2° Taller Internacional sobre el Huanglongbing y el Psílido Asiático de los cítricos

Biology, History and World Status of *Diaphorina citri*

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The complete proceedings article will present a fairly comprehensive overview of the Asian citrus psyllid: morphology, biology, dispersal and flight activity, ecology, sampling/detection, vector-pathogen relationship, biological and chemical control.

Due to time limitations, my presentation will focus on only some of these aspects.

Taxonomy –

The genus *Diaphorina* (Hemiptera: Psyllidae) includes 74 described species.

Six other obscure *Diaphorina* species are known to have been associated with citrus or closely related plant species.

- Population fluctuations of *D. citri* are closely correlated with flush growth because oviposition and development of nymphs take place exclusively on flush.
- Eggs are deposited on terminal flush growth.
- Numerous eggs can be found on flush, each anchored to plant tissue on one end in an upright position
- Initially light yellow but at maturity bright orange with two distinct red eye spots.

- There are five nymphal instars of development.

At 25°C:

- Eggs hatch in 4 days
- Nymphs develop into adults in 13 days
- New adults reach reproductive maturity and begin laying eggs within 2 to 5 days
- Mean population generation time of 20 to 22 days.

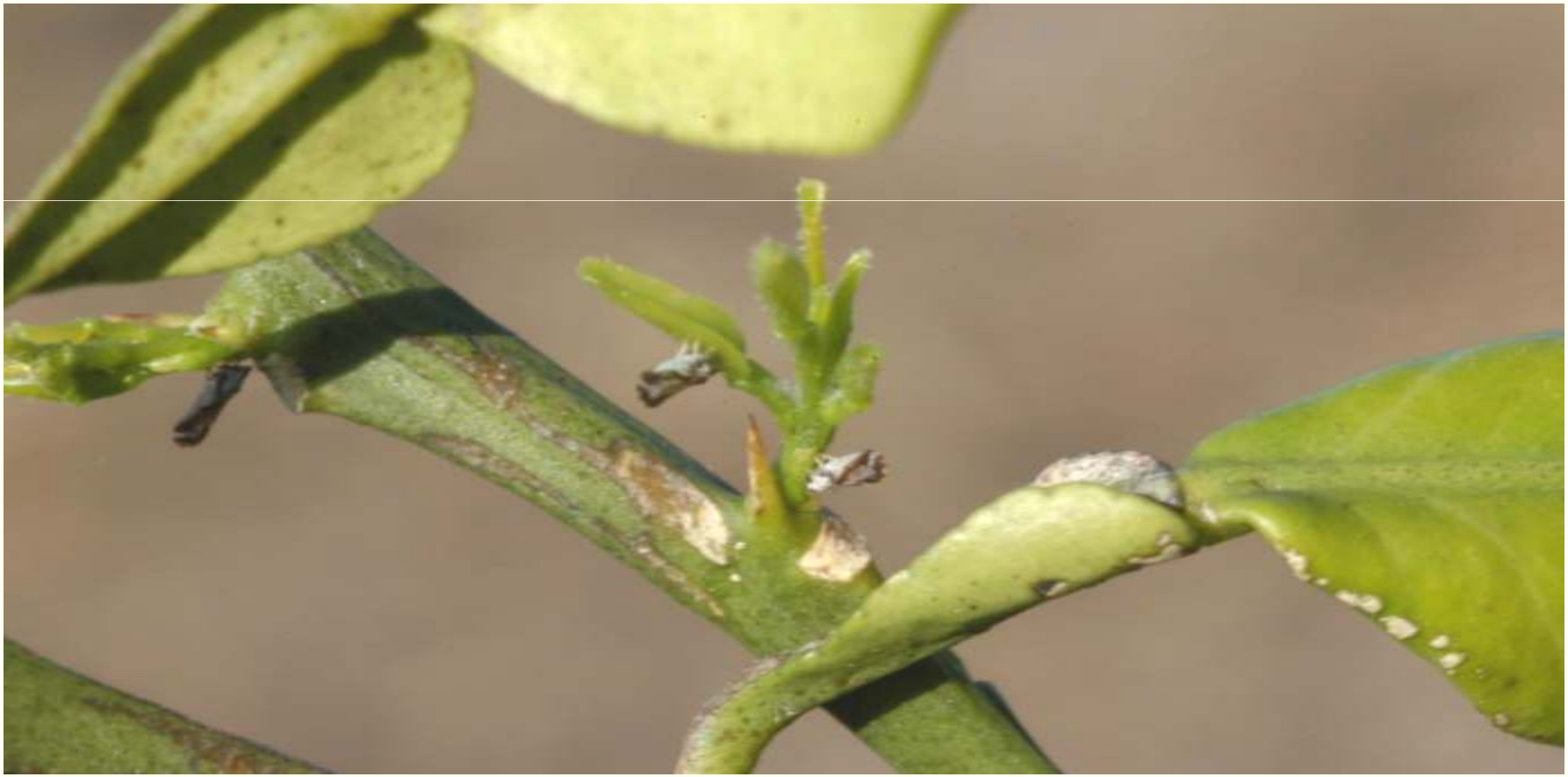
Sex ratio of about 1:1

Females lay an average of 858 eggs on grapefruit

In males, the end of the abdomen is curved upward while, in females, the end of the abdomen is straight, coming to a point


Female
Male

- At 25°C, adults live an average of 40 to 44 days
- Maximum adult longevity ranges from 51 days at 30°C to 117 days at 15°C.



