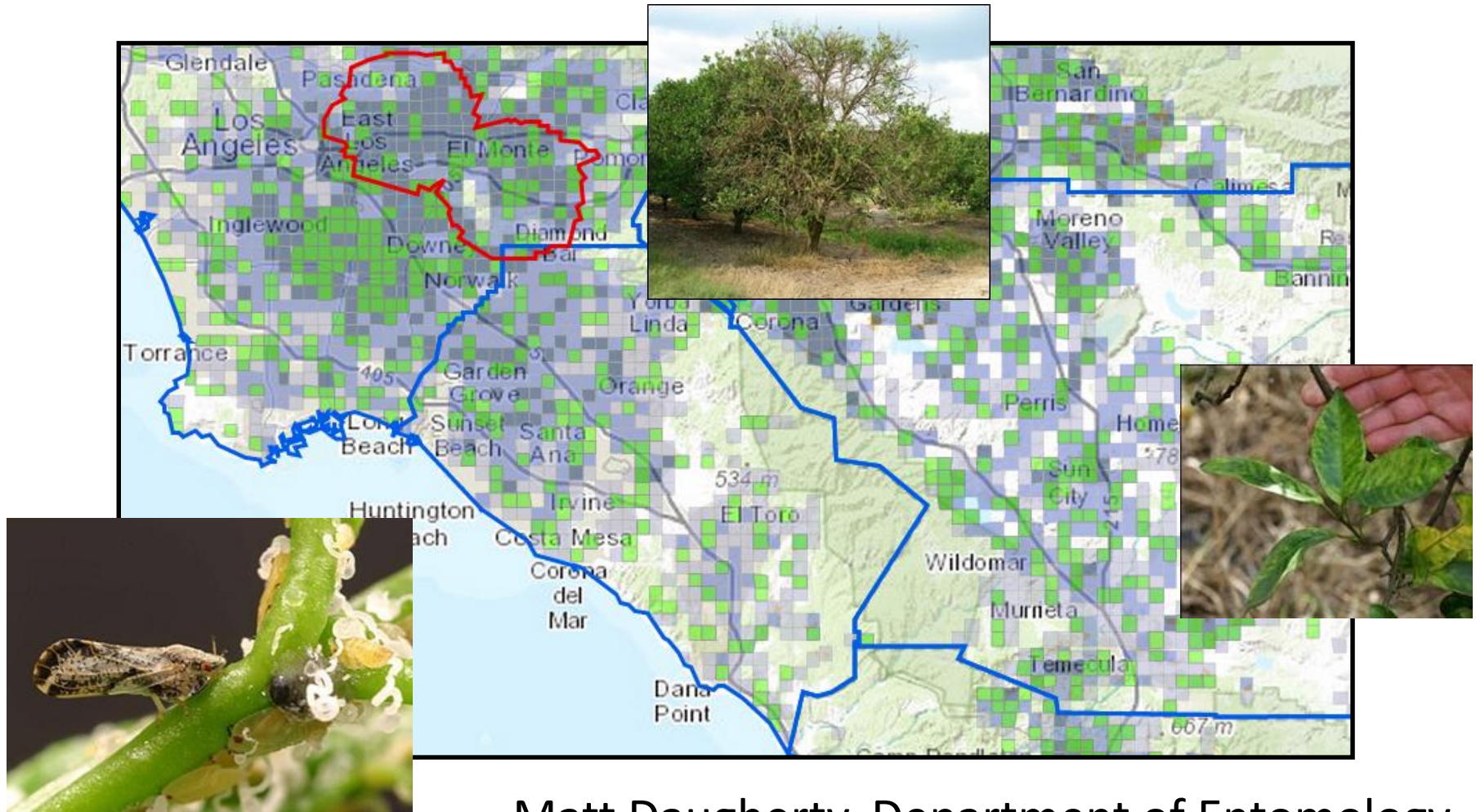


Minimizing the potential for nurseries to contribute to Asian citrus psyllid spread in California



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With support from

Citrus Research Board

California Department of

Food & Agriculture

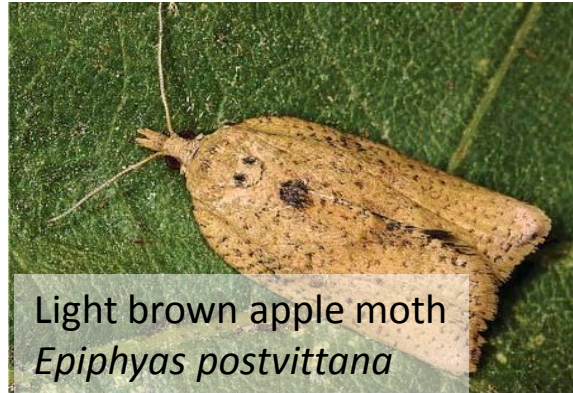
Recent invasive insects in California



Brown Marmorated Stink Bug
Halyomorpha halys



Olive fruit fly
Bactrocera oleae



Light brown apple moth
Epiphyas postvittana



Polyphagous shot hole borer
Euwallacea sp.



Red Palm Weevil
Rhynchophorus ferrugineus

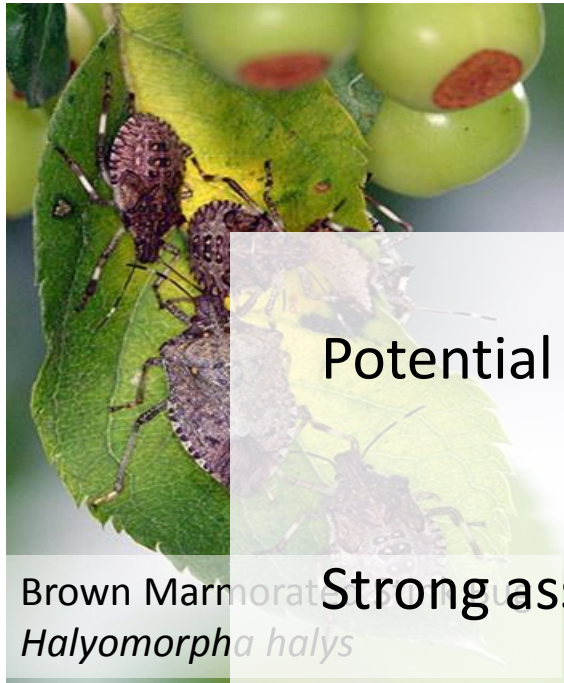


Glassy-winged sharpshooter
Homalodisca vitripennis

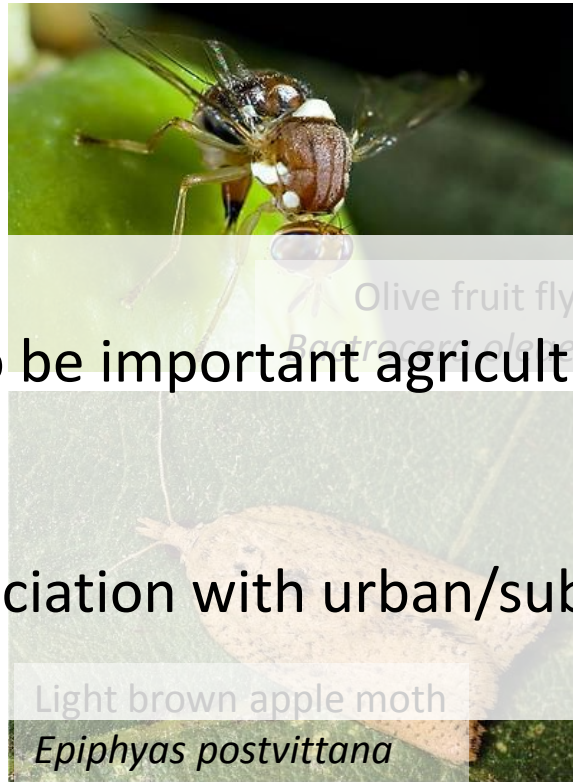


Bagrada bug
Bagrada hilaris

Recent invasive insects in California



Brown Marmorated Stink Bug
Halyomorpha halys



Light brown apple moth
Epiphyas postvittana



Polyphagous shot hole borer
Euwallacea sp.

Potential to be important agricultural pests

Strong association with urban/suburban areas



Red Palm Weevil
Rhynchophorus ferrugineus



Glassy-winged sharpshooter
Homalodisca vitripennis



Bagrada bug
Bagrada hilaris

Recent invasive insects in California



“Urban invaders” threaten garden and landscape flora

Also put nearby Ag areas at risk in the event of spillover

-lots of Urban-Ag interface in CA

Manage urban infestations to curb spillover

Limit human-assisted spread



Asian citrus psyllid (*Diaphorina citri*)

Native to Southern, Southeast Asia

Highly invasive in the Americas

-FL, TX, CA

Capable of rapid population growth

-hundreds of eggs per female

-multiple generations per year

Population dynamics strongly tied to flushing cycles in host plants



- *Citrus* (limes, lemons, oranges, grapefruit, mandarins...)
- *Fortunella* (kumquats)
- *Citropsis* (cherry orange)
- *Murraya paniculata* (orange jessamine)
- *Bergera koenigii* (Indian curry leaf)
- *Severinia buxifolia* (Chinese box orange)
- *Triphasia trifolia* (limeberry)
- *Clausena indica* (wampeï)
- *Microcitrus papuana* (desert-lime)
- Others.....



Calamondin



Murraya



High densities of ACP nymphs can damage young shoots, causing stunting of plants

-inject salivary toxin to help with ingestion

Huanglongbing (Citrus greening disease)

Associated with infection by group of pathogenic bacteria (*Candidatus Liberibacter* spp.)

