



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

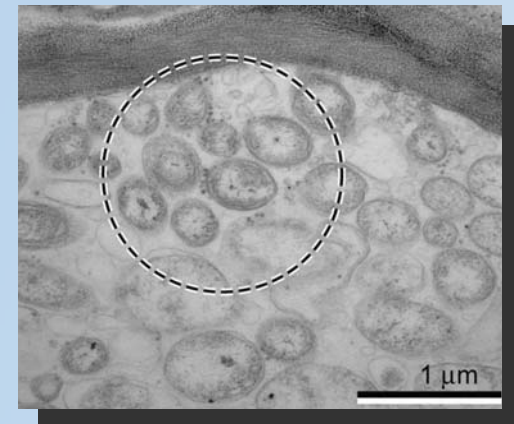


Pathogens associated with Citrus Greening Disease

- ▶ **Class:** α -Proteobacteria
- ▶ **Order:** Rhizobiales
- ▶ **Family:** Rhizobiaceae

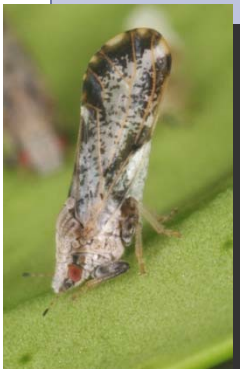
- ▶ 3 species associated with HLB:
 - ▶ ‘*Candidatus Liberibacter africanus*’ (Laf)
 - ▶ ‘*Candidatus Liberibacter americanus*’ (Lam)
 - ▶ ‘*Candidatus Liberibacter asiaticus*’ (Las)

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



Insect vectors of HLB

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

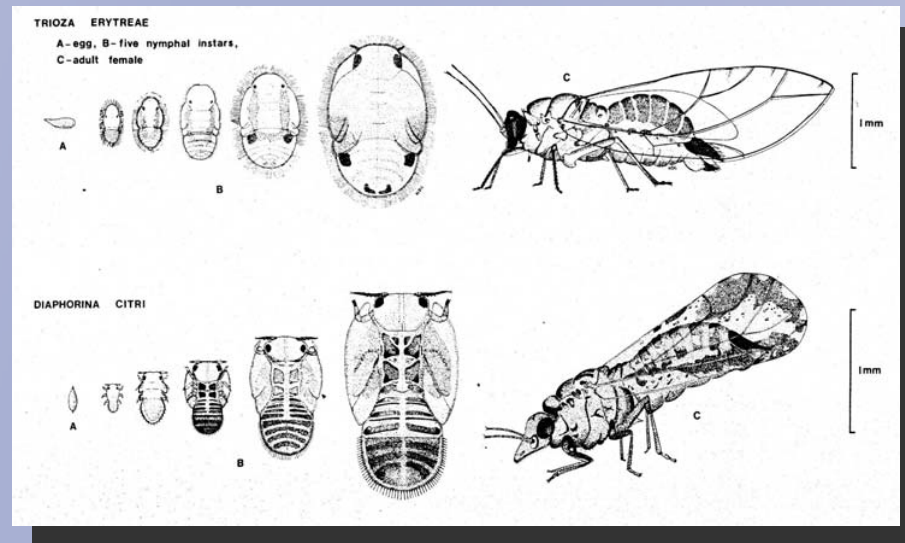


□ *Diaphorina citri*

Asian citrus psyllid (ACP)

□ *Trioza erytreae*

African citrus psyllid (AFP)



