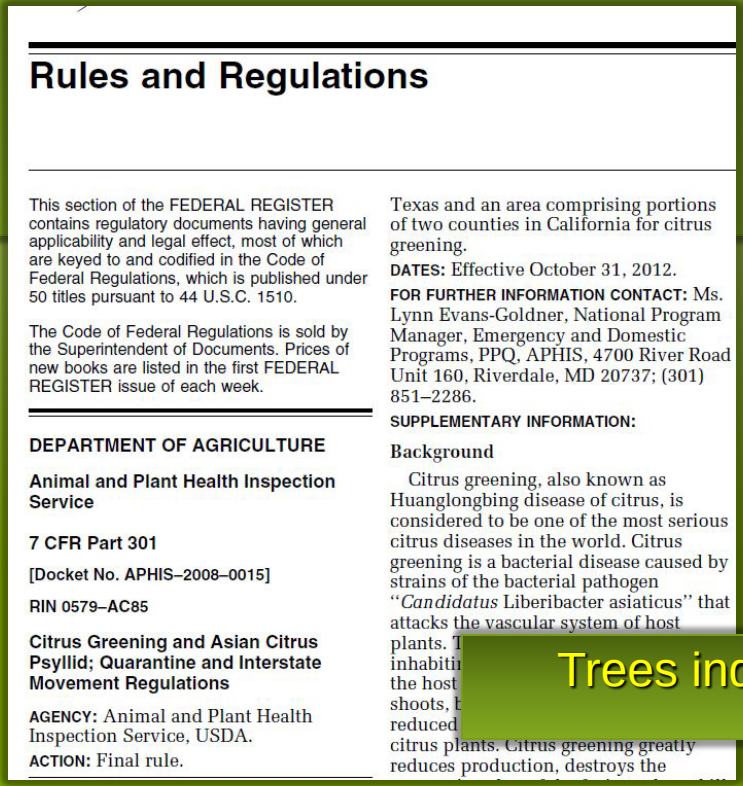
# Regulatory requirements for interstate shipment of fruit
## ( Current )

- The only pre-harvest field surveys and packinghouse inspections performed today are for European Union shipments.
  - Organic growers not using a fungicide treatment during the packing process and only PAA (Peroxyacetic Acid) require packinghouse inspections of fruit:
    - Fruit moves with a limited permit to noncommercial citrus-producing states
    - If fruit originates from outside a citrus black spot quarantine:

| | | |
|---|---|---|
| LIMITED PERMIT<br>USDA – APHIS – PPQ<br>NOT FOR DISTRIBUTION TO:<br>CA, HI, American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands | **Limited Permit**:<br>Distribution prohibited in California, Hawaii and the island territories. | Fruit that originates outside a Citrus Black Spot quarantine area, and was not treated with an approved fungicide and/or wax. Most often used with organic fruit. |

# Regulatory requirements for interstate shipment citrus nursery stock 2013

- Interstate movement of citrus nursery stock governed by Code of Federal Regulations CFR 301
  - 7 CFR 301 Citrus Greening and Asian Citrus Psyllid; Quarantine and Interstate Movement Regulations
  - Subpart—Citrus Canker (7 CFR 301.75–1 through 301.75–14)



## Rules and Regulations

This section of the FEDERAL REGISTER contains regulatory documents having general applicability and legal effect, most of which are keyed to and codified in the Code of Federal Regulations, which is published under 50 titles pursuant to 44 U.S.C. 1510.

The Code of Federal Regulations is sold by the Superintendent of Documents. Prices of new books are listed in the first FEDERAL REGISTER issue of each week.

DEPARTMENT OF AGRICULTURE

**Animal and Plant Health Inspection Service**

**7 CFR Part 301**

**[Docket No. APHIS–2008–0015]**

**RIN 0579–AC85**

**Citrus Greening and Asian Citrus Psyllid; Quarantine and Interstate Movement Regulations**

**AGENCY:** Animal and Plant Health Inspection Service, USDA.

**ACTION:** Final rule.

Texas and an area comprising portions of two counties in California for citrus greening.

**DATES:** Effective October 31, 2012.

**FOR FURTHER INFORMATION CONTACT:** Ms. Lynn Evans-Goldner, National Program Manager, Emergency and Domestic Programs, PPQ, APHIS, 4700 River Road Unit 160, Riverdale, MD 20737; (301) 851–2286.