Bacteria can be transmitted by ACP after feeding on infected trees

Nymphs are especially efficient at acquiring the pathogen



Earliest symptoms include blotchy, irregular yellowing of leaves

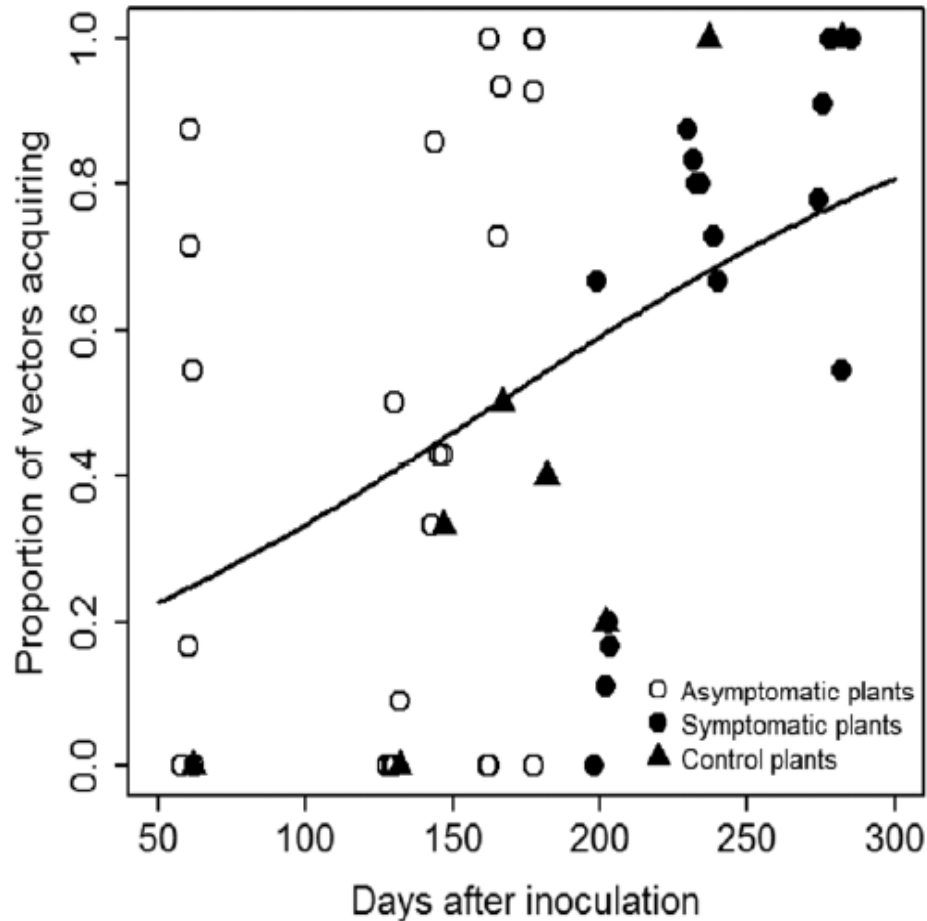
Fruit don't develop properly; small, deformed, poor flavor

Lack of tree vigor, stunting; excessive fruit drop

Tree mortality in as little as 5 years



HLB epidemiology makes it difficult to manage



HLB latent period < incubation period

>6 months for symptoms

<2 months for acquisition

Lots of pathogen spread during asymptomatic phase

-undermines roguing

-earlier detection needed

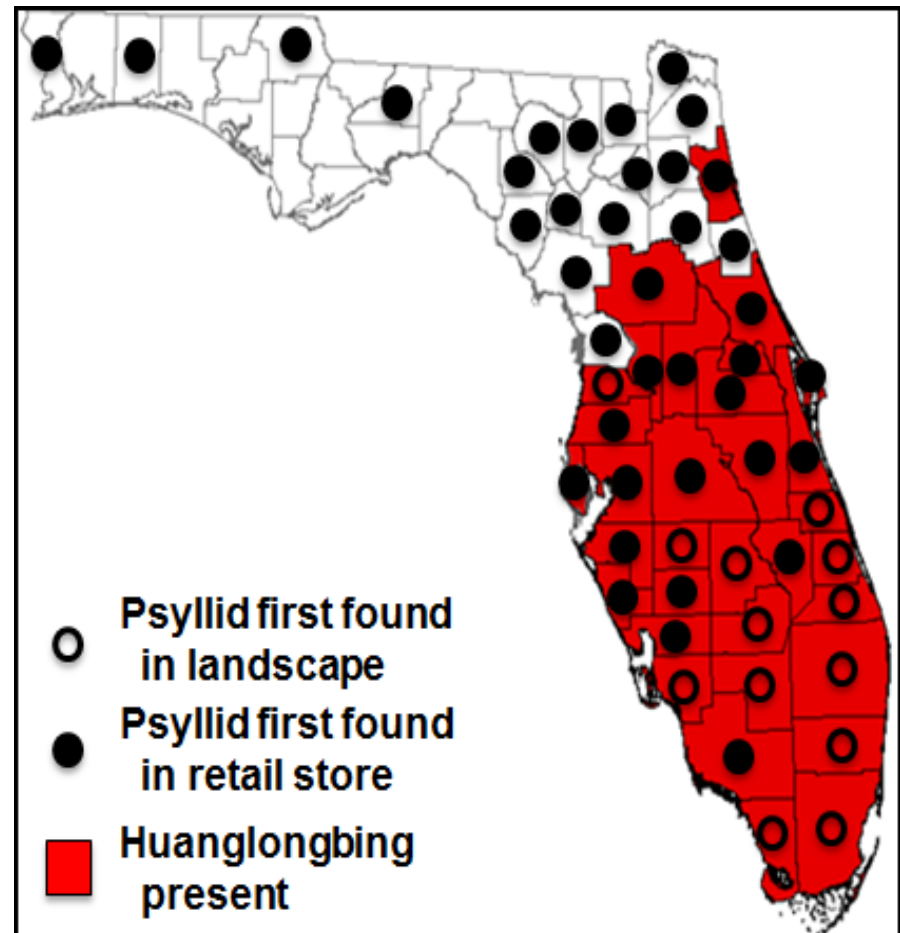
ACP and HLB in Florida: How bad it can get

The psyllid was first detected in 1998, after which it spread rapidly throughout the state.

-assisted by nursery shipments of infested ornamentals

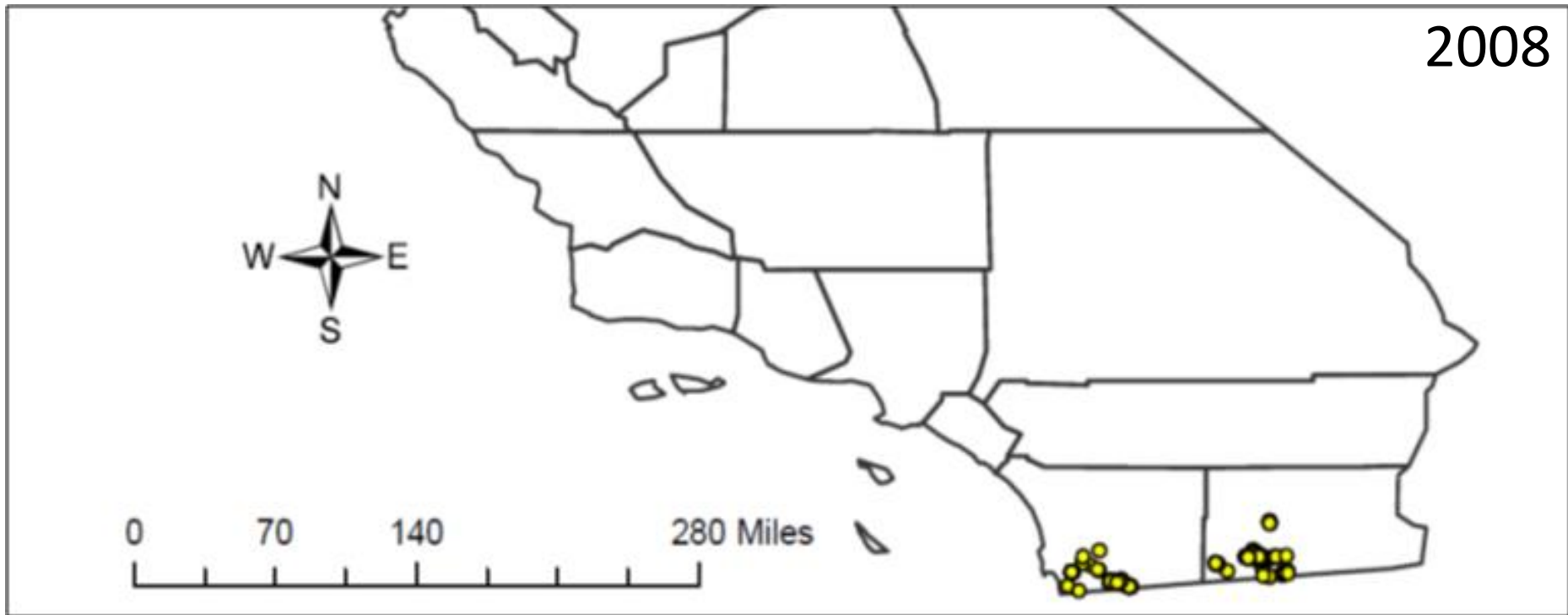
Within 3 years the disease spread to most citrus growing regions in FL

-citrus production has been reduced by >50% due to canker & HLB



The situation in California

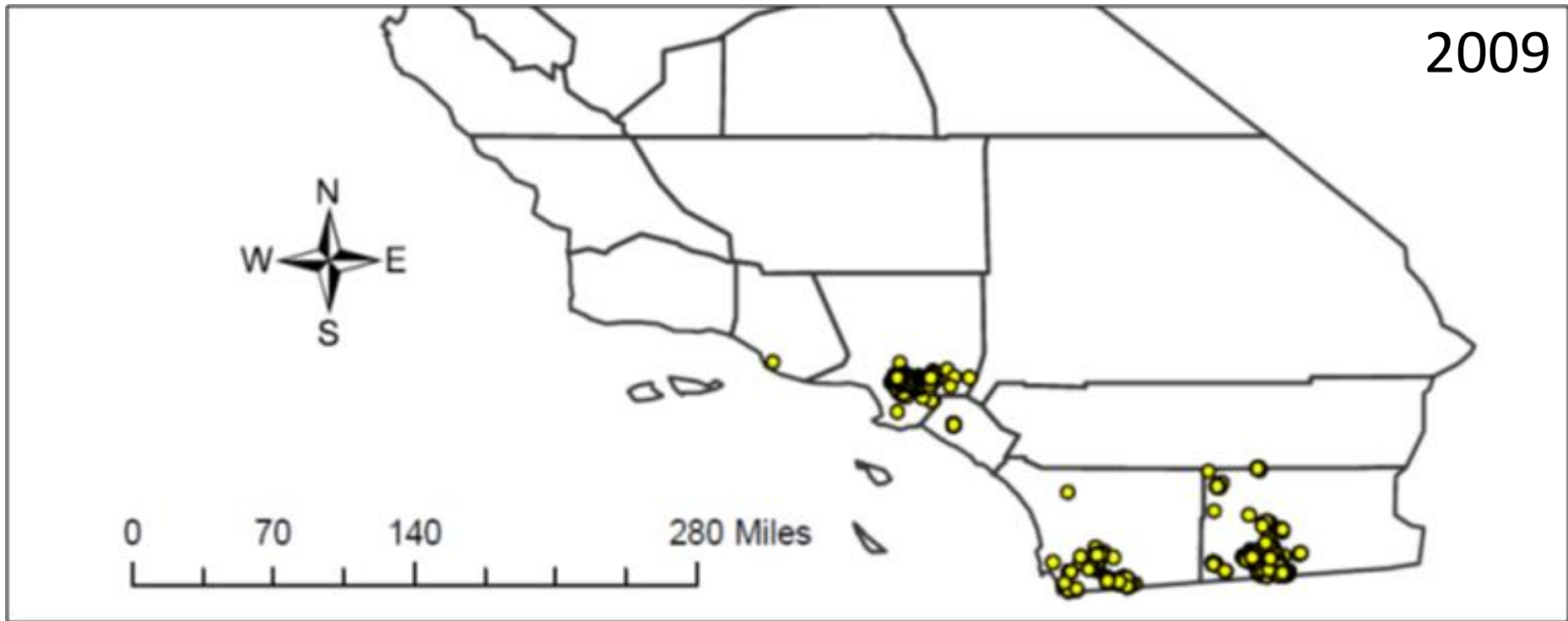
ACP was found in San Diego in 2008. It has since spread throughout urban/suburban Southern California