Adults feed and mate only during daylight hours

Females and males mate multiple times (sometimes daily) with different partners – multiple mating is essential!

Abdomen color has no value in identifying sex, is not a indicator of sexual maturity, and has only limited value as an indicator that females have mated.

Host plants

- *D. citri* has a restricted range of host plants that includes citrus, orange jasmine and related species of Rutaceae – largely in the subfamily Aurantioideae.
- Based on studies in grapefruit and jasmine, *D. citri* did not prefer one host over the other.
- The development, longevity and reproduction of *D. citri* vary somewhat on different host plants.

Host plants

- Host plant resistance might hold promise as a control tactic for *D. citri* and thus HLB
- In choice studies, *Poncirus trifoliata, Glycosmis pentaphylla, and Zanthoxylum clavushercules* have appeared to be poor reproductive hosts.
- Aubert (1987, 1990) noted that *Poncirus trifoliata* might be an occasional adult food host but not a reproductive host.

Vector-pathogen interactions

- The HLB pathogen can be acquired by an adult within a 30 min feeding period and transmitted during a 5-7 hr feeding period.
- Adults can transmit the pathogen many days after acquiring it, the pathogen replicates in the insect.
- Fourth and fifth instar *D. citri* nymphs can also transmit HLB, and they retain the pathogen after reaching the adult stage.
- Transovarial transmission of the pathogen to psyllid progeny does not occur.

Detection and Samping

Methods available to detect Asian citrus psyllid

- Visual searches of plants
- Sweep net samples
- Suction traps
- HVac samples
- Yellow sticky traps
- Stem-tap sampling

Some detection methods are good in certain situations and not in others.

Sweep net sampling to detect adults

Sweep net sampling:

- Can damage very young trees.
- Concerns of spreading citrus canker.

Suction trap for detecting adult psyllids (photo courtesy of Susan Halbert)

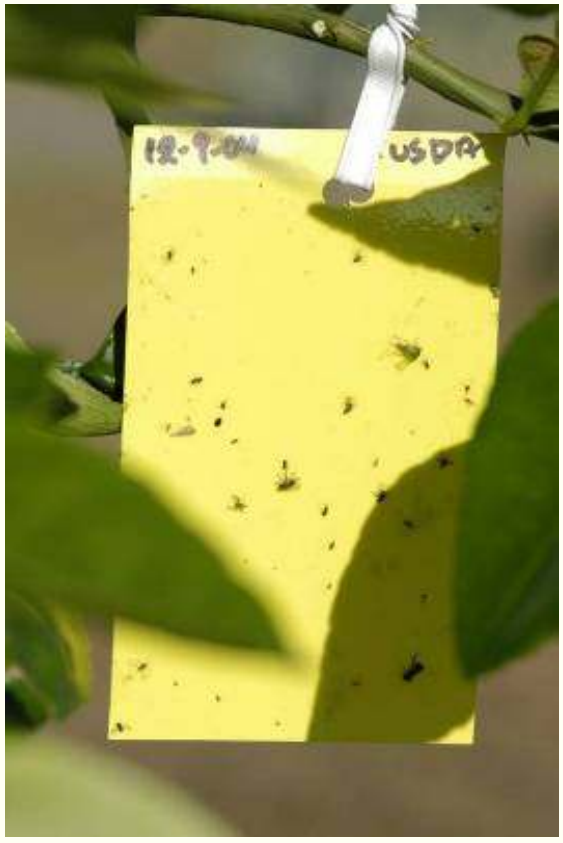
Suction trap for detecting adult psyllids
(photo courtesy of Susan Halbert)

Pest Detection/Emergency Projects Branch, California Department of Food and Agriculture in San Diego

