Mealybugs in Citrus

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UC IPM
UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources
Statewide Integrated
Pest Management Program

Outline

- Background
- Life cycle, life stages, and identification
- Scouting/monitoring
- What do we know about its seasonal phenology
- Management options and best management practices

Mealybugs

- Hemiptera: Pseudococcidae
- Soft, oval-bodied insect
- Distinctly segmented and covered with mealy wax
- Common pests in greenhouses
- Found in colonies
- Hard to control

Mealybugs in California citrus

Scarlet mealybug
Pseudococcus calceolariae

Comstock mealybug
Pseudococcus comstocki

Long-tailed mealybug
Pseudococcus longipinus

Citrus mealybug
Planococcus citri
Most common species

Barret and Lloyd 1958

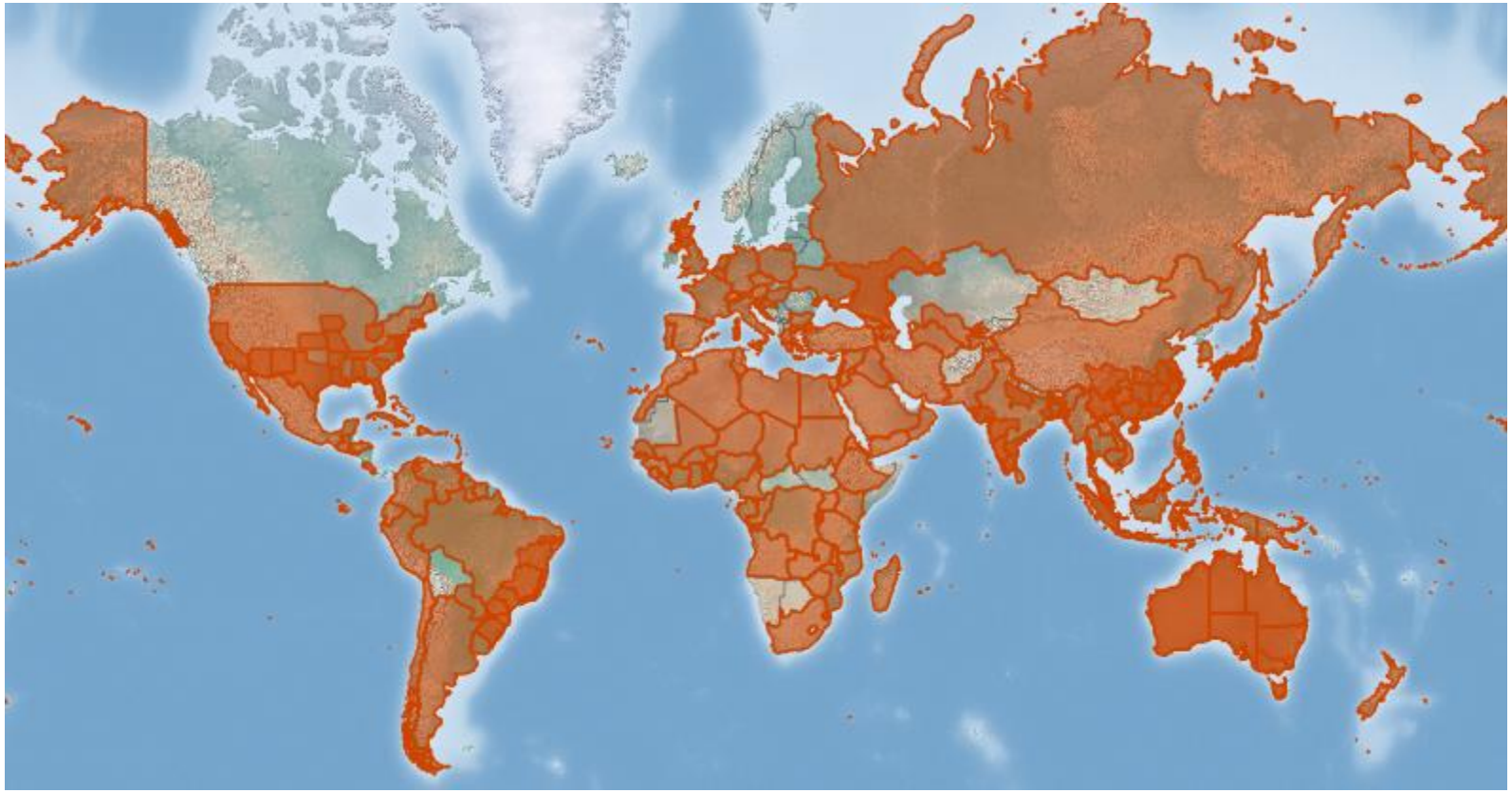
Hosts

- Polyphagous
- Recorded from 200 host plants
- Ornamentals – marigold, gardenia, hibiscus
- Fruits: citrus, banana, cocoa, pineapple, pomegranate, olive, grapes, coffee, potato tubers