First found in residential citrus in San Diego; Imperial shortly afterward

The situation in California

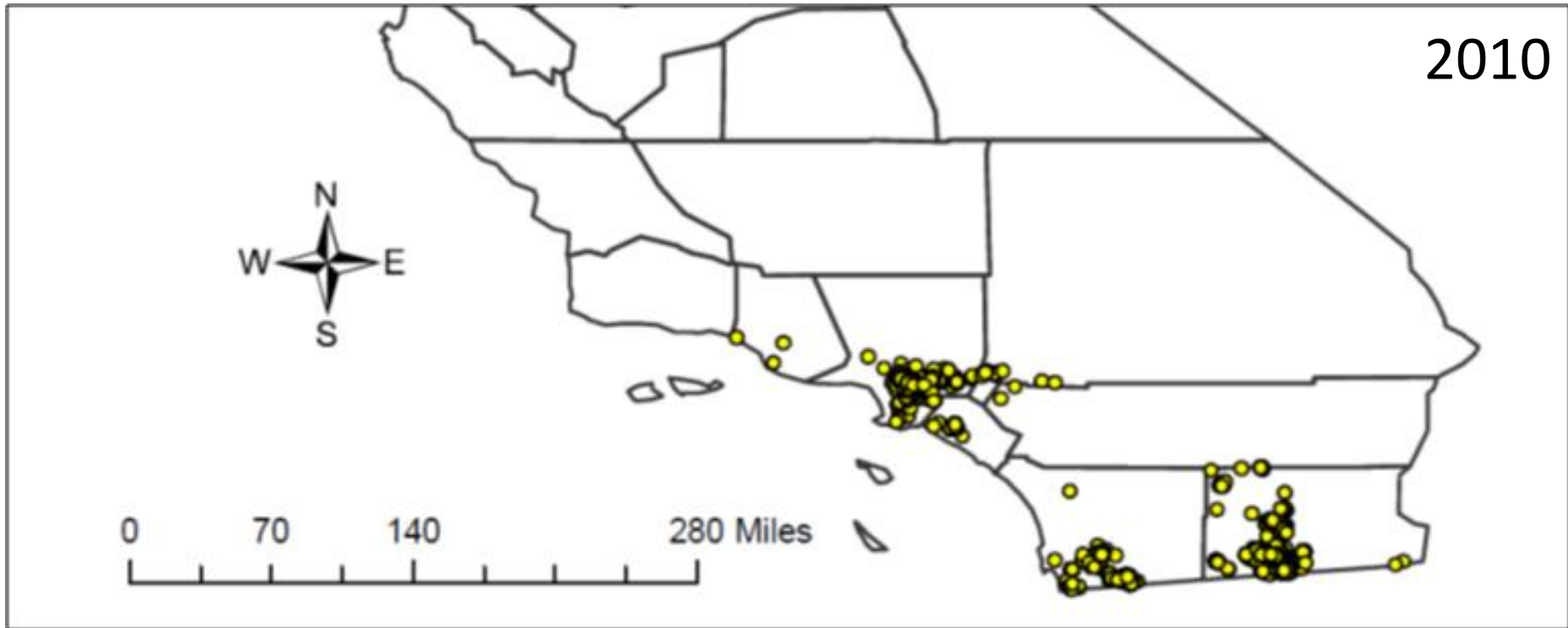
ACP was found in San Diego in 2008. It has since spread throughout urban/suburban Southern California



Documented in Los Angeles and quickly spread; isolated new occurrences elsewhere

The situation in California

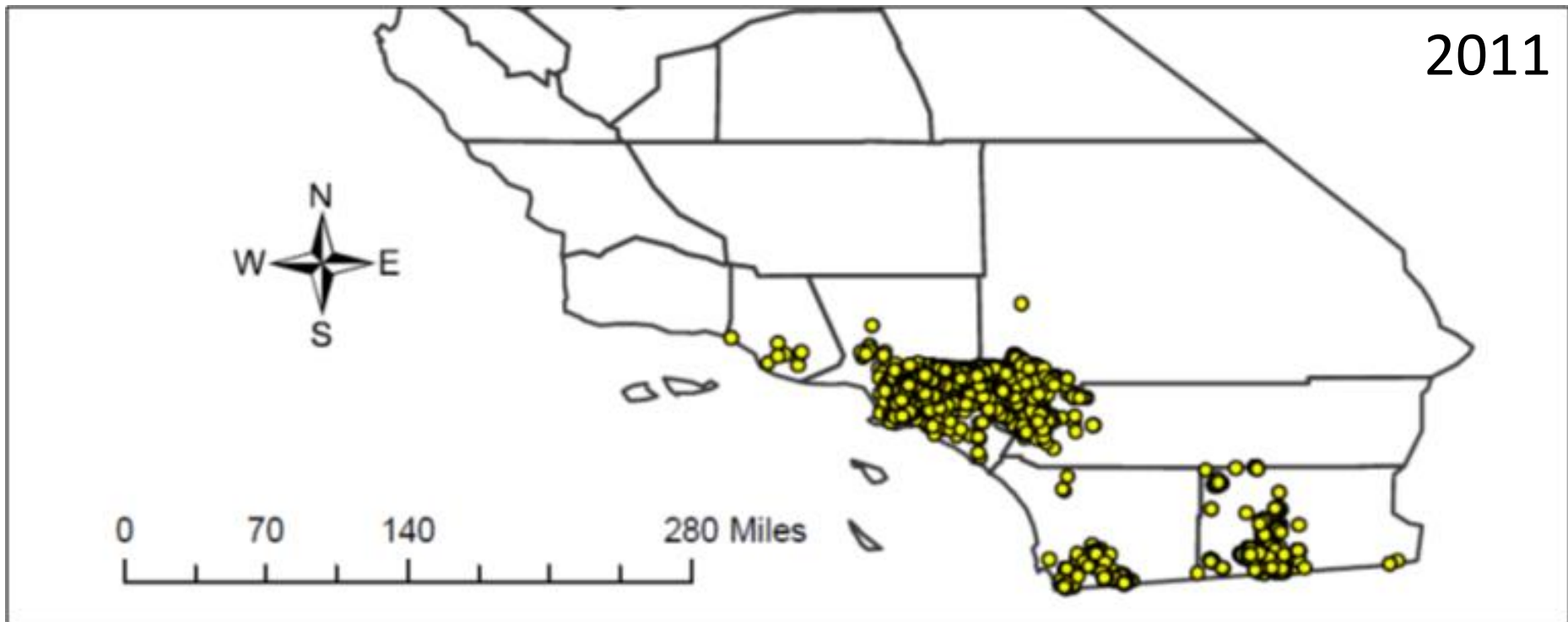
ACP was found in San Diego in 2008. It has since spread throughout urban/suburban Southern California



Spread east from Los Angeles into San Bernardino and Riverside Counties

The situation in California

ACP was found in San Diego in 2008. It has since spread throughout urban/suburban Southern California

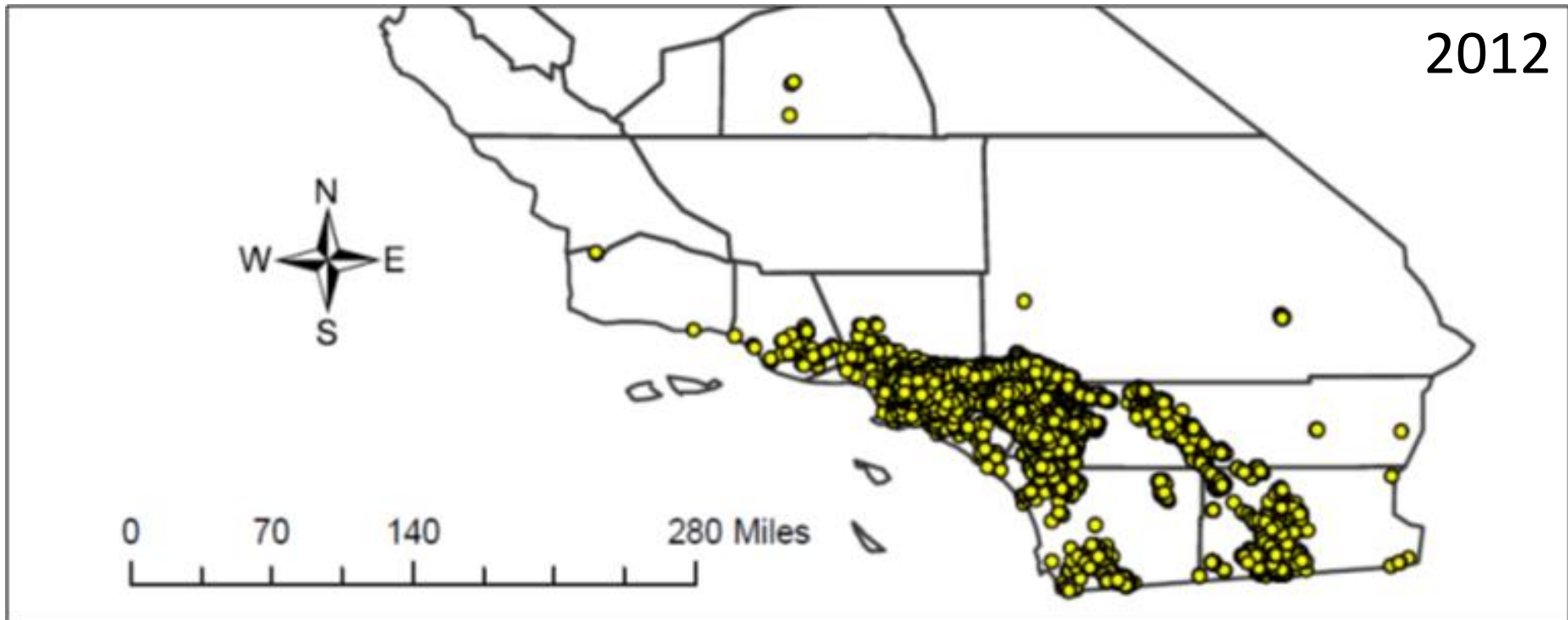


Continued spread south and east from Los Angeles

First commercial citrus finds (“urban spillover”) and nursery finds

The situation in California

ACP was found in San Diego in 2008. It has since spread throughout urban/suburban Southern California

