NPRG
Citrus Greening Disease

Floyd, J. and C. Krass, 2006
Stefano Costanzo, CIPM-NCSU Raleigh, NC 2011

Introduction

- Citrus greening (HLB)
  - major disease for citrus and nursery industries
    - Spread by insect vectors and grafting
    - Present in Florida since 2005 (grows 71% of U.S. citrus-$9.3 billion citrus industry)
  - increasing threat for California's citrus production
    - California grows 27%
  - concern to maintain access to export markets

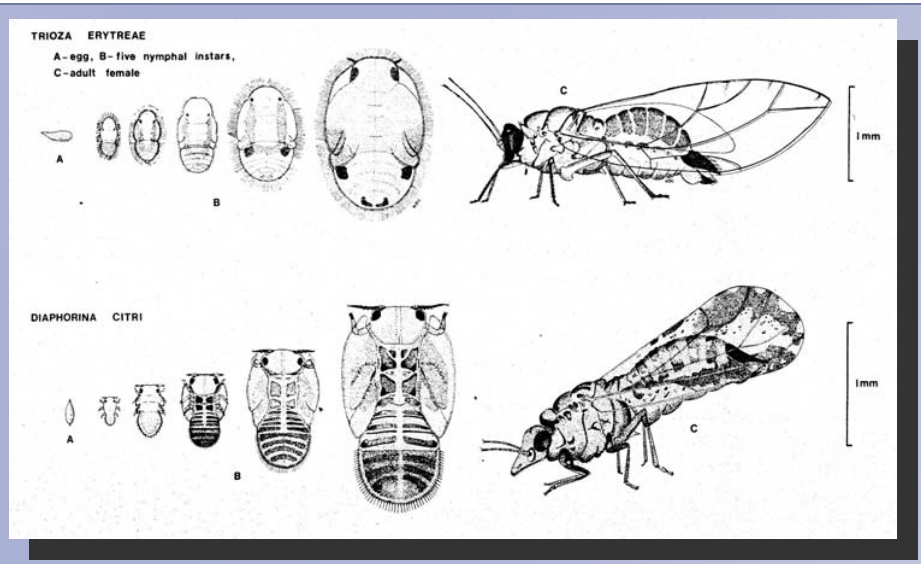
Pathogens associated with Citrus Greening Disease

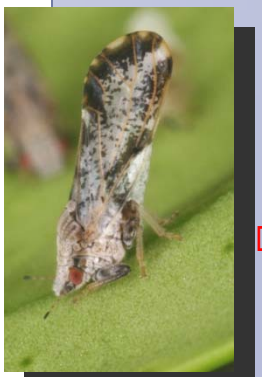
- Class: α-Proteobacteria
- Order: Rhizobiales
- Family: Rhizobiaceae
  - 3 species associated with HLB:
    - '*Candidatus* Liberibacter africanus' (Laf)
    - '*Candidatus* Liberibacter americanus' (Lam)
    - '*Candidatus* Liberibacter asiaticus' (Las)

- Common name:
  - Citrus Huanglongbing (HLB; yellow shoot disease)

Insect vectors of HLB

- Class: Insecta
- Order: Hemiptera
- Family: Psyllidae





- *Diaphorina citri*

Asian citrus psyllid (ACP)