Damage

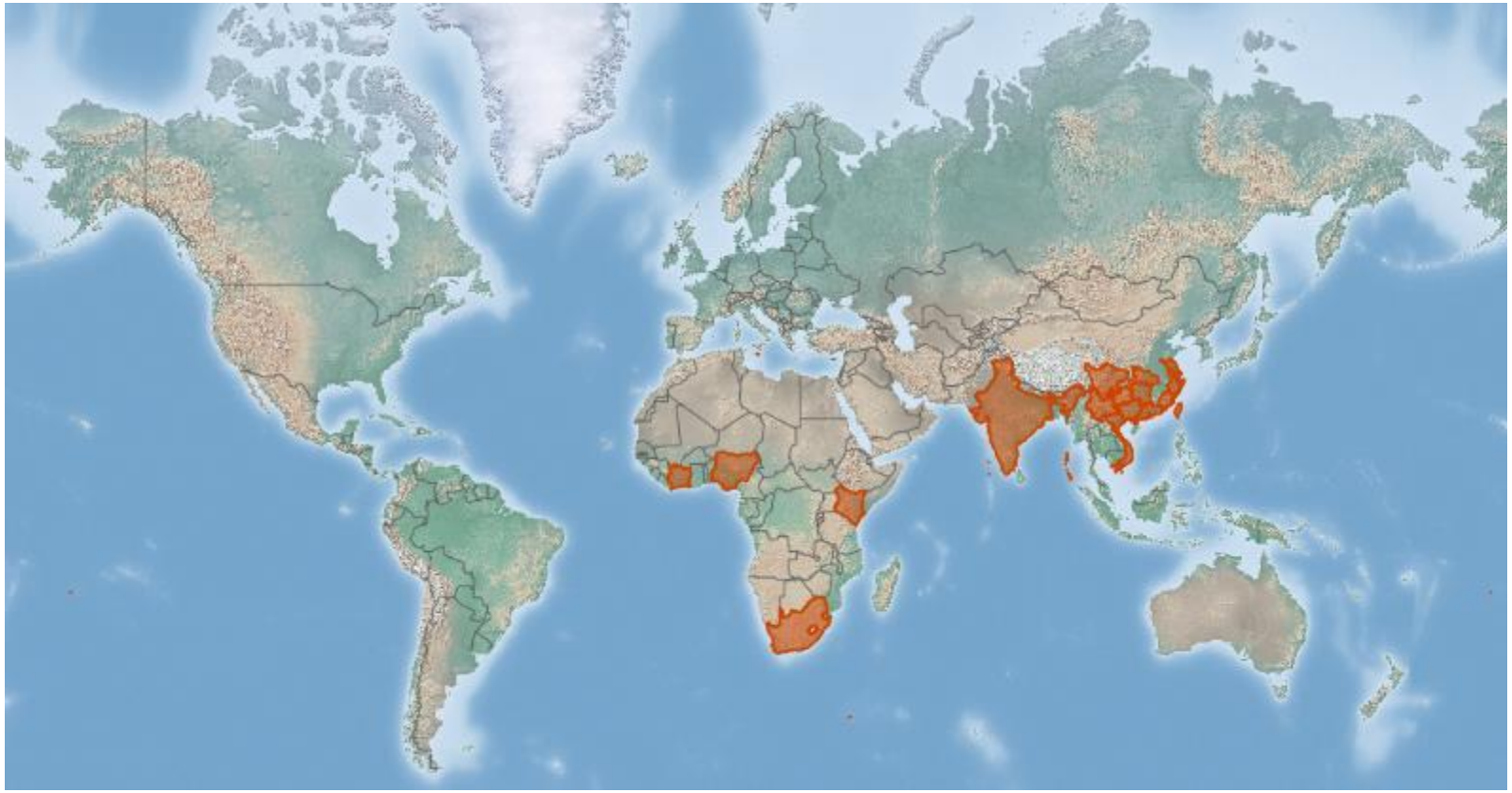
- Direct feeding:
  - Suck plant sap, reduce vigor
  - Leaves: discoloration, leaf drop (80% reported)
  - Fruit: Bleached feeding spots, abnormal shape, fruit drop (100% reported)
- Indirect damage:
  - Presence of honeydew and sooty mold