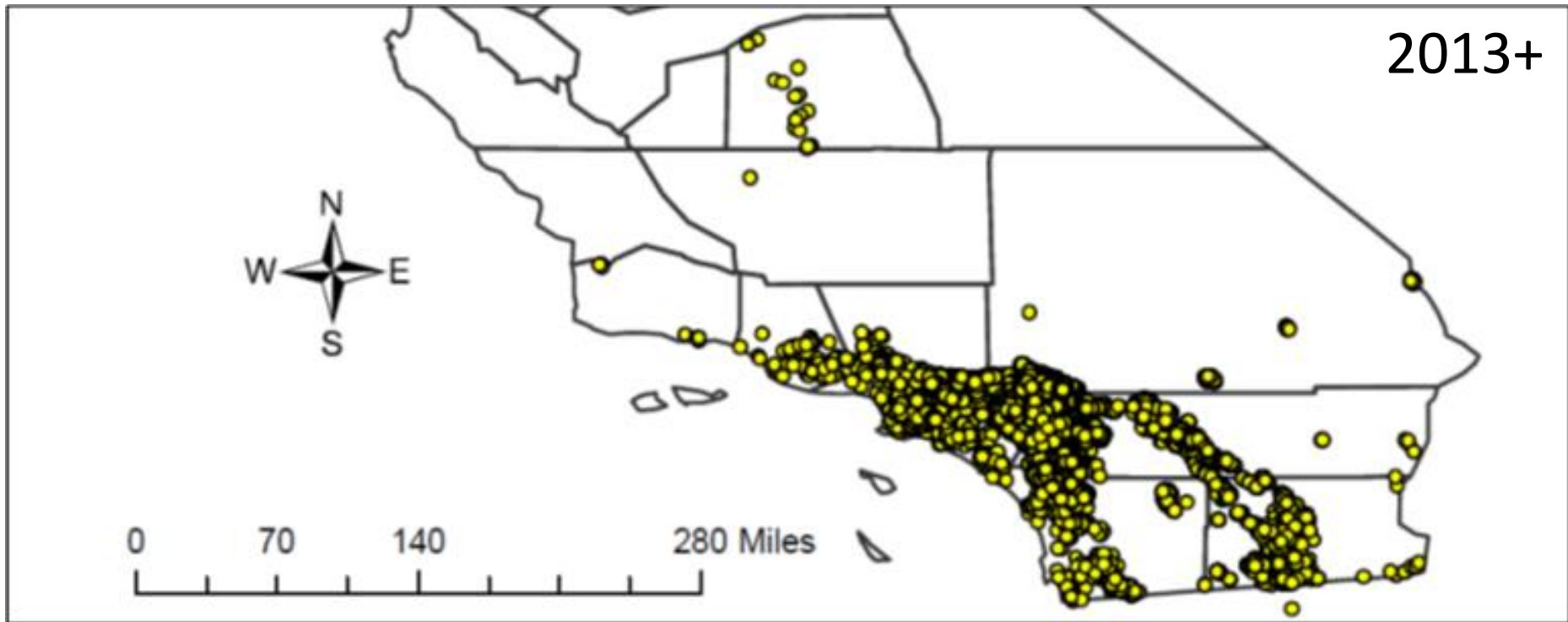


First finds in the Central Valley

First case of HLB (Hacienda Heights)

The situation in California

ACP was found in San Diego in 2008. It has since spread throughout urban/suburban Southern California



Additional finds in the Central Valley and the Bay Area

Additional cases of HLB in Southern California

Steps being taken to limit the impact of ACP and HLB in California

1. Statewide monitoring for ACP and HLB
 - residential and commercial trapping
 - inspections of nurseries
2. Treatments of residential citrus
3. Quarantine zones established around infested areas
 - restrictions on nursery shipments
4. Biological control
5. Area-wide treatments of commercial citrus

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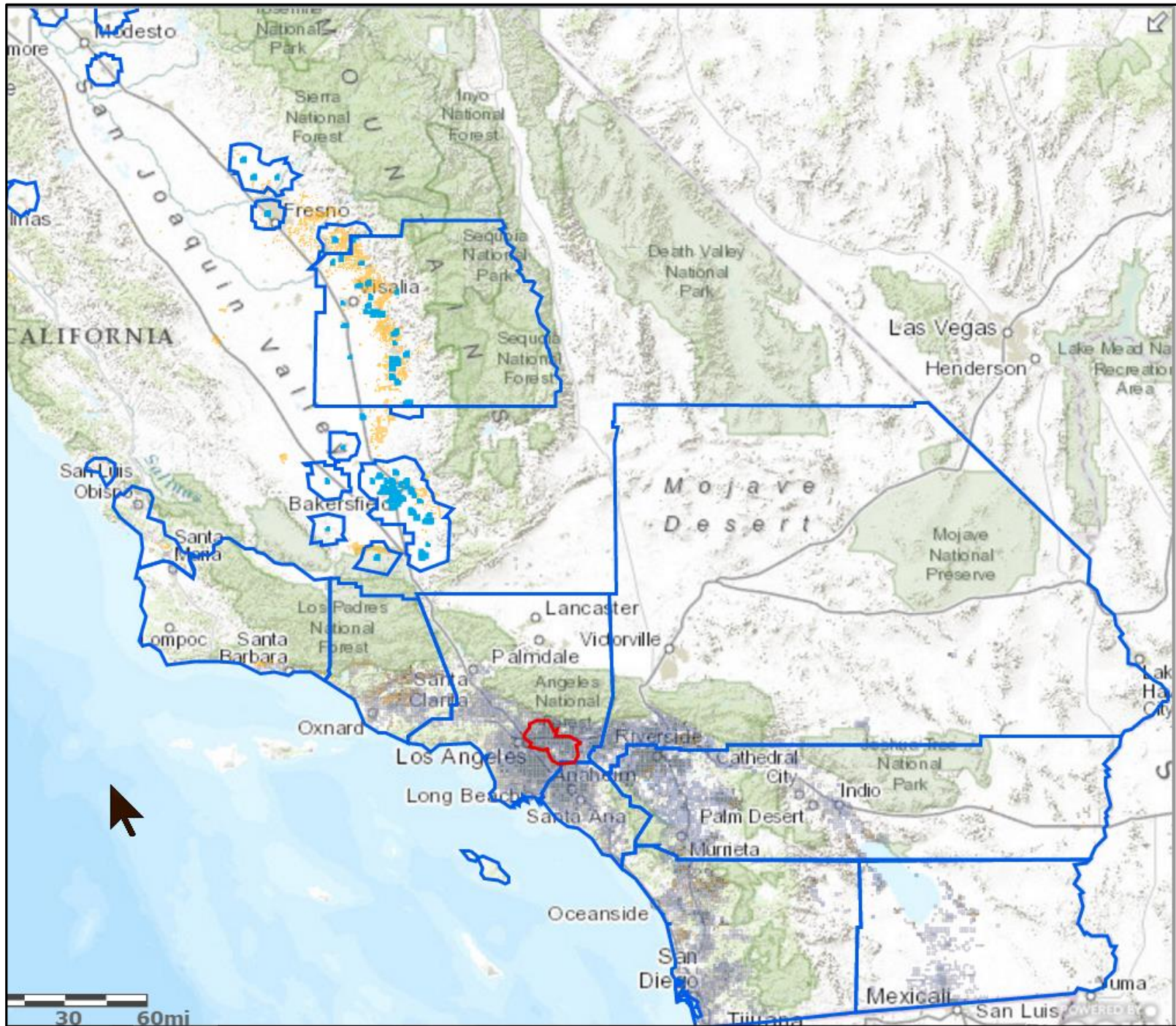
1. Regulations to limit risk posed by retail nursery citrus



2. How long is containerized citrus protected from ACP?

3. Are plants at retail nurseries adequately protected from ACP?





Regulations to limit risk posed by retail nursery citrus

1. Insecticide treatment of plants prior to shipping to retail stores

- foliar (pyrethroids, OPs) and systemic (neonicotinoids)