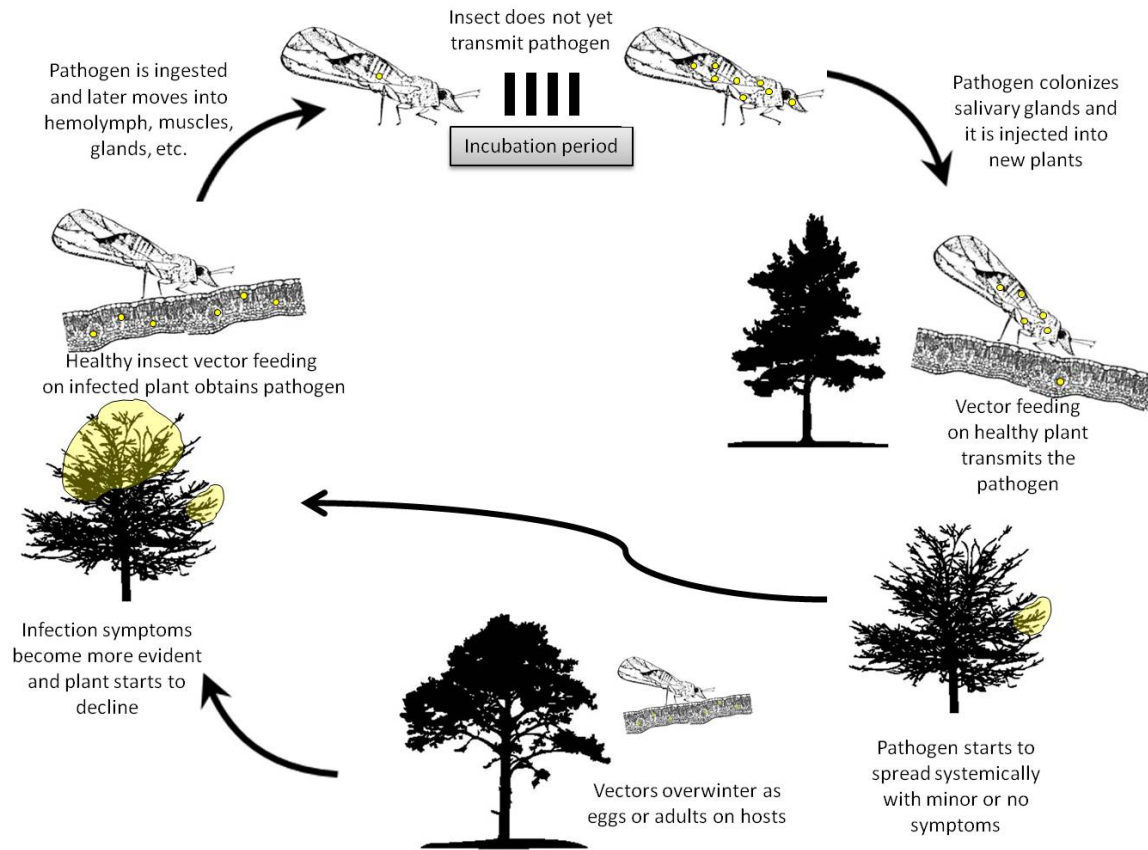
Asian citrus psyllid *Diaphorina citri* Kuwayama



African citrus psyllid *Trioza erytreae* (del Guercio)



Disease Cycle



Hosts

Rutaceous plant species

Citrus spp.

Murraya spp.

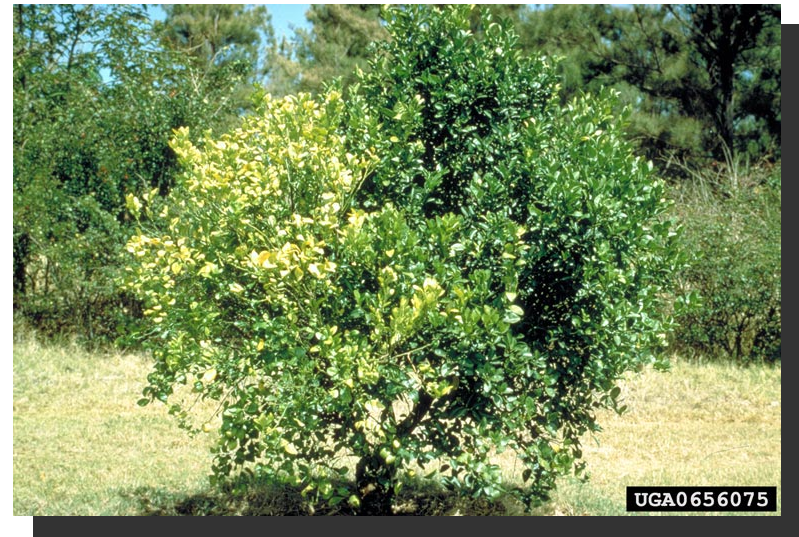
Murraya paniculata (Orange jasmine)