- *Trioza erytreae*

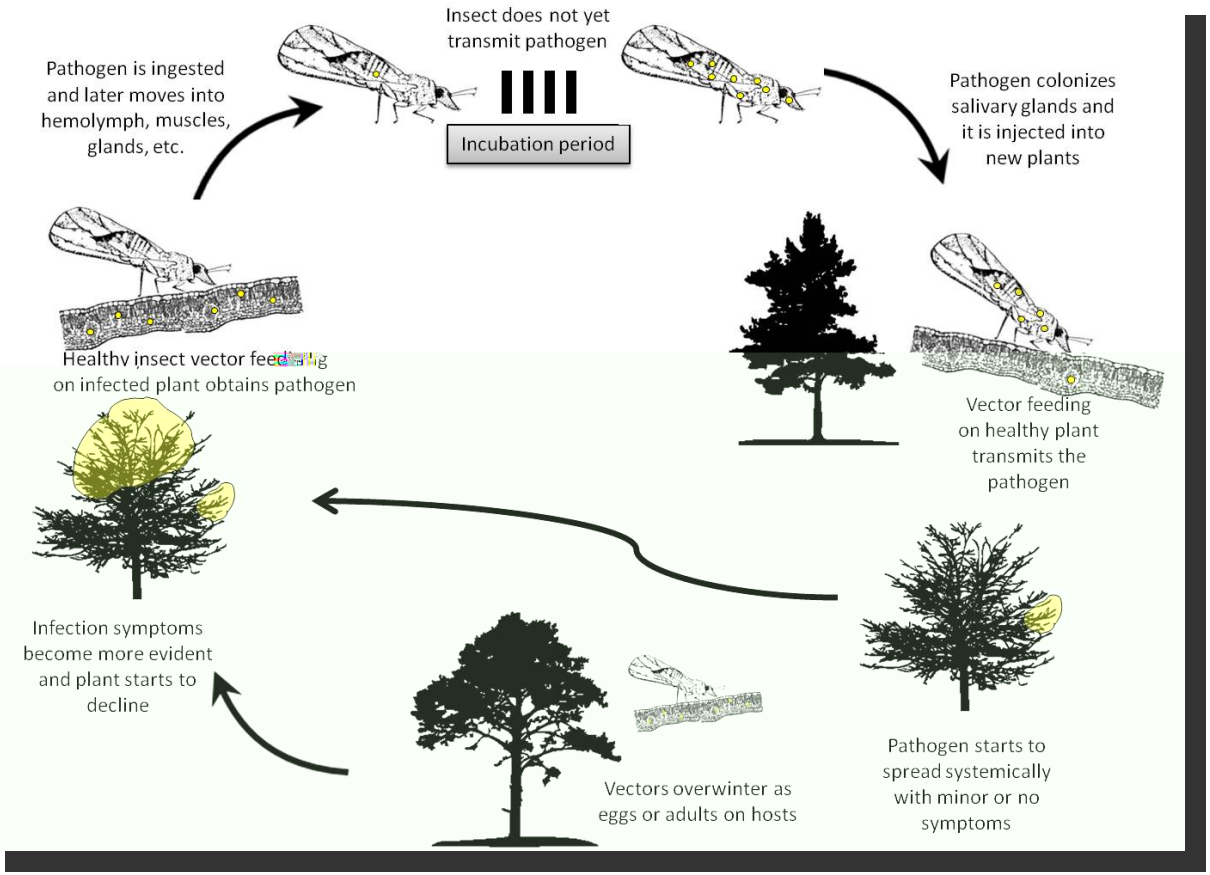
African citrus psyllid (AFP)

Asian citrus psyllid
Diaphorina citri Kuwayama

- http://edis.ifas.ufl.edu/hs383 Cooperative Extension Service, University of Florida

African citrus psyllid
Trioza erytreae (del Guercio)

Disease Cycle



Hosts

Rutaceous plant species

Citrus spp.

Murraya spp.

Murraya paniculata (Orange jasmine)

Severinia buxifolia (Orange boxwood)

Bergera spp.