- retreatment is necessary after 90 days

2. Tagging of all ACP/HLB host plants

- tag number tracks treatment information

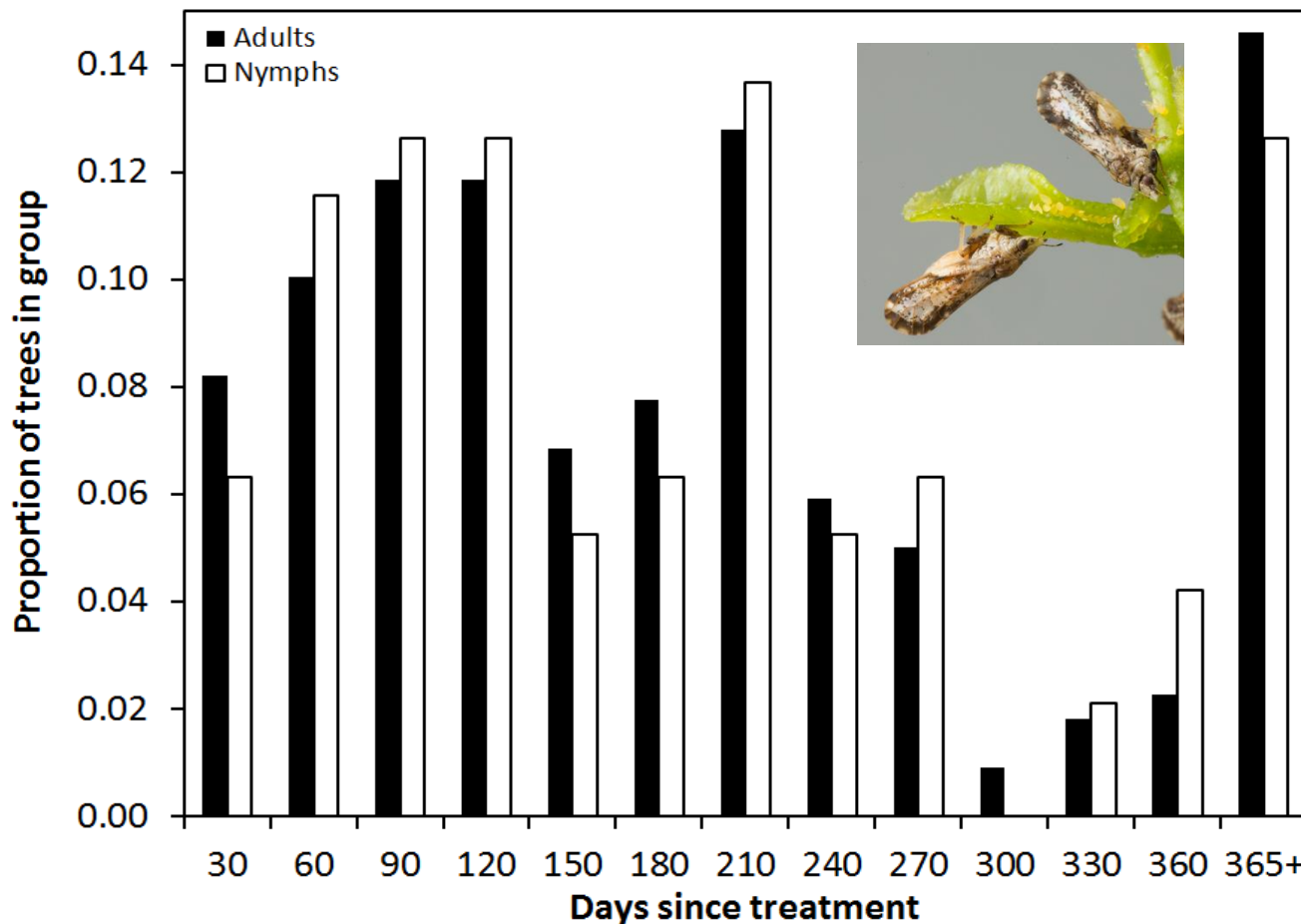
3. Restricted movement of host plants

4. Additional restrictions in HLB quarantines



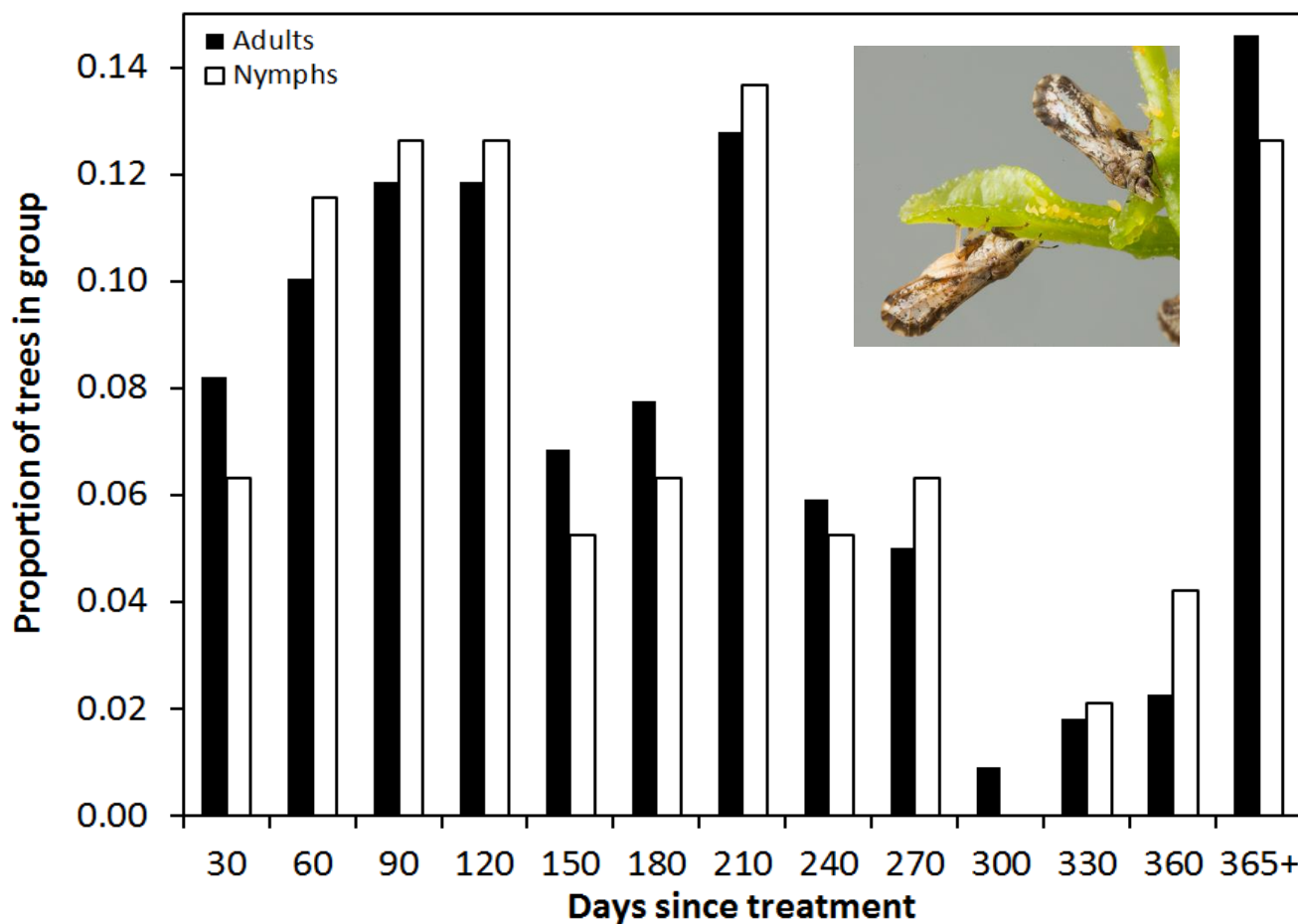
For the first few years CDFA inspected nurseries in quarantine zones

- >400 ACP infested nursery shipments found since 2011
- >80,000 plants retreated or destroyed



For the first few years CDFA inspected nurseries in quarantine zones

- plants can sit around a long time (up to 3 years)
- some plants infested less than 90 days after treatment



How well do required treatments protect potted citrus?

Expt 1: imidacloprid uptake and retention

Expt 2: comparison of different systemic insecticides

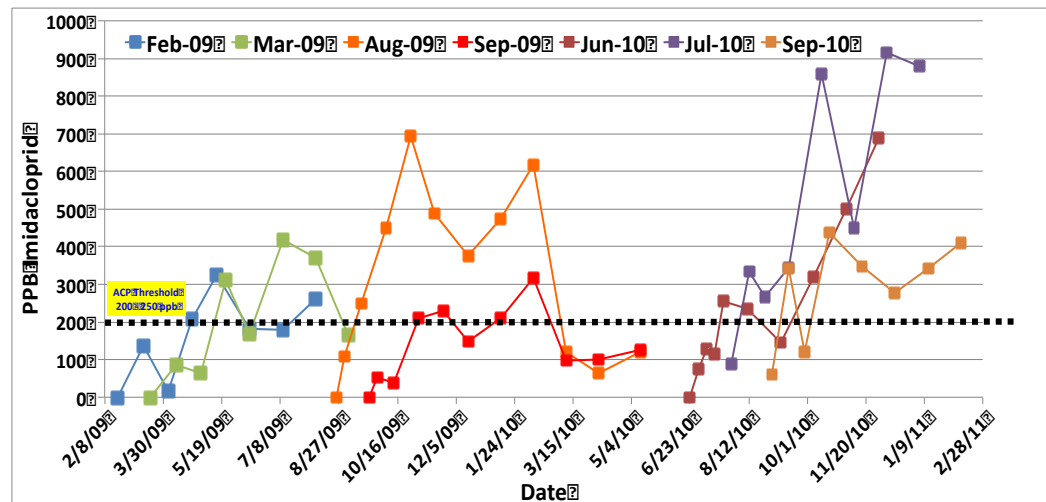


Imidacloprid uptake and retention in potted citrus

~220ppb of imidacloprid is needed for high ACP mortality

In commercial citrus, under ideal conditions, target concentration can last for 6 mo

Morse and Byrne

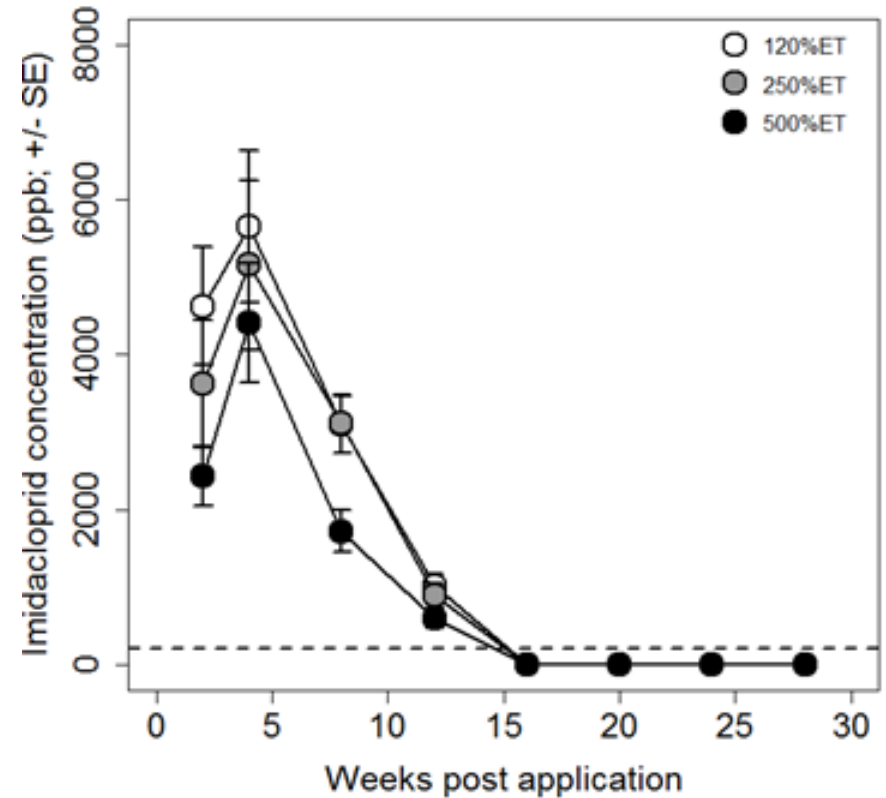
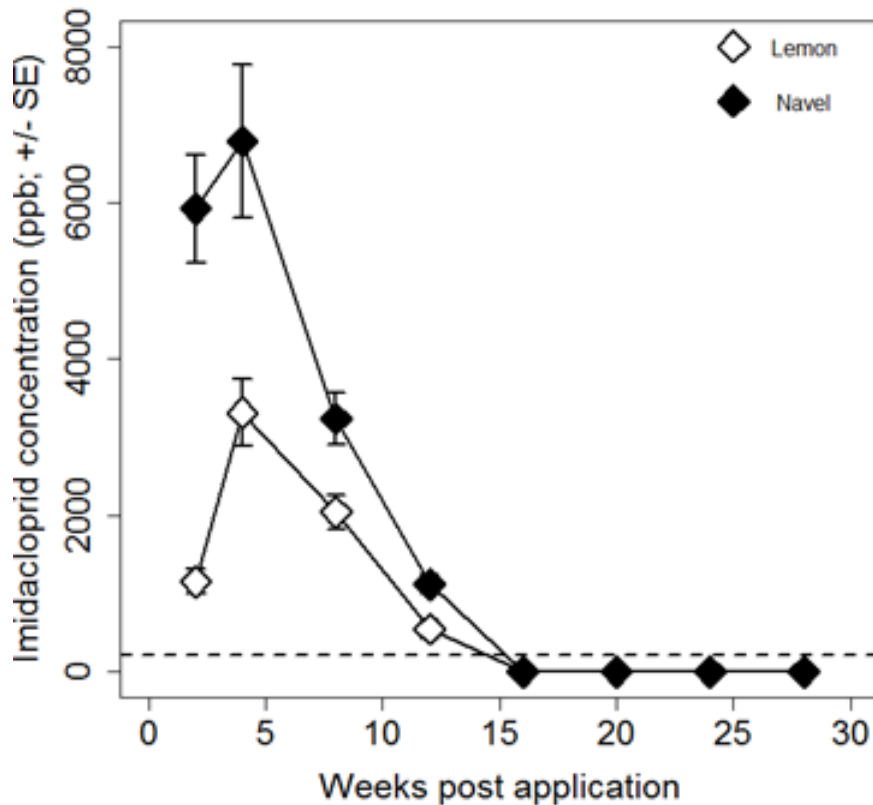


Retention is shorter in containerized citrus?