Distribution



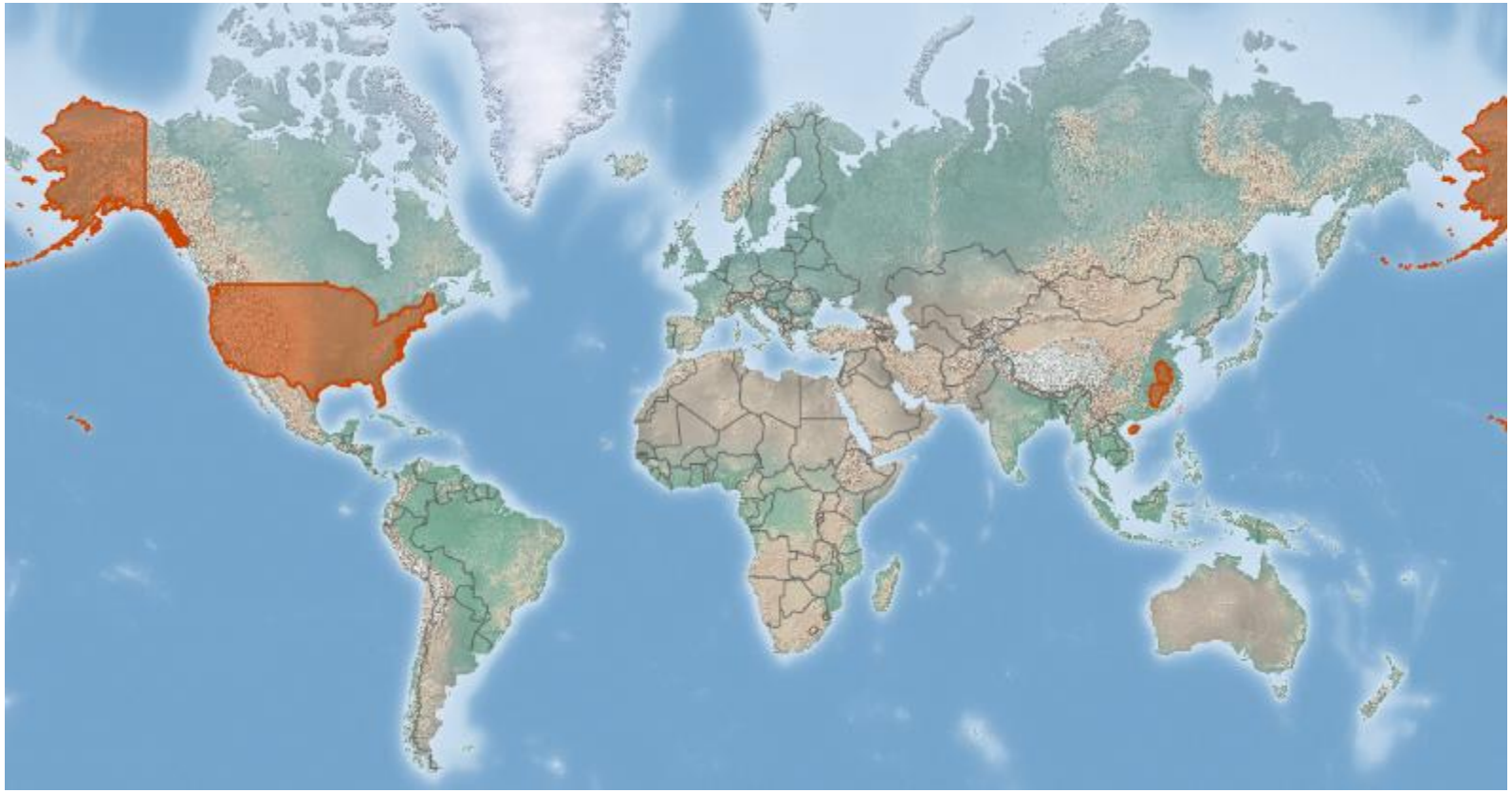
Present throughout the world!