**SUPPLEMENTARY INFORMATION:**

**Background**

Citrus greening, also known as Huanglongbing disease of citrus, is considered to be one of the most serious citrus diseases in the world. Citrus greening is a bacterial disease caused by strains of the bacterial pathogen "*Candidatus* Liberibacter asiaticus" that attacks the vascular system of host plants. T
inhabiti
the host
shoots, b
reduced
citrus plants. Citrus greening greatly reduces production, destroys the

Trees individually wrapped or boxed prior to shipping

# Regulatory requirements for interstate shipment citrus nursery stock 2013

## Citrus Nursery Clean Stock Program

Basic system monitoring includes:

- inspection;
- testing;
- surveillance;
- remediation; and
- checks on system integrity (quality assurance).



# Regulatory requirements for interstate shipment citrus nursery stock

2013

- All citrus nursery stock produced for interstate movement must originate from an APHIS-approved State certified clean stock program
- Citrus nursery stock must be grown in a APHIS-approved pest-exclusionary facility
- Facility must be inspected every 30-days for *citrus canker, citrus greening disease, and Asian citrus psyllid*

# Regulatory requirements for interstate shipment citrus nursery stock

APHIS-approved State certified clean stock program

DPI Division of Plant Industry

FLORIDA DEPARTMENT OF AGRICULTURE & CONSUMER SERVICES

**Citrus Nursery Stock Certification Manual**

Procedure Manual Revised 12/08

**The Citrus Budwood Technical Advisory Committee provides oversight to the Citrus Nursery Stock Certification Program.**

The policies in Rule 5B-62 govern citrus nursery regulations and the operation of the program. The purposes, methods and many of the procedures guiding the program are specified by this document.

# Regulatory requirements for interstate shipment citrus nursery stock 2013

- Any person engaged in growing, processing, handling, or moving citrus nursery stock in an area quarantined for citrus canker, Citrus greening disease, or Asian citrus psyllid must enter into a compliance agreement with APHIS if he or she wishes to move citrus nursery stock interstate.

- Citrus nursery stock may only be shipped interstate to all U.S. States if accompanied by a certificate verifying that all protocols are met outlined in the compliance agreement.
  - Due to Sweet Orange Scab quarantine, a Limited Permit is now required

| | | |
|---|---|---|
| LIMITED PERMIT<br>USDA – APHIS – PPQ<br>NOT FOR DISTRIBUTION TO:<br>AZ, CA, LA, HI, TX, American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands | **Limited Permit**:<br>Distribution prohibited in all citrus producing states and territories, excluding Florida. | This stamp is only used under the Citrus Nursery Stock program.<br>(Currently the citrus canker CFR only allows for interstate movement under a Federal Certificate or to direct export under seal: 301.75-7(b)) |

# Citrus Nursery Training to reduce the risk of introducing or spreading citrus canker within the exclusionary facility

- Disease identification (symptomology)
  - Early detection
- Decontamination procedures
- Preventive management practices


# Management Strategies for Control of Citrus Canker

3 things to consider where canker is already endemic:

- **Planting Windbreaks** slows wind-blown rain droplets
- **Copper sprays** can protect leaves and fruit
- **Leafminer control** can decrease the inoculum created from infected wounded tissue.