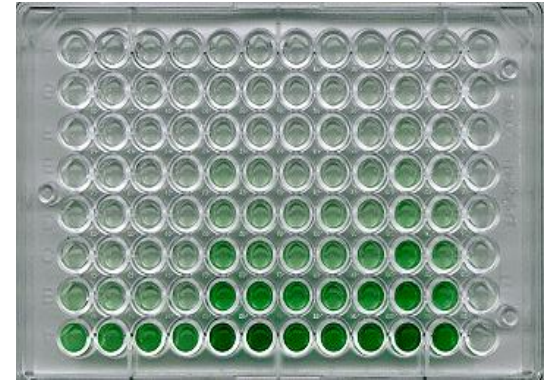
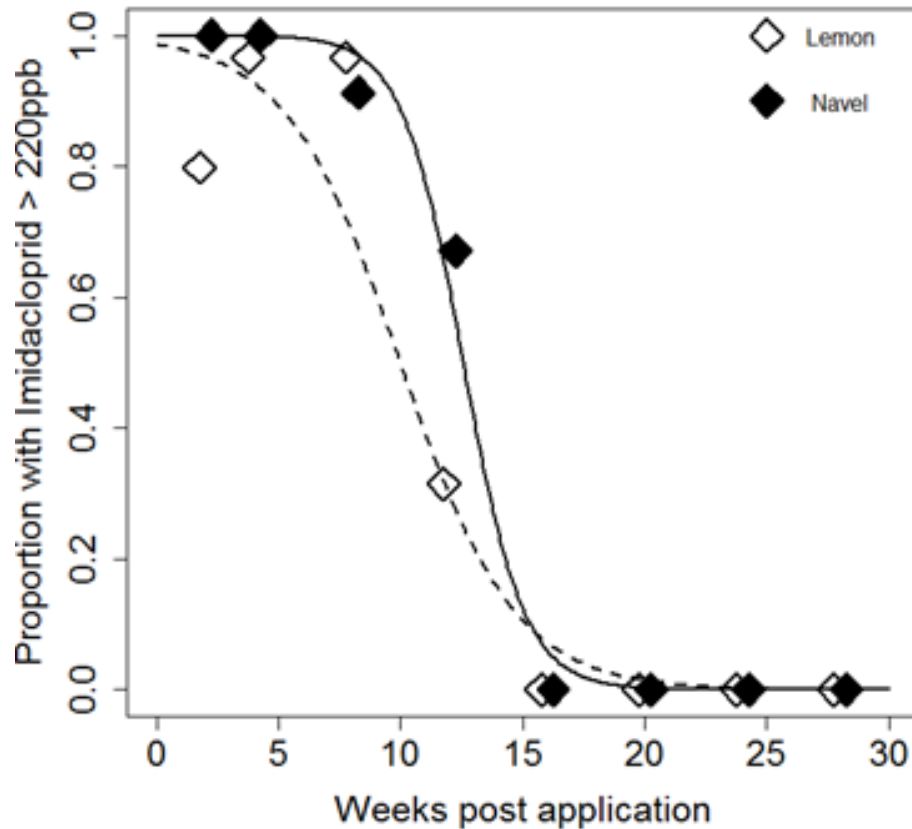
Expt #1: 2 citrus varieties (Eureka lemon, Navel) x 2 soil types (sandy, less sandy) x 3 watering levels (120, 250, 500% ET)

Imidacloprid is rapidly taken up into containerized citrus

Concentrations vary among conditions and decline over time



Residues drop faster in lemon (more flushing), higher watering levels reduce residues, modest effect of soil type



On average 50% of trees (70% of lemons) were below 220ppb by 12 weeks post application

No trees had sufficient imidacloprid concentrations at 16 weeks post application

Expt #2: effectiveness of different systemic insecticides

-imidacloprid, thiamethoxam, dinotefuran

-field trial and lab bioassays

-insecticide residues 1 to 16
wk post application

-visual inspection of potted
citrus every 2 wk for ACP
adults or eggs/nymphs



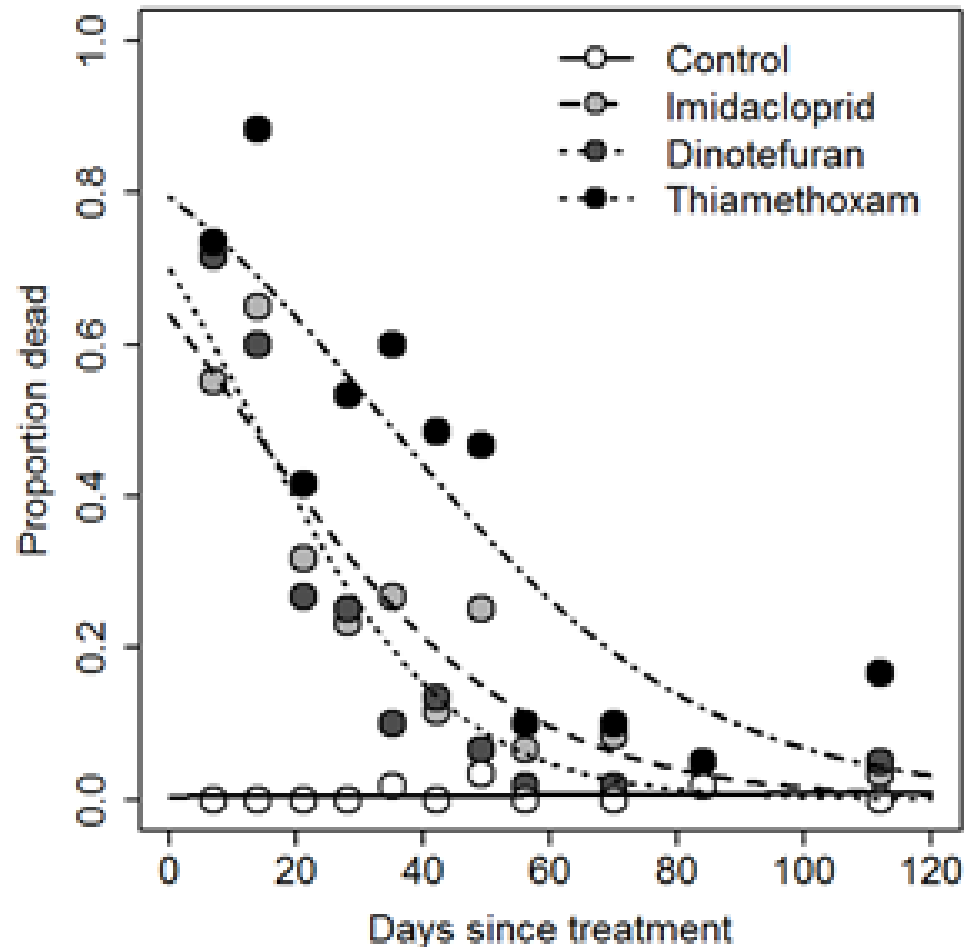
Rapid uptake of all 3 insecticides to high concentrations

-don't know the target concentration of dinotefuran and thiamethoxam

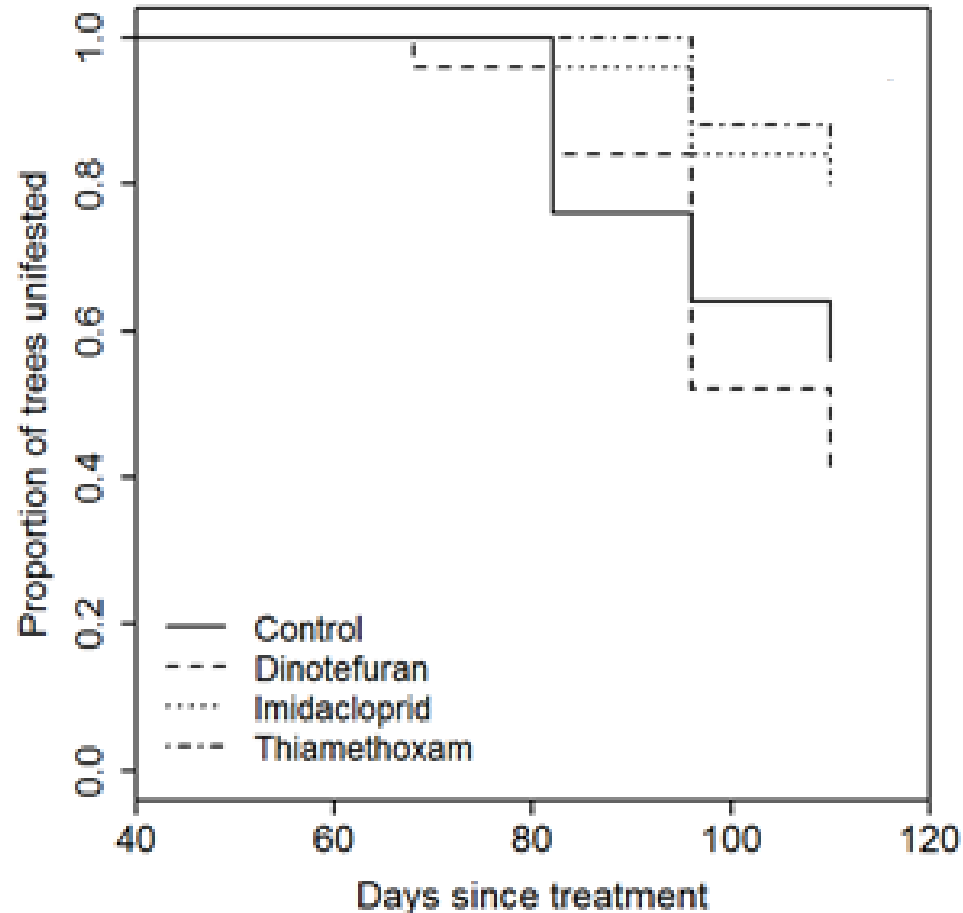
High initial ACP adult mortality in bioassays

-60 to 80% at 1 week post treatment

Dinotefuran effectiveness declines the fastest, thiamethoxam persists the longest



ACP establishment in the field also differed among insecticides



Dinotefuran was colonized at the highest rate (before 10 wk, 60% after 16 wk) and thiamethoxam at the lowest rate

Are plants at retail nurseries adequately protected from ACP?