Severinia buxifolia (Orange boxwood)

Berberis 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

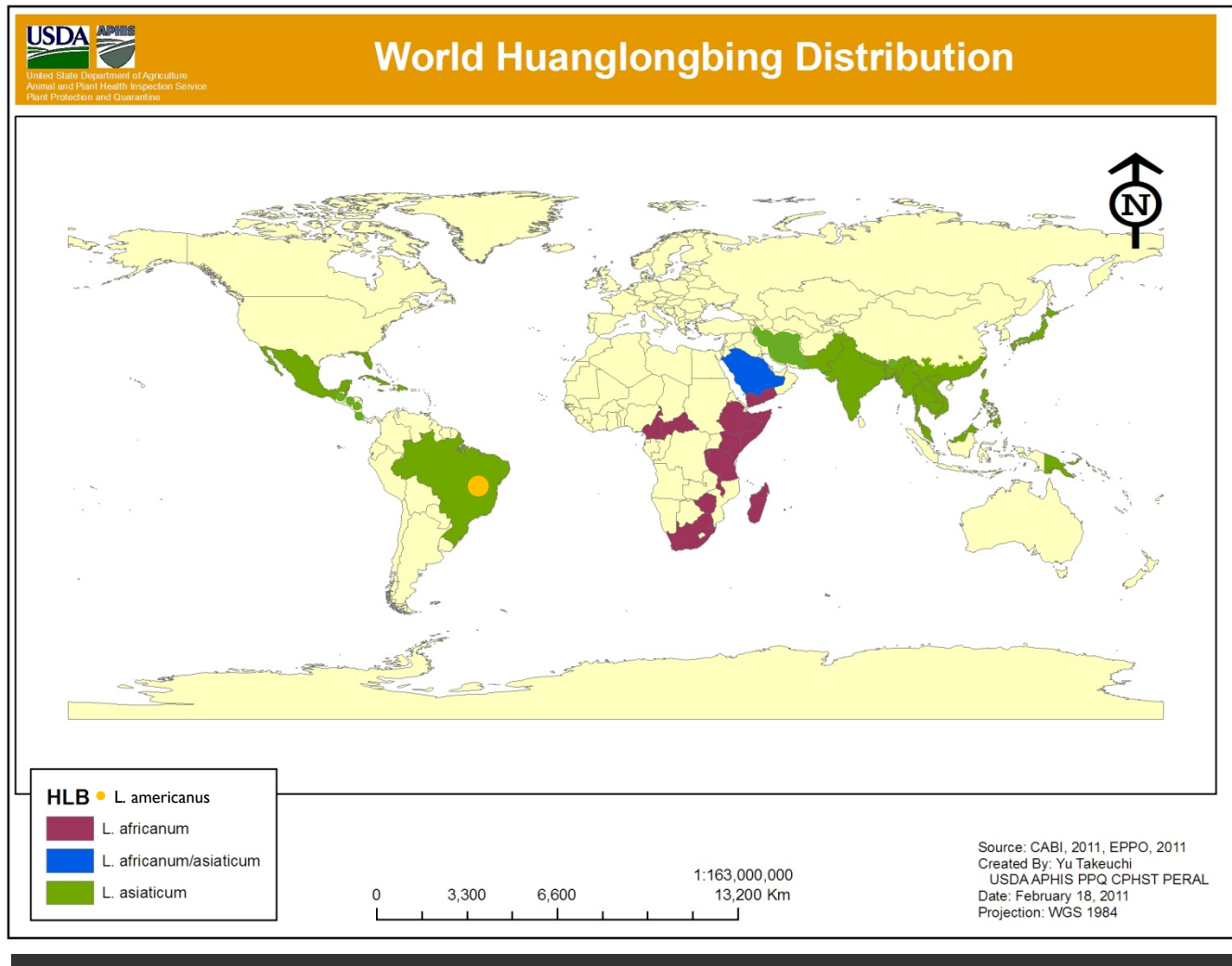
Citrus fruits infected with CG