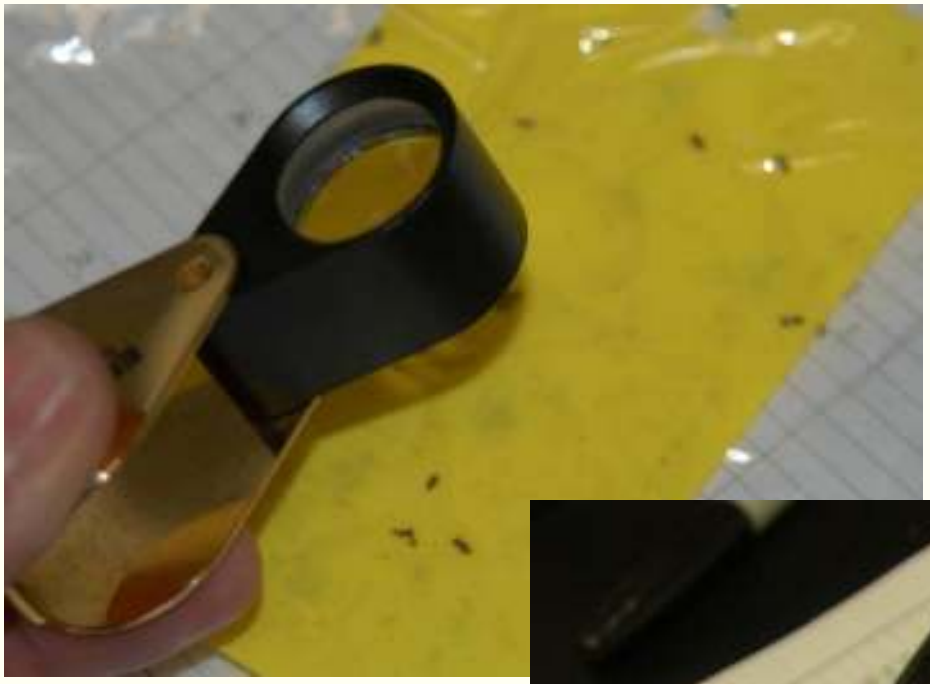
Detecting adults – Hvac samples

Could develop a protocol for estimating relative adult ACP abundance

Detecting adults - sticky traps



Sticky traps – wrapped in saran or placed in Ziploc bag



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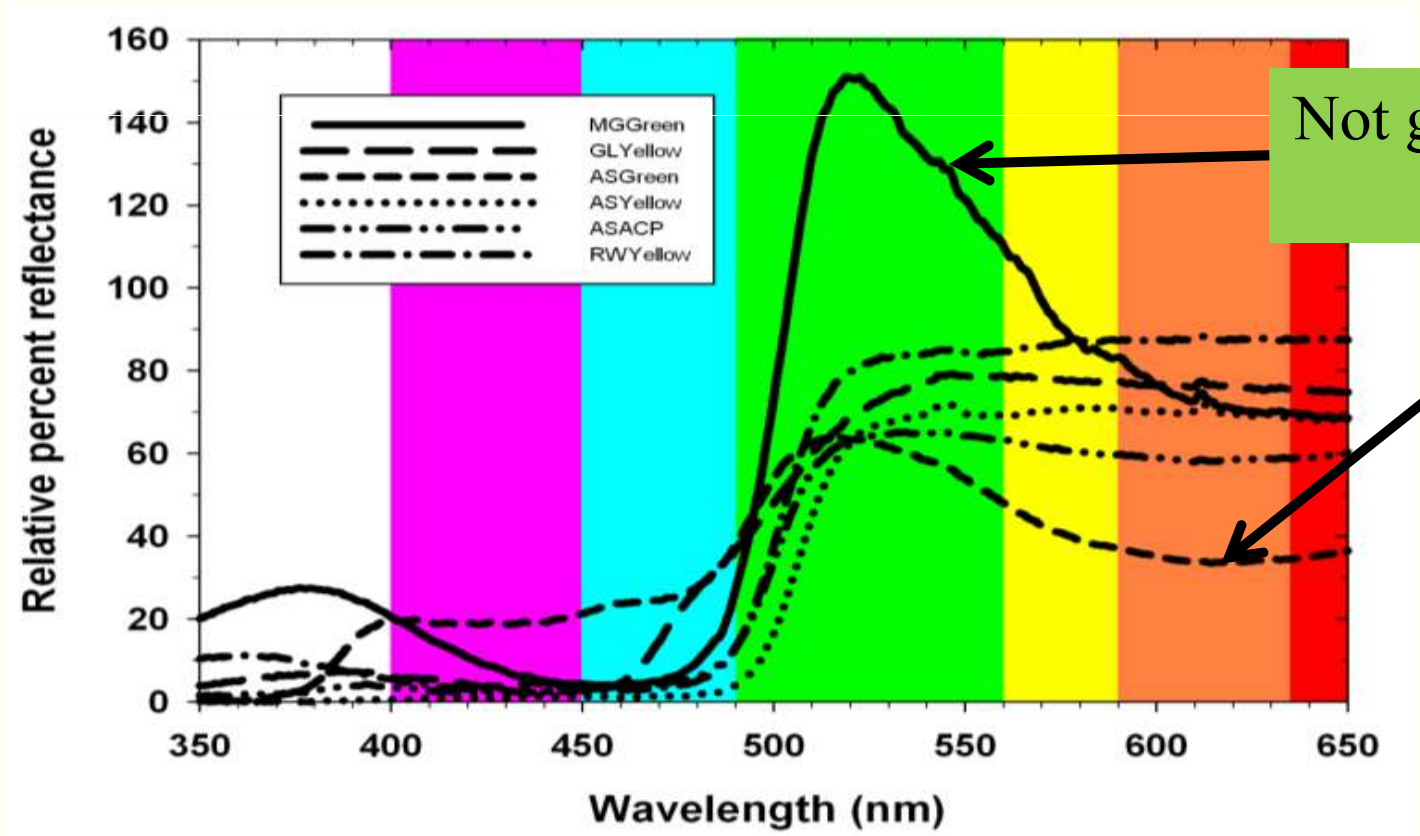
TECHNIQUIP

Comparison of six sticky traps varying in color.