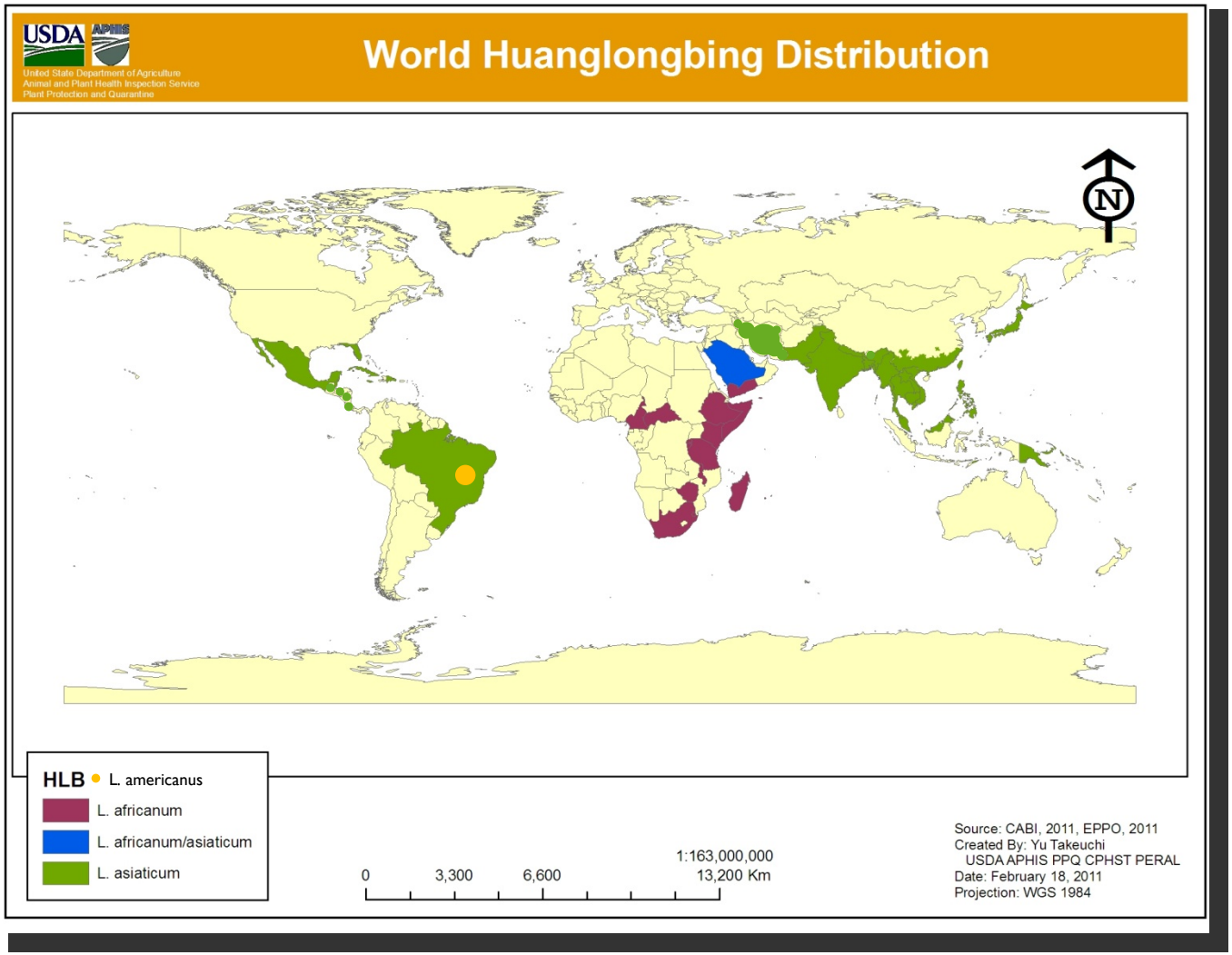
Citrus plants infected with CG

- Shoot color yellow
- Leaves with characteristic blotchy mottling
- Normally green tissue turns yellow (chlorosis)
- Total foliage reduced
- Leaf tips dieback