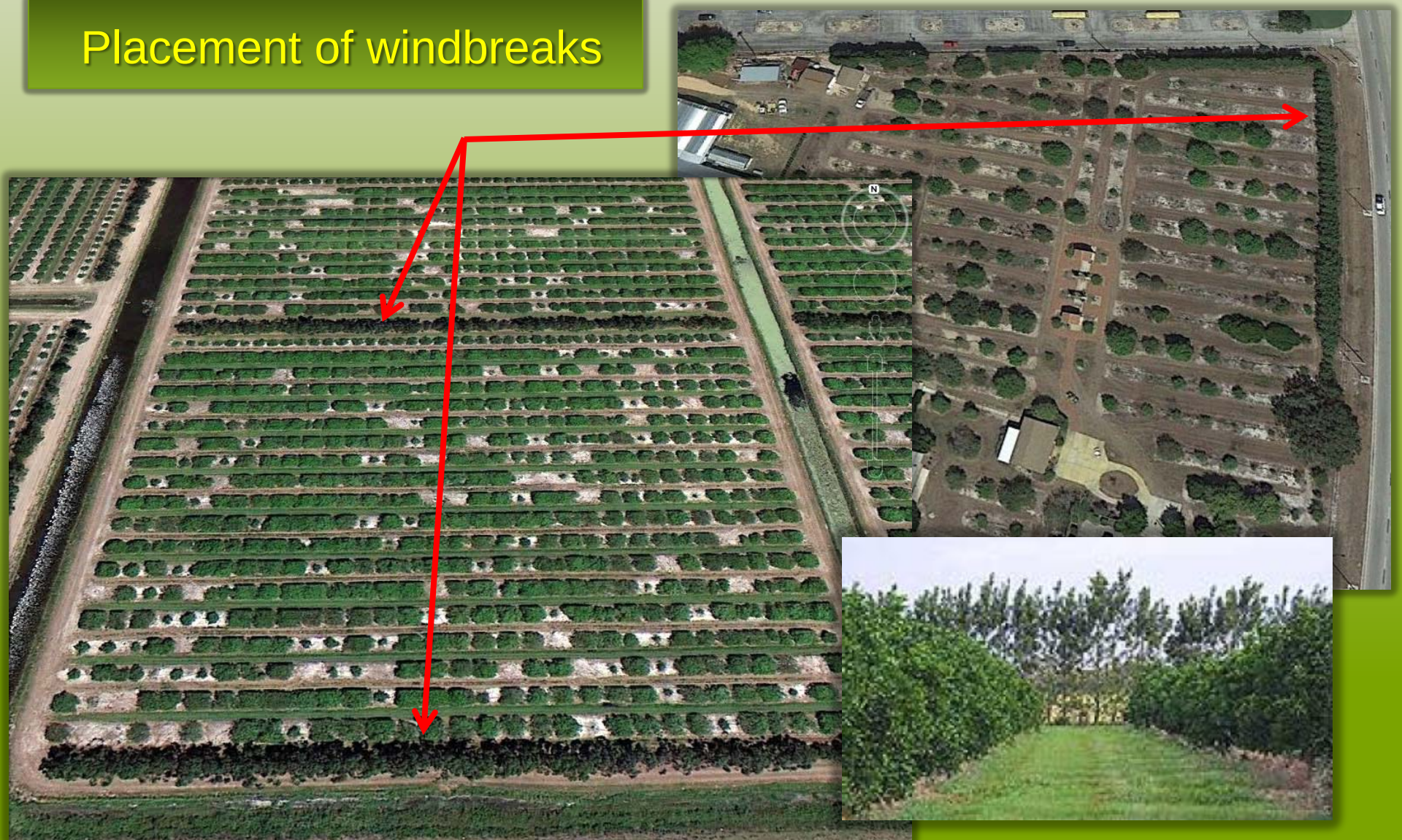
# Management Strategies for Control of Citrus Canker

## Wind breaks

- Highly effective in reducing spread and severity of infection
- Reduce wind speed for a distance of 5-10 times the height of the Windbreak