Distribution



Widely distributed

Distribution



Localized

Distribution of citrus mealybug in California

CDFA reports

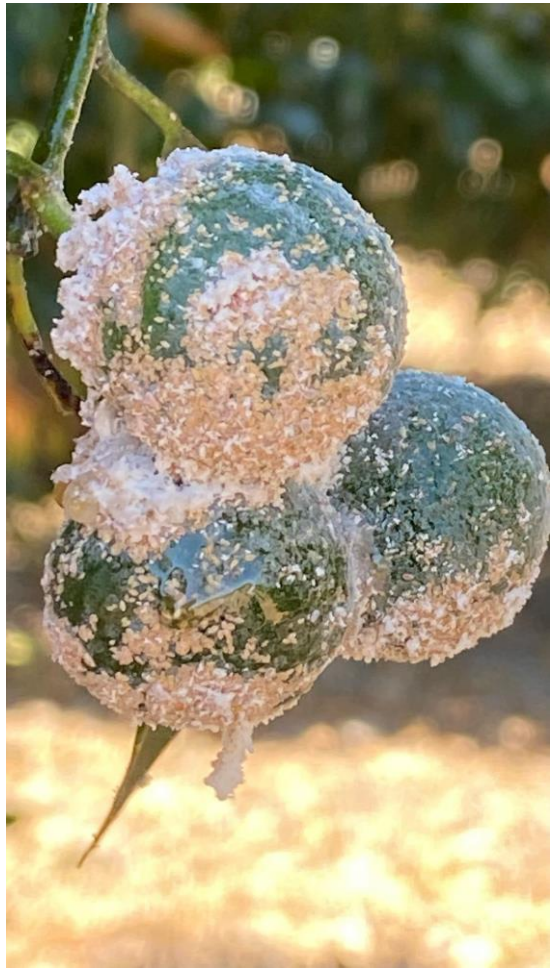
- Riverside: 1900
- Ventura: 1900
- Los Angeles: 1900
- Kern: 1989
- Kings: 1996
- Fresno: 1996
- Tulare: 1991
- Madera: 2000

- Other counties: Placer, Santa Cruz, Contra Costa, San Mateo, San Jose, San Luis Obispo, Santa Barbara

Serious infestations reported from SJV in recent years!

- Increasing reports from the San Joaquin Valley
- Infests all citrus varieties - lemons, mandarins, oranges, grapefruit
- Some growers treated for mealybug in 2021

Some photos of 2022 infestations



Why is mealybug becoming an issue?

- Loss of chlorpyrifos – December 2020
- Reduced use of systemic insecticides
- Use of broad spectrum and its effect on natural enemies
- Cryptic nature of the pest
- Warm winter = less overwintering mortality

Early infestations are easy to miss

- Cryptic behavior or clumped spatial distribution – concealed in protected areas
- Frequent overlapping generations – eggs are protected within egg sac
- The hydrophobic waxy body covering of adults repels hydrophilic (water-loving) insecticides. Eggs are somewhat protected.

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Working towards Mealybug IPM in citrus

- Biology – Life cycle and identification
- Scouting and monitoring mealybugs
- Seasonal phenology – What do we know and how can it help?
- Evaluate chemical control options for near-term management

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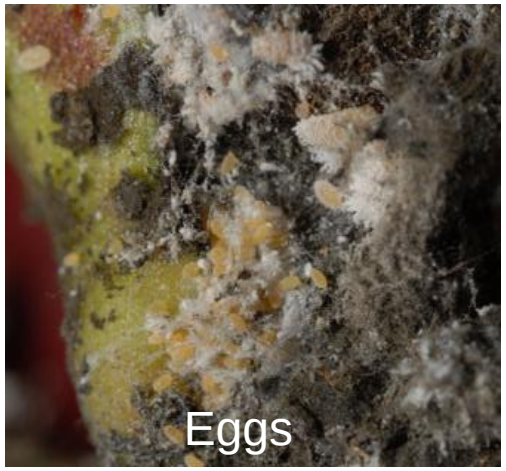
Life cycle of mealybug