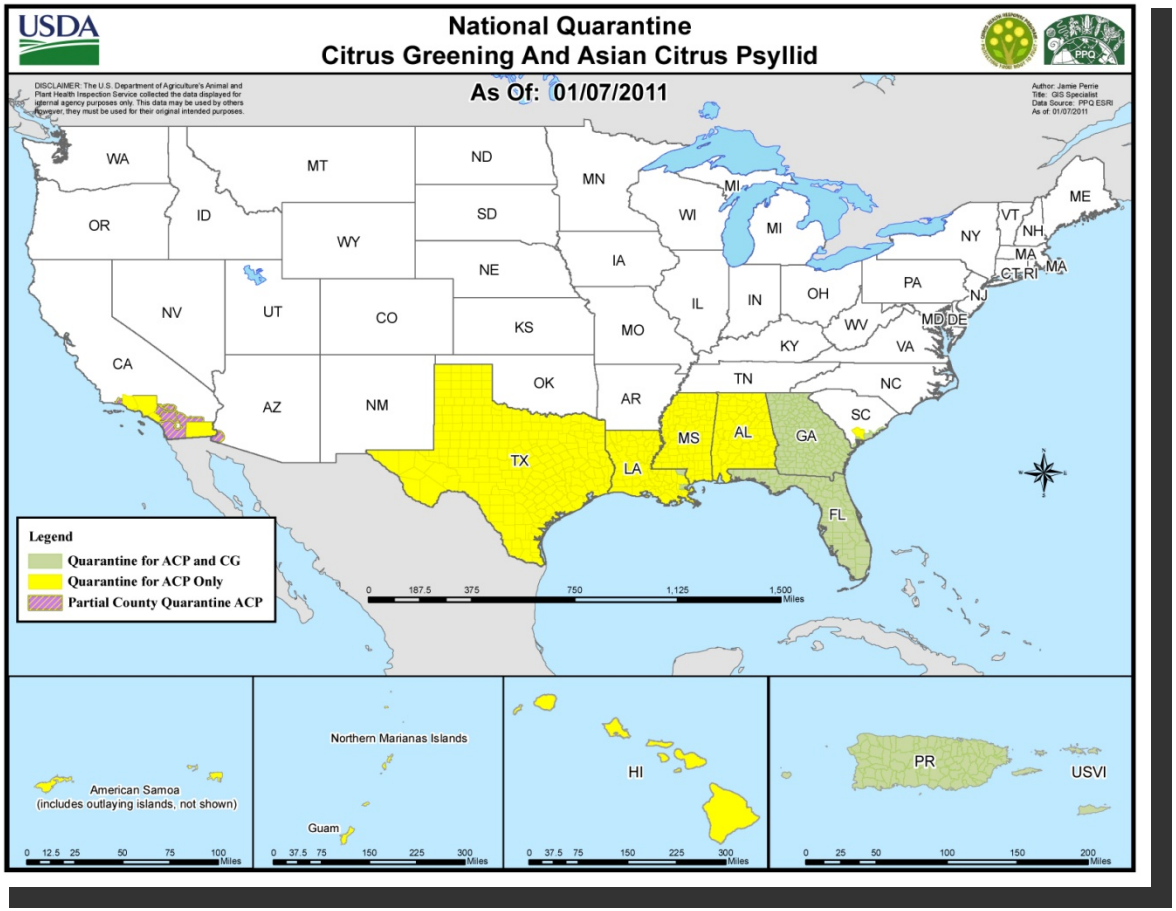
Citrus fruits infected with CG

- Shape lopsided
- Size small
- Color remaining green with seeds aborted
- Taste sour
- Excessive and premature fruit drop