In 2012 and 2013 we surveyed citrus in 29 retail nurseries and garden centers in Riv, SB, SD

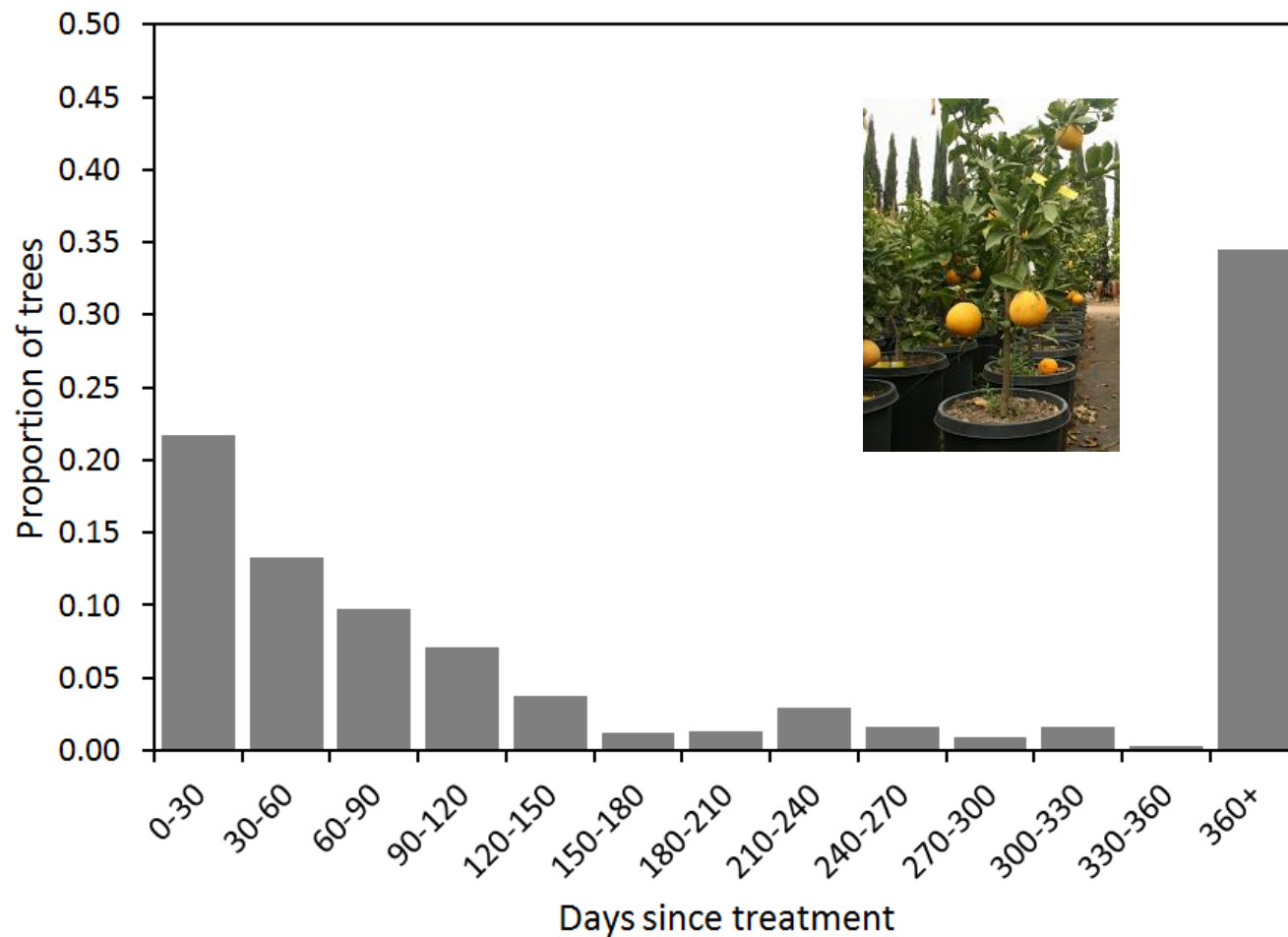
1. How common are ACP infestations at nurseries?
2. How many trees have ACP effective insecticide residues?
3. How long do plants reside at retail stores?

Visual inspection, tissue sampling, tag numbers



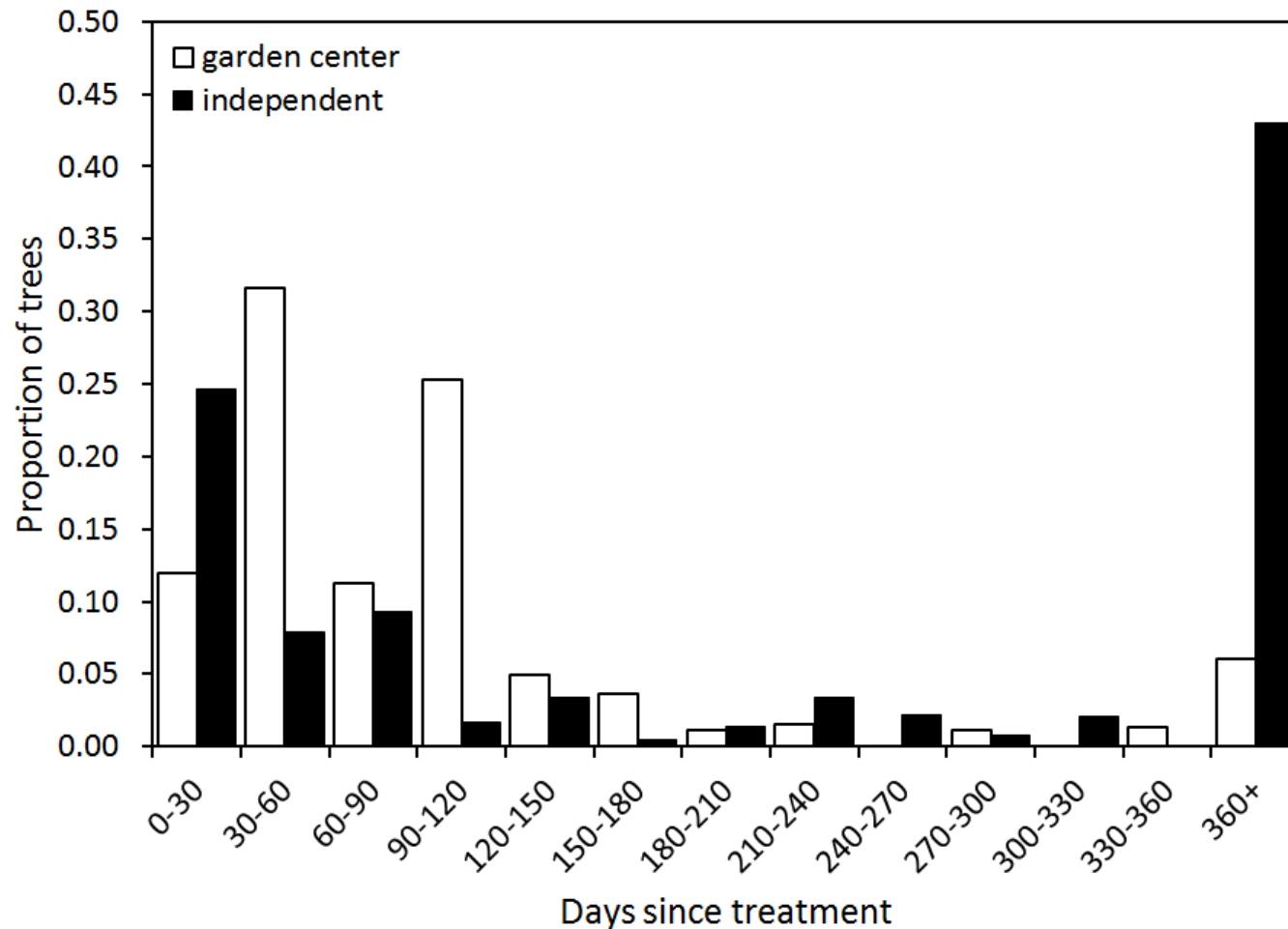
Trees can reside at nurseries for protracted periods

- 55% of trees treated more than 90d prior
- 35% were treated more than 1 year prior



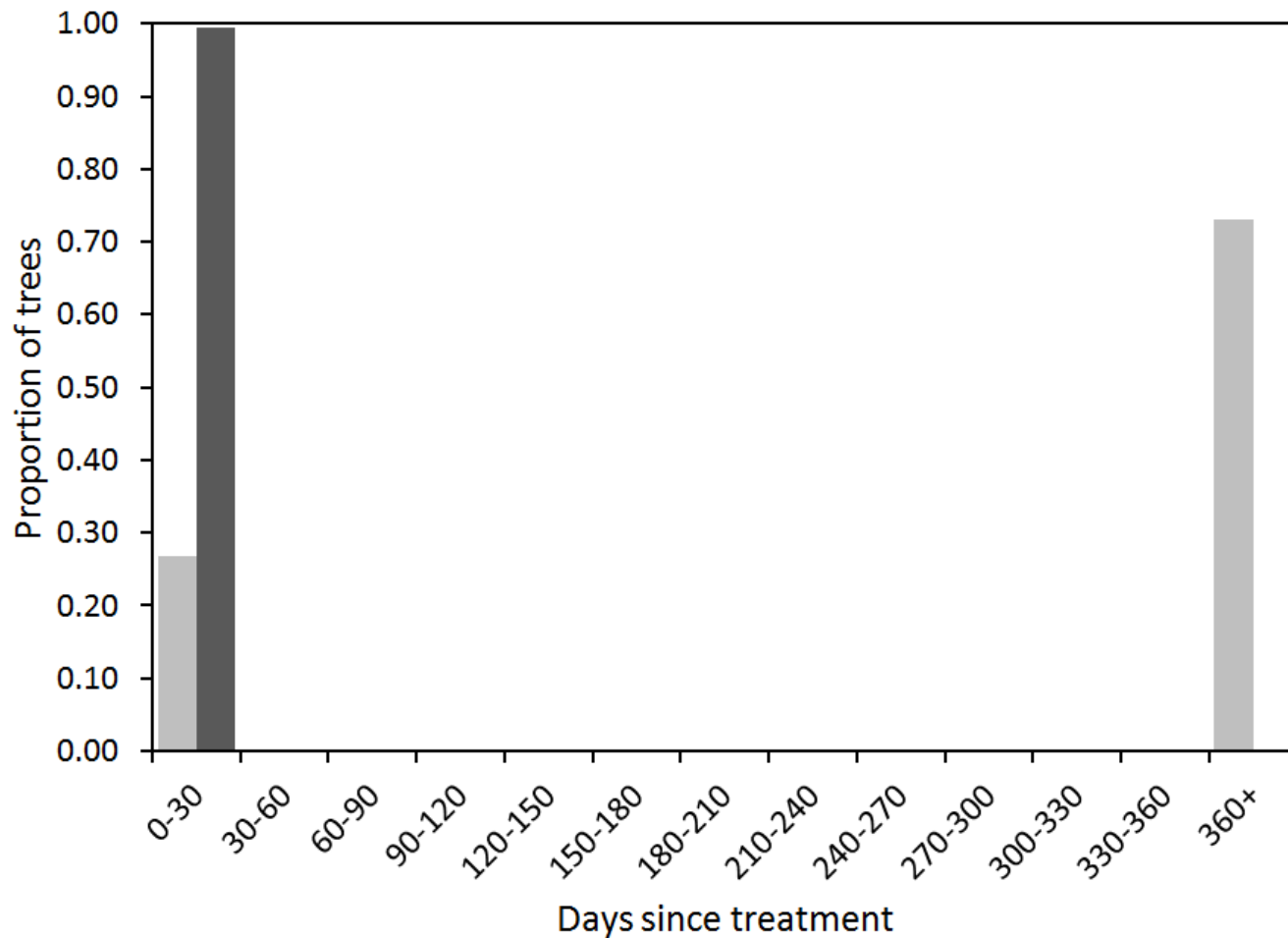
Trees can reside at nurseries for protracted periods