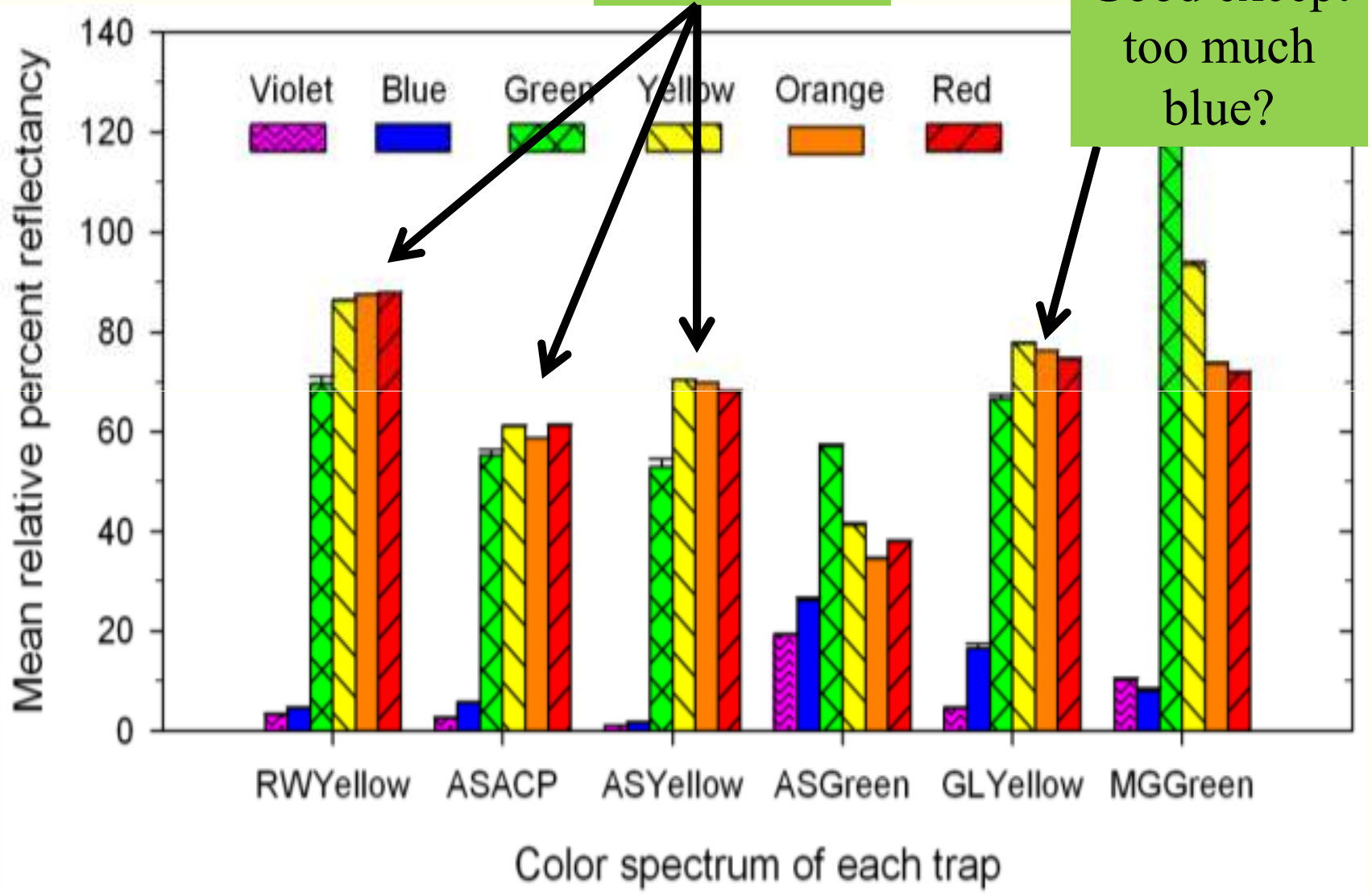
Trap code	Source	Price per trap (US$)
GLYellow	Great Lakes IPM	0.25
ASYellow	AlphaScents	1.20
ASACP	AlphaScents	1.20
ASGreen	AlphaScents	0.80
RWYellow	Great Lakes IPM	1.24
MGgreen	Great Lakes IPM	1.24



Not good, too much green

Not good, not enough yellow, orange and red

Helps to have reflectance (color) in yellow, orange and red, but blue reduces captures of adu



Tap sampling – hold a pan or tray under a branch, tap 3 times (not much force)

Some psyllids dropping to the surface will fly, others will land on the surface and fly. A large sticky card can be placed into the pan to prevent some escape.