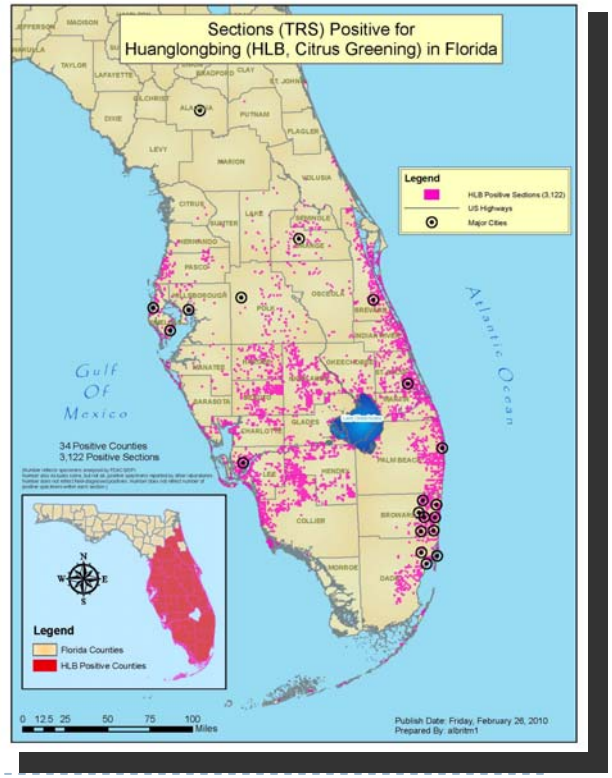
‘*Ca.* L.’ spp. World Distribution



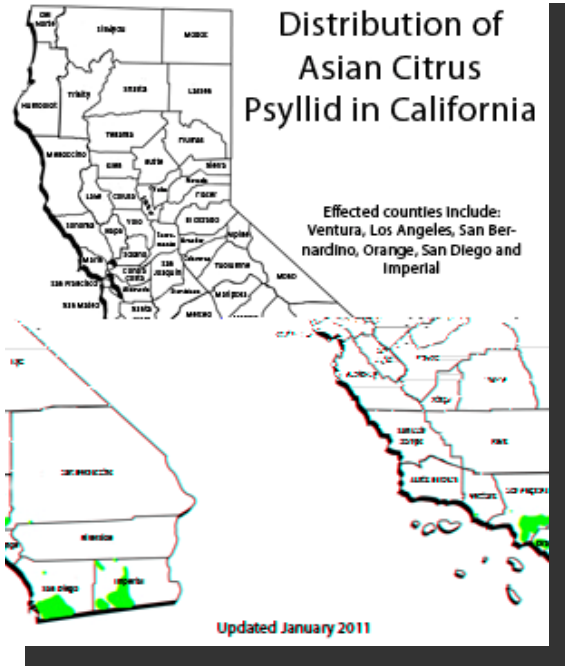
U.S. distribution of CG

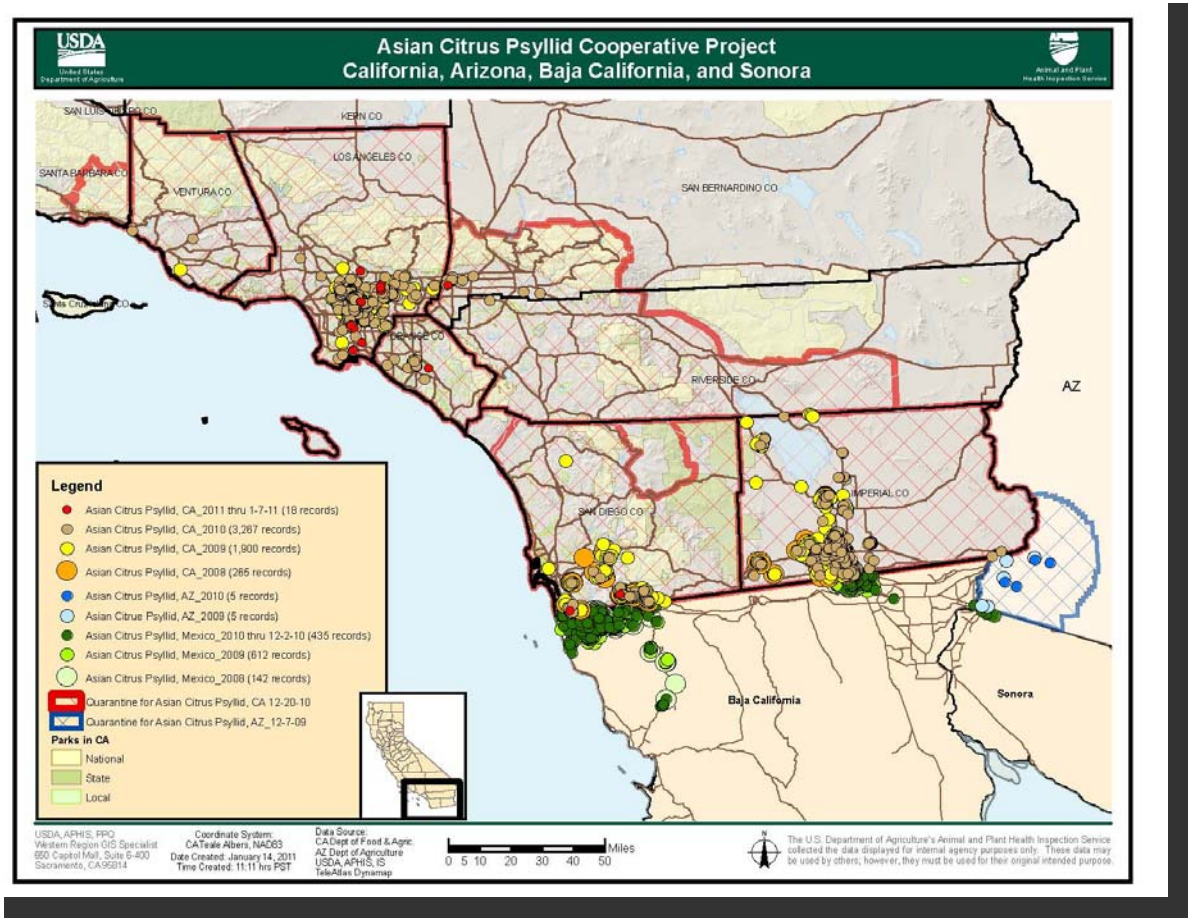


2005 south Miami-Dade County, Florida
2008 Louisiana
2009 South Carolina



ACP in California





Control

- reduction of the Asian citrus psyllid populations
- visual identification and prompt removal of infected trees
- production of propagation material in insect-proof facilities

- CG disease:
  - Remove and destroy infected trees
  - Quarantine program

- Psillid vectors:
  - Chemical and biological control
    - *Tamarixia dryi* (from South Africa) -» ACP
    - *Tamarixia radiata* (from India) -» AFP
    - [*Diaphorencyrtus aligarhensis*]
      - *Olla v-nigrum* (Ashy Gray Lady Beetle)
      - *Harmonia axyridis* (Multicolored Asian Lady Beetle)
      - Isaria fumosorosea (Sordariomycetes: Hypocreales)
  - Removal of preferred alternative hosts
    - *Murraya paniculata* (orange jasmine)

Research needs

- Breeding/ Engineering *citrus* spp. for HLB resistance
  - Clementine Mandarin Genome
  - Sweet Orange Genome

- Pathogen detection and control measures
  - '*Candidatus* Liberibacter asiaticus' str. Psy62 (complete; 1.23 Mb)
  - '*Candidatus* Liberibacter americanus' (close to completion)

- Vector control measures
  - Asian citrus psyllid Genome (Psyllid Genome Consortium)

  ~ 20,000ESTs

Recent Updates & Conclusions

- New hosts:
  - Fabaceae, *Archidendron Pithecellobium lucidum* (China)
- Pesticide resistance
- Nutritional Programs
- New detection techniques
- Control strategies (RNAi; Phages)

- NPRG should be updated regularly:
  - Host plants
  - Advances in detection techniques for pathogen
  - Distribution of pathogens and vectors
  - Surveillance methodology
  - Improvements in control methods

Thank you!