# Management Strategies for Control of Citrus Canker

Placement of windbreaks



# Management Strategies for Control of Citrus Canker

## Copper spray program

- Highly effective in reducing spread and severity of infection

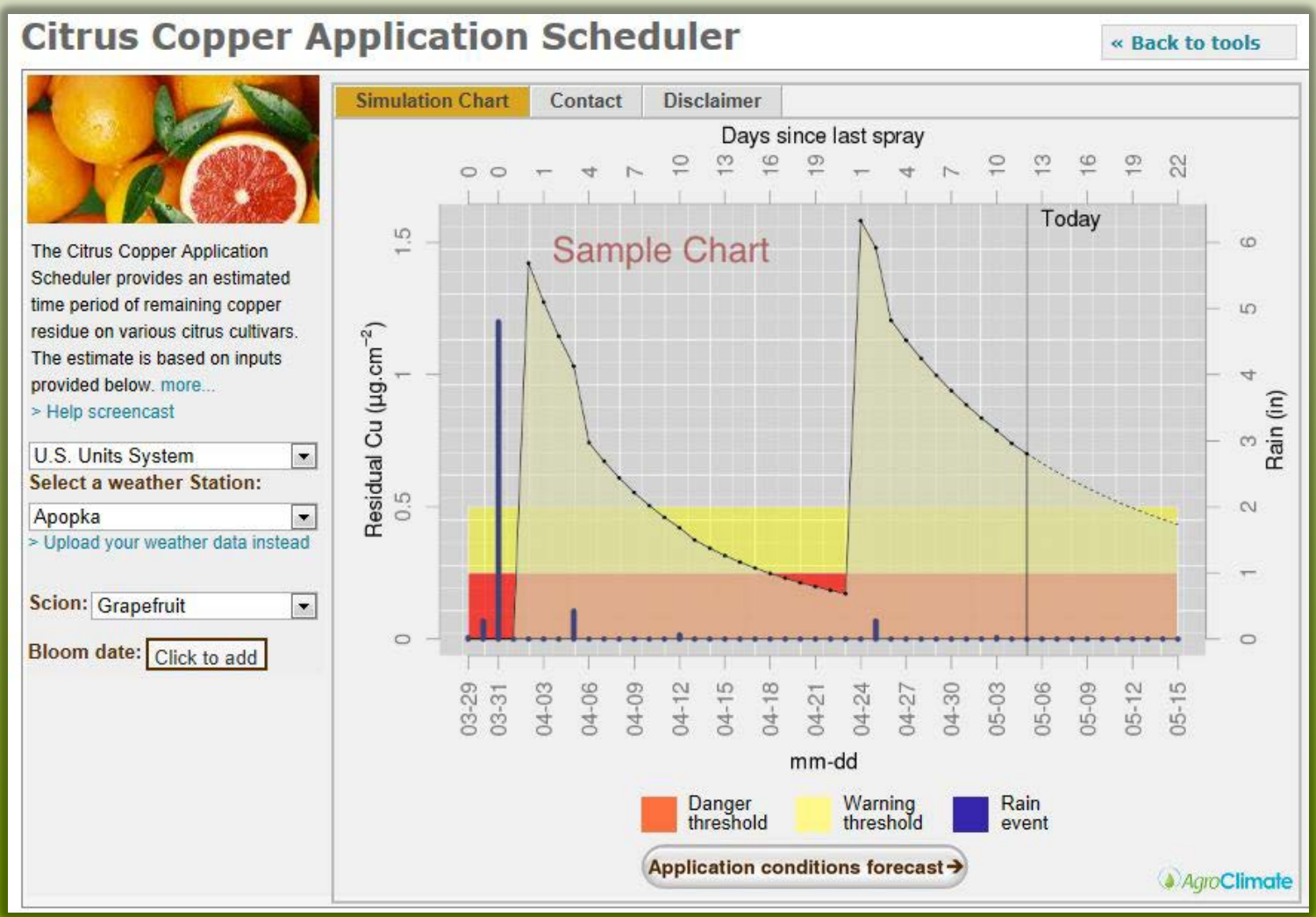
Copper hydroxide products:

- More effective in preventing fruit infection (slower cell expansion)
- Less effective on foliar infections (rapid expansion of leaf tissue)

# Management Strategies for Control of Citrus Canker

- Five copper sprays applied at 21-day intervals are recommended for early processing oranges
- Three applications at a 21-day interval should be sufficient for Valencia and midseason varieties
- Maintain a 21-day spray schedule for Grapefruit
  - Fruit susceptible from the 0.5 to 0.75 inch size to full expansion in late September to mid October. Mature fruit is no longer susceptible.

# Management Strategies for Control of Citrus Canker




EDIS PP289 *A Web-Based Tool for Timing Copper Applications in Florida Citrus* (http://edis.ifas.ufl.edu/pp289)

# Management Strategies for Control of Citrus Canker

## Leafminer control

- Leafminer control on the first summer flush can reduce disease pressure

Lesions associated with Leafminer wounds represent an important source of inoculum

# Economic Impact 1995-2007

Citrus Canker Eradication Program Statistics:
1995 -2007

Total trees destroyed (final as of October, 2007):

| | | |
|---|---|---|
| Commercial | 11,323,298 | (87,493 acres) |
| Nursery | 4,334,154 | |
| Residential | 865,779 | |
| Total | 16,523,176 trees | |

Over $1.3 billion in taxpayer dollars to combat the disease


# Economic Impact

- Quarantine of State has negatively affected markets
- Added fruit production costs
  - Tree removal when warranted
  - Copper sprays
  - Windbreaks
- Higher fruit packing costs
  - Additional fungicide treatment

Today it is difficult to separate the costs due to the presence of citrus greening disease, citrus black spot, and sweet orange scab their associated quarantines including regulatory actions.