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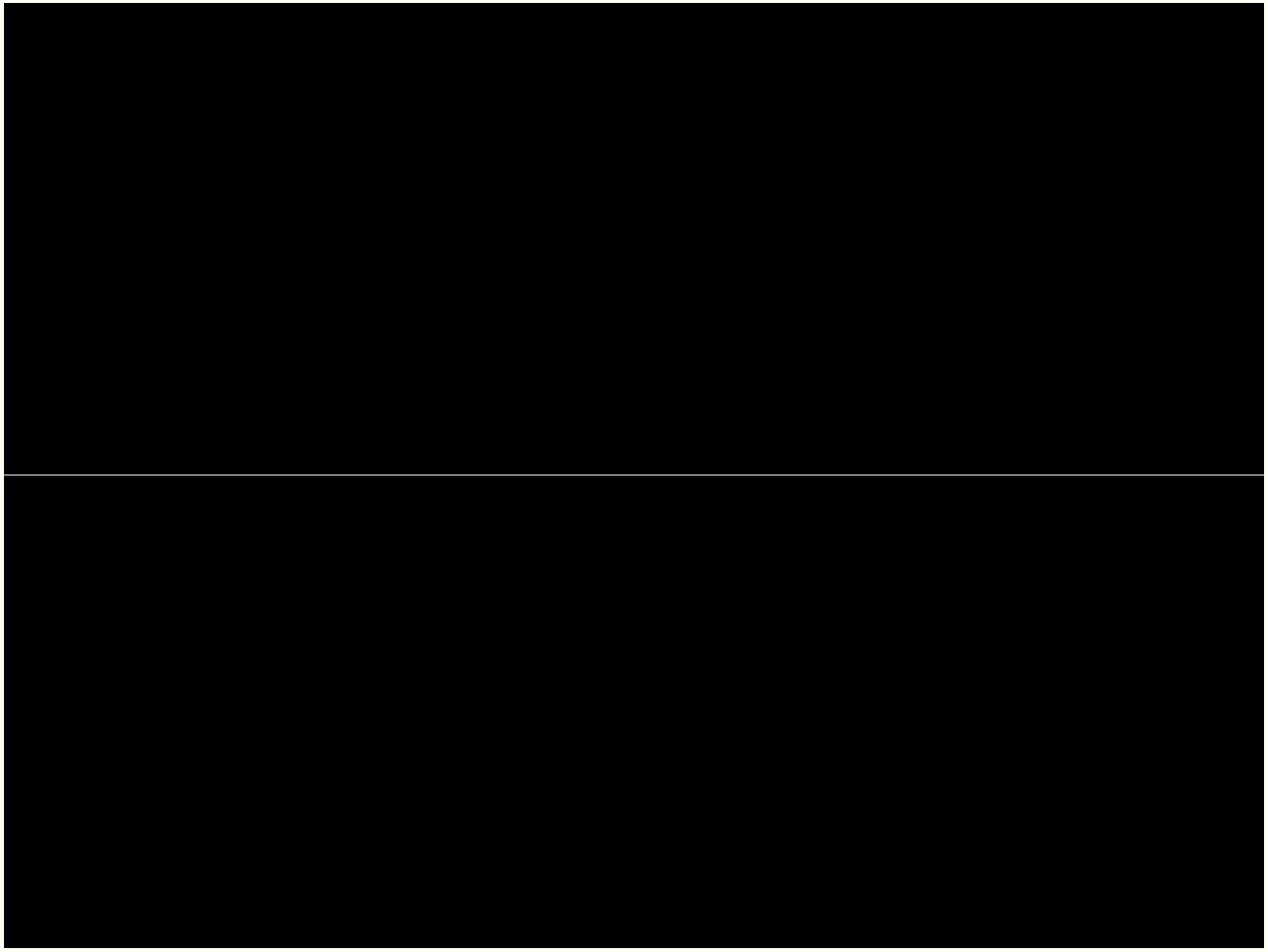

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Methods for quantifying ACP population levels - protocols that have been developed:

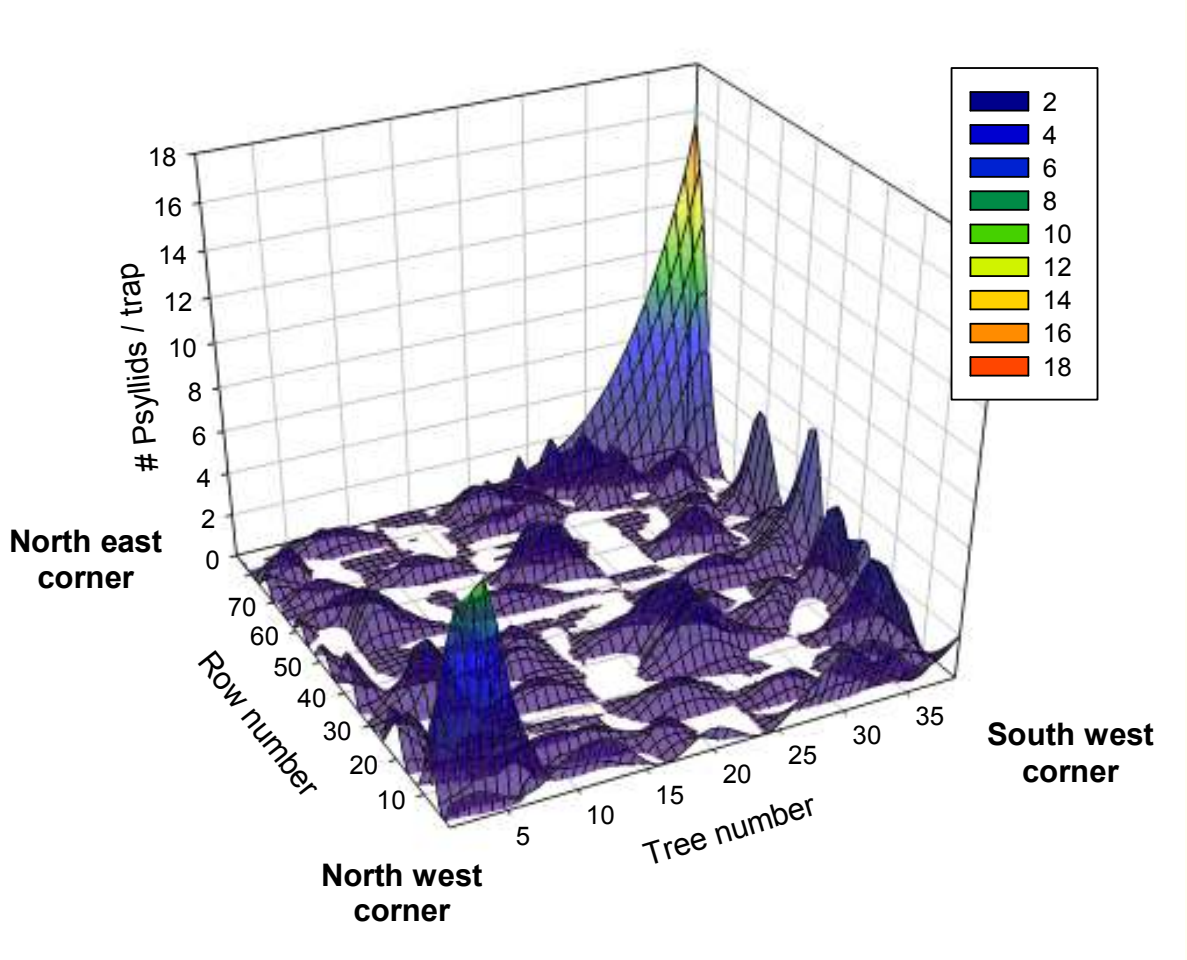
- Flush shoot protocol for eggs, nymphs, adults: Sample 8 flush shoots on each of 10 trees (based on data from blocks of trees averaging 12 acres in size)
- Yellow sticky trap protocol for adults: Deploy one trap per tree on each of 28 trees across an area up to 10 acres in size
- Stem-tap sampling protocol for adults: Take one tap sample per tree on each of 30 trees across an area up to 10 acres in size

Asian citrus psyllid flight

- Adults are active, jumping/flying insects that can readily fly short distances.
- Adult flight can occur all day long, pronounced during warm, windless, sunny afternoons between 4 and 6 pm.

Asian citrus psyllid flight

- A trapping study in Florida indicated major southeast edge flight activity and minor northwest activity.



Asian citrus psyllid flight

- Routinely flies to find mates, food and oviposition sites.
- The psyllid is considered a weak flier with weak flight muscles.
- This means that routine, intentional flight activity by the psyllid will occur only when there is little wind.
- In the absence of wind, the psyllid flies pretty good.
- The longest flight duration by *D. citri* was 47 min for females and 49 min for males, and the longest flight distance was 978 m for females and 1,241 m for males.
- Thus any routine flights in excess of around 1,000 m will require a number of repetitive flights.




Asian citrus psyllid flight

- Short trivial flights by *D. citri* routinely occur within individual trees and between trees within a grove
- Flight activity by the psyllid at distances of 30 to 100 meters from citrus has been observed during almost every month of the year in Florida, but peaks in flight activity distant from citrus consistently occurred only during the spring
- Long trivial flights could be stimulated by lack of flush, crowding or other factors.
- Data from Florida suggest that most trivial flights by *D. citri* occur at relatively low altitudes even when they are distant to citrus.