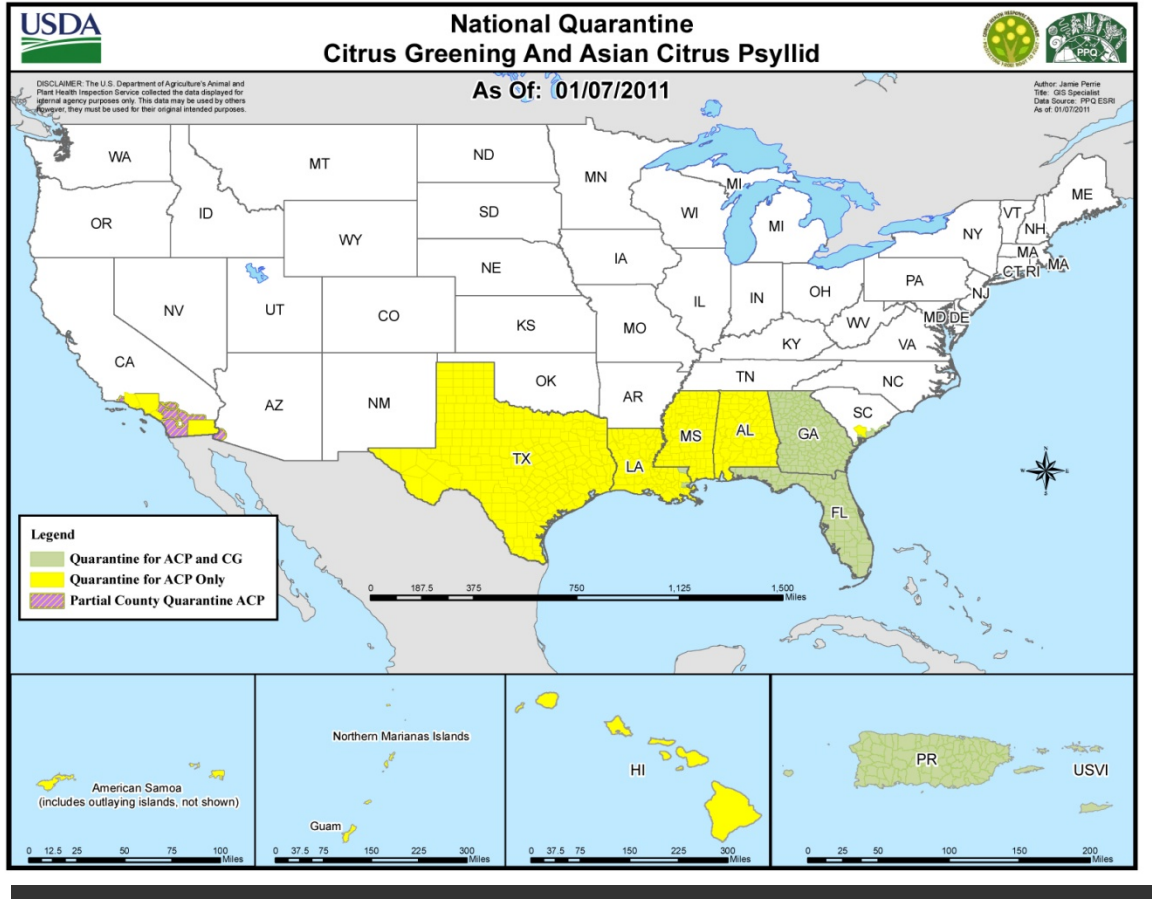
- Shape lopsided
- Size small
- Color remaining green with seeds aborted
- Taste sour
- Excessive and premature fruit drop