# Conclusion

## 2007 – 2013

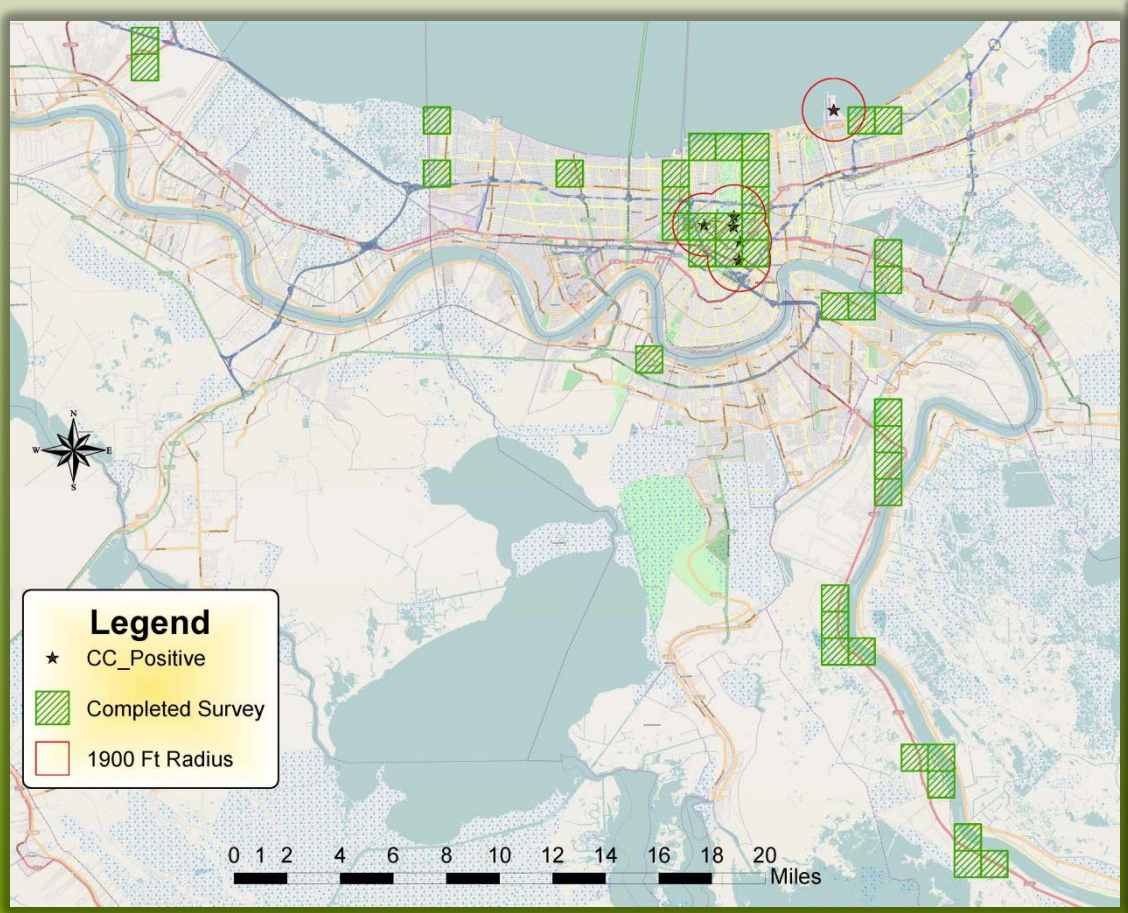
- Since the end of the eradication program, science based regulatory decisions have been made which have opened markets for the movement of citrus fruit and nursery stock

## Lessons learned in Florida

The importance of an early detection strategy for citrus canker

- And if detected, the importance of an aggressive eradication effort – before it becomes a major outbreak

# Citrus canker detection update in the state of Louisiana, USA
# First detection on June 10, 2013 in Orleans Parish




- Confirmed positive trees (residential):
  - Orleans Parish 77
    - 9 removed
  - Jefferson Parish 117
    - 4 removed
  - St Charles Parish 2
- Surveys continue in:
  - Plaquemines,
  - St. Bernard,
  - St. John the Baptist,
  - St. Charles
  - Lafourche
  - St Tammy
  - Terrebonne

**As of 8-9-2013**

United States Department of Agriculture


# Thank You


## Acknowledgements:

Hilda Gomez and Dan Robl
plant pathologist s USDA APHIS PPQ

Claire Franklin – maps