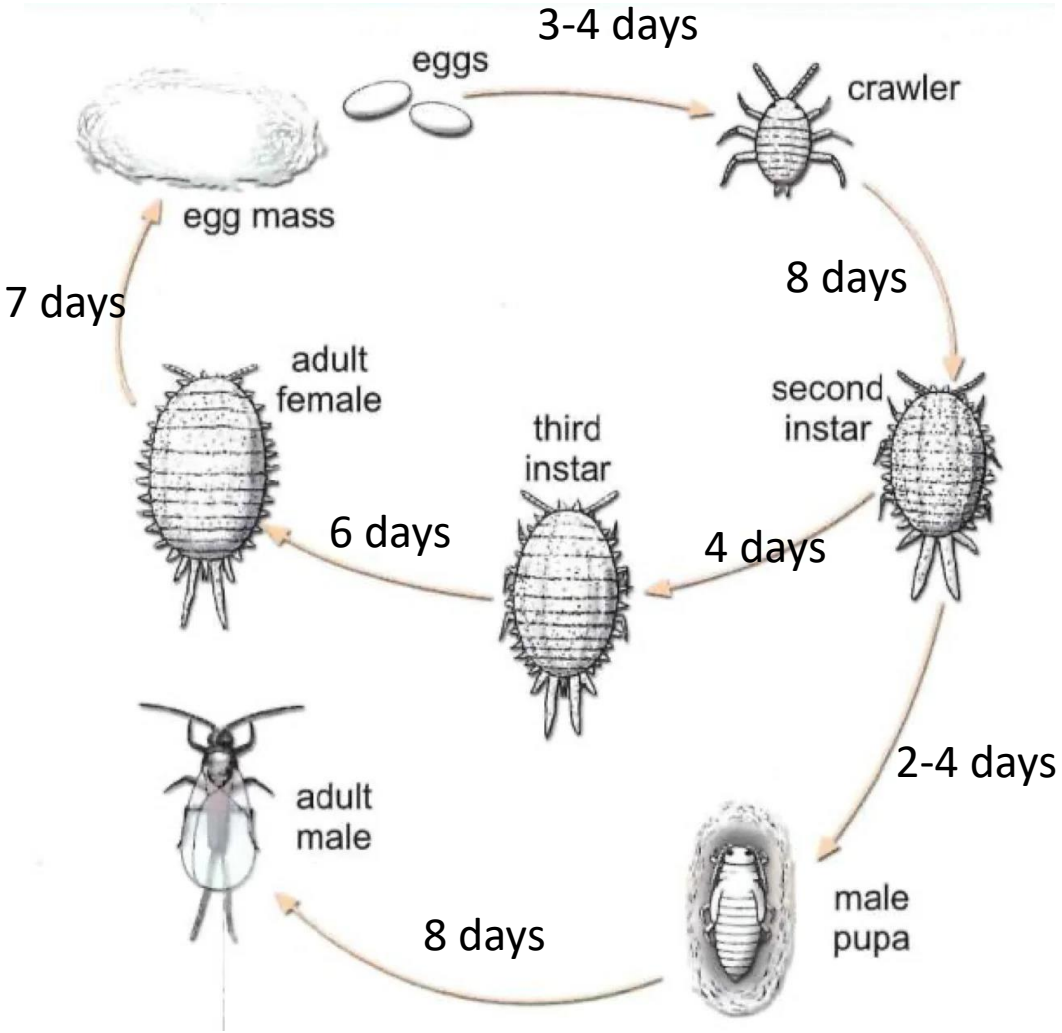

Egg laying female with ovisac


Eggs

Females have three nymphal instars, males have two nymphal instars, pupa and adult.