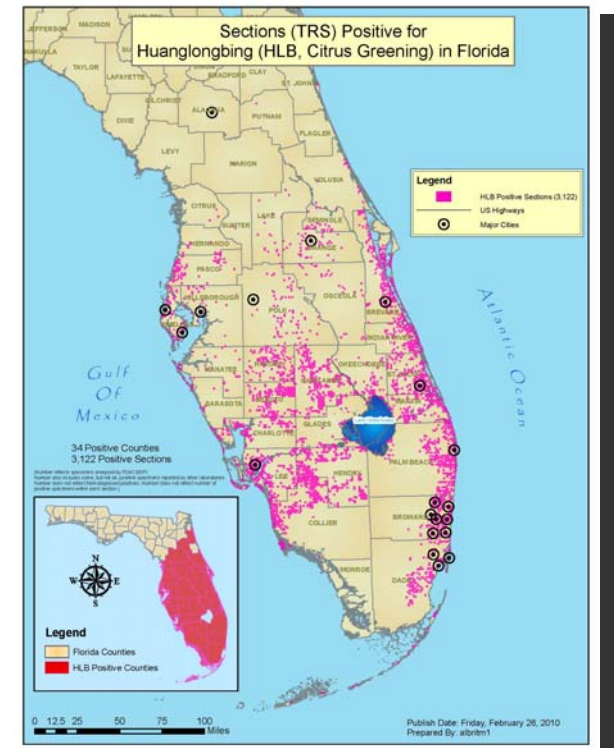
'Ca. L.' spp. World Distribution



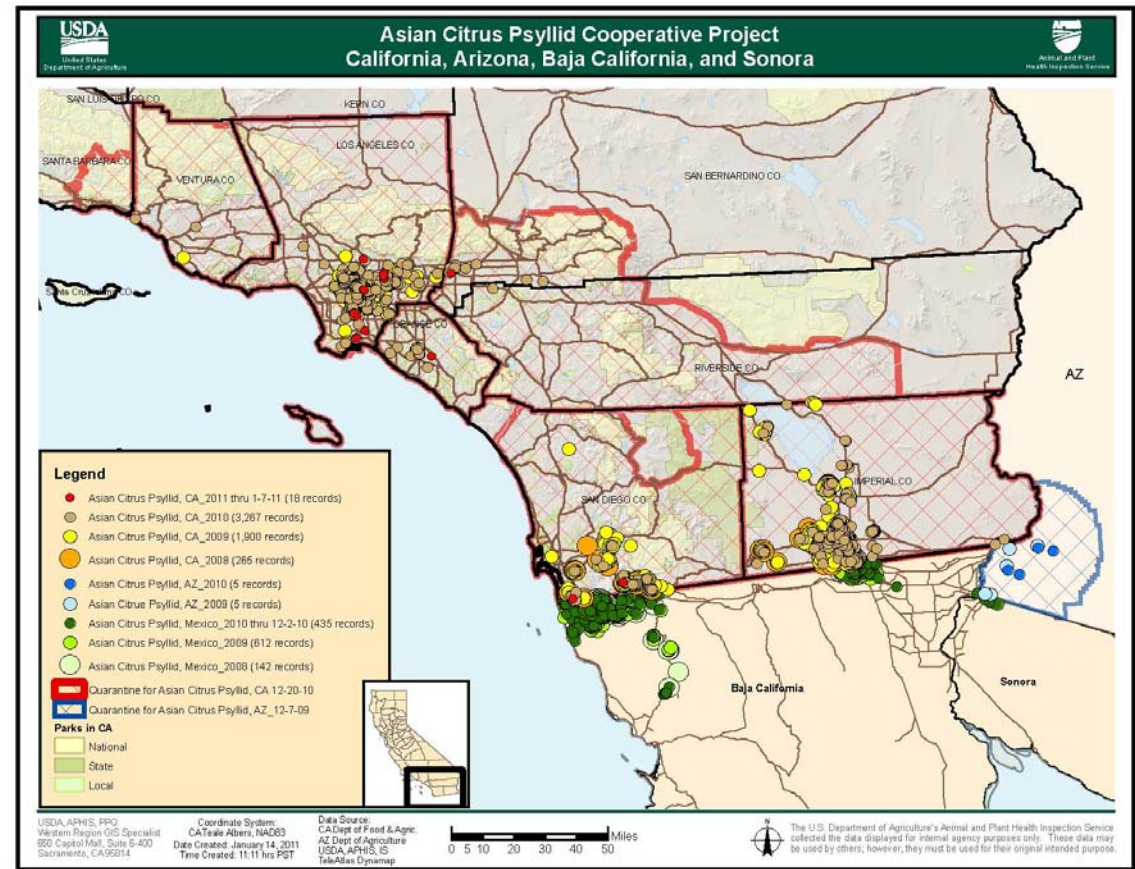
U.S. distribution of CG



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

▶ Psyllid 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!