- garden centers had fewer trees, more recent additions
- independent nurseries had 40% of trees treated > 360 d prior



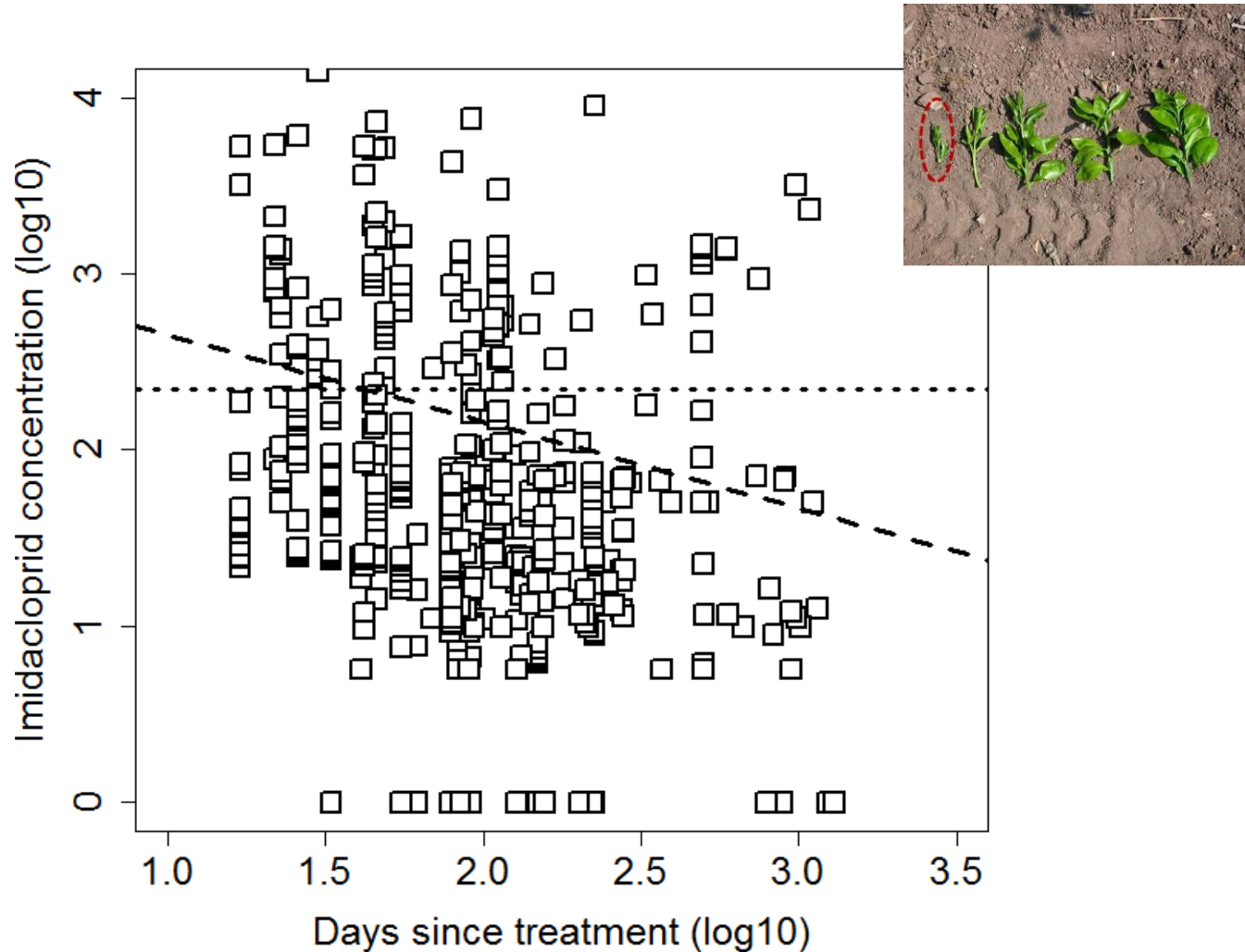
Lots of variability in residence time among nurseries

- one independent had 100% treated within the last month
- another independent had 75% that were treated more than 1 year prior



Lots of variability in imidacloprid concentration

- 90% of samples below effective concentration
- time of year of application may be important?



Nursery citrus:

- treatments likely reduce ACP risk for 10-12 weeks after treatment
- plants frequently reside at nurseries far longer than the insecticide retention period

Additional steps needed to ensure nursery citrus don't contribute to ACP/HLB spread

- Labelling program to ensure turnover of nursery stock
- Supplementary chemical control, appropriate watering practices, screenhouses, etc.

Categories of response and likely outcomes

Appropriate nursery practices:

- ensure timely turnover of stock**
- avoid overwatering**
- don't prune out infested shoots**

Occasional to frequent ACP finds and holds on plants

Appropriate nursery practices

- Shade or partial screening**
- Regular use of insecticidal soaps**
- Fans**
- Spray washing**

Infrequent ACP finds, few holds on plants

Appropriate nursery practices

- Full screening**
- Occasional use of insecticidal soaps**

ACP finds rare, rarely (if ever) holds on plants

Asian Citrus Psyllid and Huanglongbing Disease

Information for nurseries and garden centers

The Asian citrus psyllid and the deadly bacterial disease it spreads, Huanglongbing (HLB), threaten citrus trees in backyards and on farms. The psyllid arrived in Southern California in 2008, and HLB disease was first detected in Los Angeles in 2012. All types of citrus are affected—including oranges, lemons, kumquats, and mandarins—as well as closely related ornamentals (orange jessamine, Indian curry leaf).

What are the concerns?

- ♦ The Asian citrus psyllid can damage leaves, but it doesn't kill trees by itself.
- ♦ The psyllid carries the HLB pathogen from tree to tree, which can kill trees in as little as five years. There is no cure.
- ♦ The psyllid and disease can spread rapidly, especially if infested plants or cuttings are moved.

Inspect citrus nursery stock for psyllids.

- ♦ Inspect plants at least monthly, when new shipments arrive, and at the cash register.
- ♦ Look for psyllid eggs, nymphs, and adults, especially on newly forming leaves.
- ♦ Adults are about the size of an aphid and have brownish mottled wings. They feed with their head down and their "tail" in the air.
- ♦ Nymphs are tiny and yellowish and excrete white waxy tubules.
- ♦ If you find the psyllid, contact your agriculture commissioner's office or call the California Department of Food & Agriculture Exotic Pest Hotline (800-491-1899) to confirm.

Manage the psyllid in your store.

- ♦ If possible, protect citrus from psyllids by housing in insect-proof structures.
- ♦ Ensure turnover of citrus stock. Plants are usually protected for up to three months by insecticides applied at the production source. Plants held for long periods are at increased risk of psyllid infestation. Encourage their sale or consider retreating these plants.
- ♦ Use appropriate watering practices. Excessive watering can limit pesticide effectiveness and contribute to runoff.
- ♦ Double bag citrus prunings before disposal to prevent psyllid spread.



- ♦ Don't "prune-out" psyllid infestations. This encourages more plant growth and attracts more psyllids. Instead, isolate those plants to limit movement onto other plants and treat with a psyllid-effective insecticide. Only return infested plants into retail areas after all psyllids are killed.
- ♦ Insecticides for psyllid control include oils, soaps, carbaryl, or the systemic imidacloprid. Oils and soaps need to be reapplied every few weeks. Carbaryl and imidacloprid are longer lasting, but because of toxicity to bees, should not be used when citrus is in bloom. Make sure foliar-applied insecticides reach the new growth where young psyllids hide.

Educate customers about the steps they should take.

- ♦ Tell them about the psyllid, HLB, and quarantines. Plants can't be moved out of infested areas due to the risk of spreading the insect and disease. A map can be found at: www.ucanr.edu/sites/ACPI.
- ♦ Let them know that once planted, trees should be inspected whenever new flush is present and any sightings of the insect or disease should be reported.
- ♦ Provide information about psyllid-effective insecticides and tips for their application.

See *Pest Notes: Asian Citrus Psyllid and Huanglongbing Disease* at www.ipm.ucanr.edu for more details.



Brownish adult, yellow nymphs, and white wax of Asian citrus psyllids (left). Tiny psyllid eggs and young nymphs on new developing leaves (right).

Minimize the use of pesticides that pollute our waterways. Use nonchemical alternatives or less toxic pesticide products whenever possible. Read product labels carefully and follow instructions on proper use, storage, and disposal.

For more information about managing pests, contact your **University of California Cooperative Extension office** listed under the county government pages of your phone book or visit the UC IPM Web site at www.ipm.ucanr.edu.

University of California
Agriculture and Natural Resources
Statewide IPM Program



February 2014

Downloadable brochure

General information on psyllid and disease biology, identification, and control

Share with customers

ACP and HLB online training course:

<http://class.ucanr.edu/>

Menu


- Introduction
 - Introduction
 - How to Navigate
 - Course Description
 - Table of Contents
- Chapter 1: Asian Citrus Psyllid
 - What is a Psyllid?
 - Lifecycle
 - Flush
 - Eggs
 - Nymphs
 - Tubules
 - Adults
 - Adult Characteristics
 - Host Plants
 - Orange Jessamine
 - Indian Curry Leaf
 - Damage Caused
 - Young Leaves
 - Notched Leaves
 - Summary
- Chapter 2: Huanglongbing Disease
 - What is Huanglongbing?
 - Huanglongbing Bacterium
 - Leaf Symptoms
 - Fruit Symptoms

Asian Psyllid and Huanglongbing for Nurseries


Introduction

Asian Citrus Psyllid & the Dreaded Huanglongbing Citrus Disease

A study of the biology and management from the nursery perspective



Instructors:
Matt Daugherty & Beth Grafton-Cardwell
*Dept. of Entomology,
University of California Riverside*



University of California
Agriculture and Natural Resources

Duration: 60 minutes

< PREV NEXT >



Entomology

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74155.html>

<http://ucanr.edu/sites/ACP/>

<http://citrusinsider.org/>