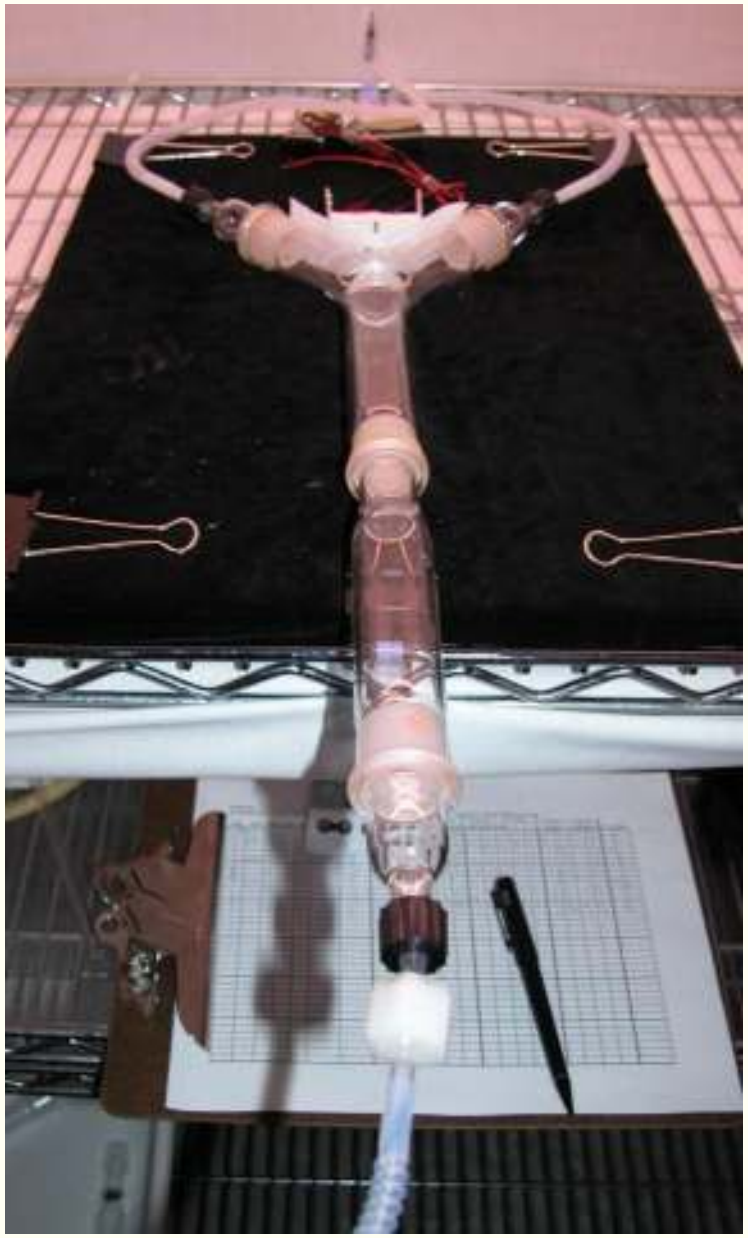

Asian citrus psyllid flight

- Does the psyllid make long distance mass migrations?
- Such flights would not be concerned with finding food, mates or oviposition sites.
- Long distance migrations would be associated with species dispersal.
- Hypothesis: The psyllid mass migrates in the spring in wind speeds that it normally avoids, flying up to higher altitudes into the wind but actually carried in the opposite direction than the psyllid is attempting to fly.
- Depending on wind speed, 45 minutes of flight time could carry the psyllid for many km.



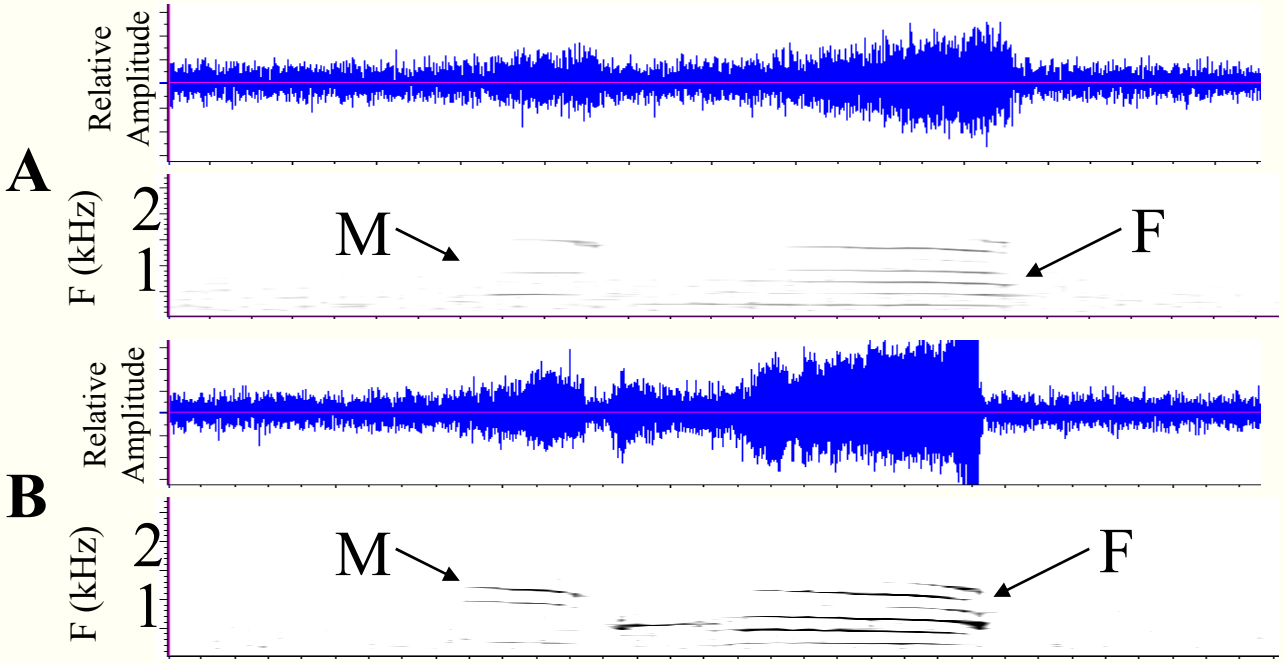

Mating – how do males and females find each other?

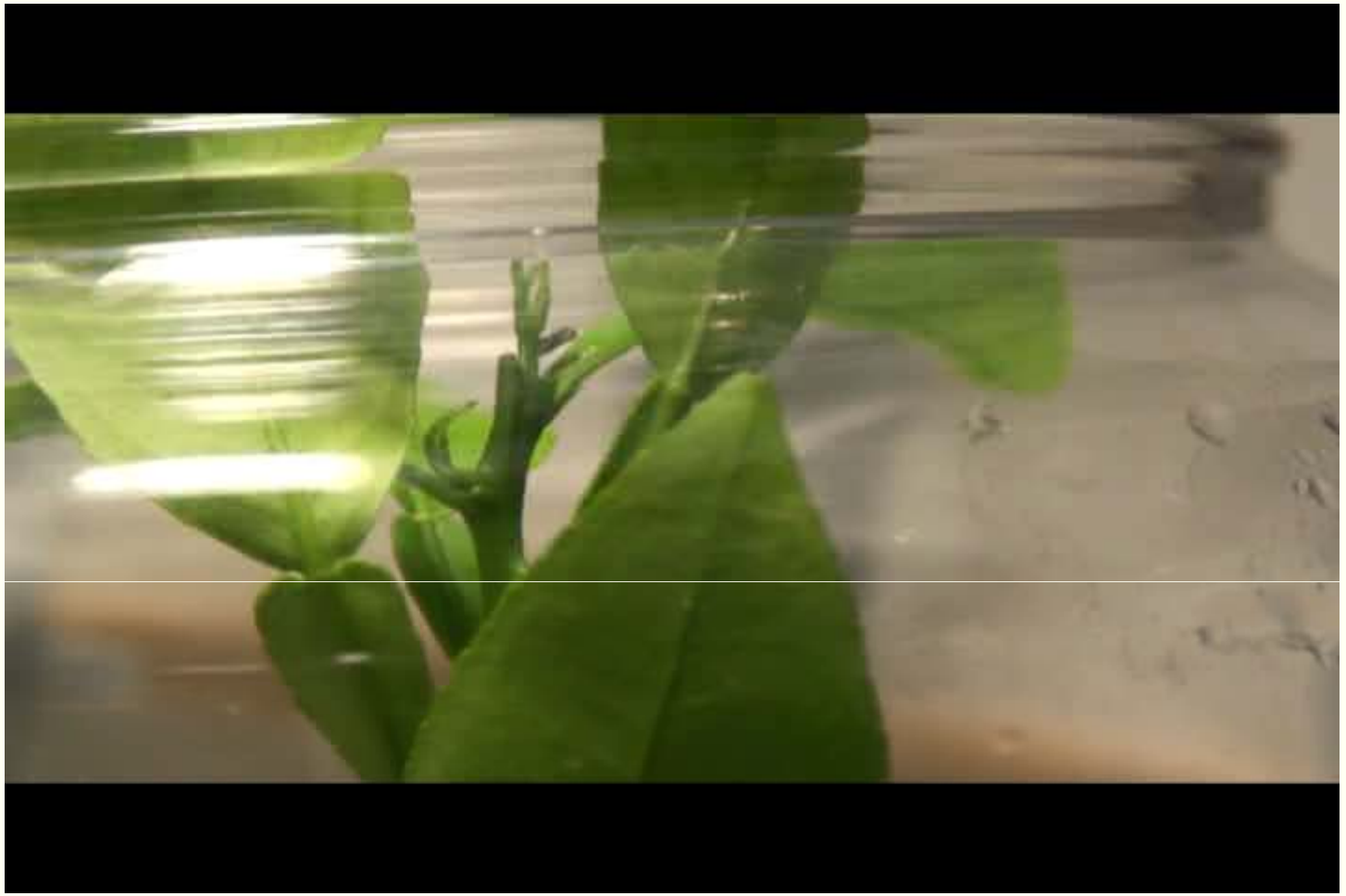
A combination of visual cues, pheromones, and sound



Y-tube olfactometer studies indicated that virgin males are attracted to mated females. This is behavioral evidence that females emit a sex pheromone.

Acoustic investigations indicated that both males and females produce low-amplitude sounds via substrate-generated vibrations





Both females and males use acoustic signaling to find each other, but mated females emit a sex pheromone that preferentially attracts virgin males

Thank you, Gracias

Psyllid vac?