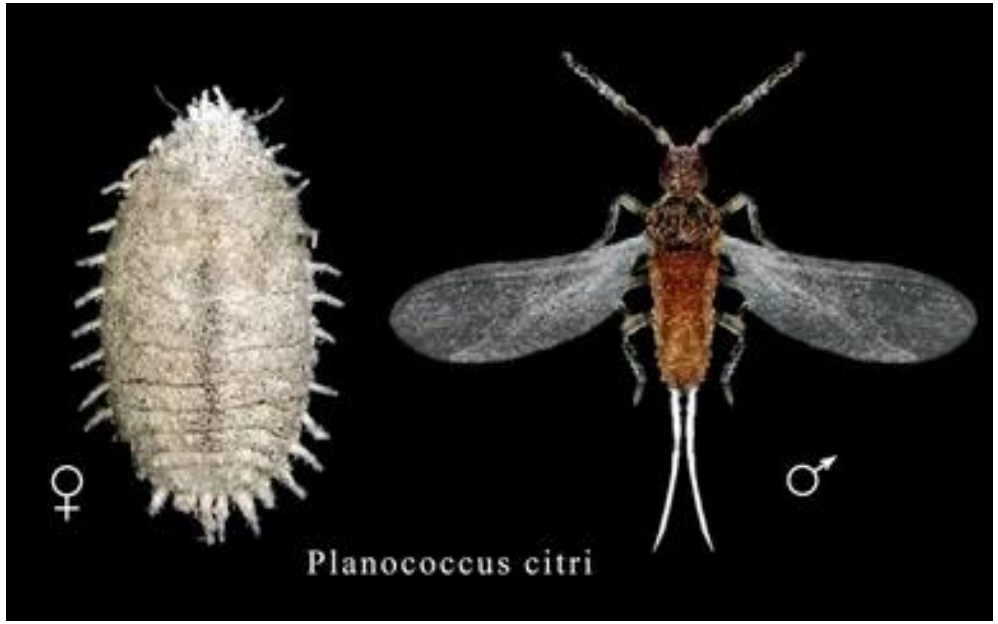

Nymph


Adult male (winged) and a female



Diagnostic characteristics female citrus mealybug

- No wings
- ~3 mm long body, half as wide
- Pink body when molted, dusted white covering, appears “dusted in flour”
- A vertical line runs through the middle of the body
- Antennae have 8 segments
- Egg sac can be present under the body
- Egg sac is loosely held whitish bag with amber yellow-colored eggs



Diagnostic characteristics male citrus mealybug

- Males have wings
- Narrower and smaller than females (4-5 mm in length)
- Reddish brown/ young adults can be lighter in color
- Two wings with minimal venation
- Antennae is hairy

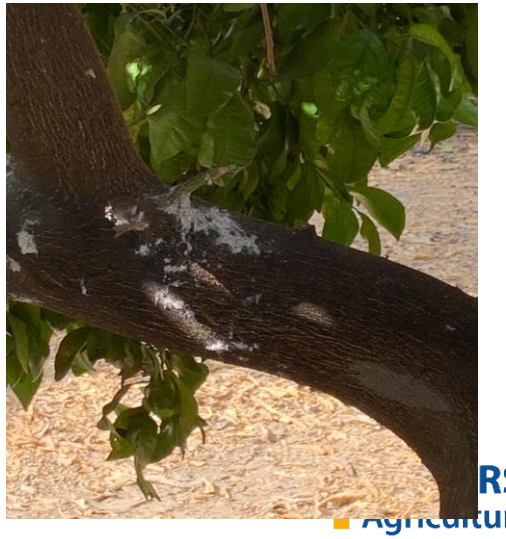
Scouting for mealybugs

➢**No simple method to monitor**
- Population density, location on plant
- Clumped distribution (sampling methods/frequency)

➢ Signs of an infestation can be an indicator of active populations – check inner canopy!

➢ **During the season (March – September)**
- White flecks or cottony/silky residues on leaves, fruit, trunk
- Honeydew/sootymold
- Crawlers, adults and eggs sacs between clusters of the fruit

➢**Before or at harvest (September-February/March)**
- White flecks or cottony/silky residues trunk
- Between dense foliage (sooty mold can be an indicator)
- Adults and eggs sacs on fruit (navel end, between clusters)
- Check fruit bins – sepal or navel end of fruit



How biology and movement can inform management?

Life stage	Does it feed?	Does it move?	Monitoring	Management		
				Chemical	Biological	Mating disruption?
Eggs	No	No	Egg sacs near females	Protected within the sacs – most likely ineffective	Cryptolaemus prefers feeding on egg sacs	N/A
Crawler	Unknown	Yes	Sticky tape	Contact insecticides	Predators and parasites	N/A
2-3 instars	Yes	Yes, but less than crawlers	Sticky tape	Contact Systemic	Predators and parasites	N/A
Adult female	Maybe	Limited		Little effect – waxy covering	Predators and parasites	N/A
Adult male	No	Yes, flight	Trap cards	N/A	Unknown	potential

Questions 1 and 2

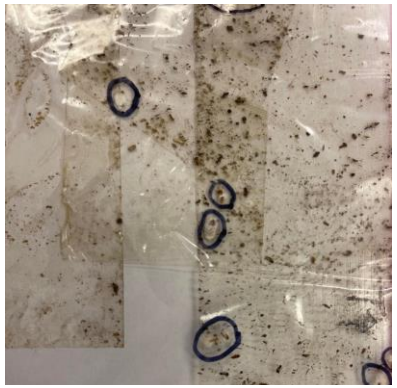
1. Which of the following is an indicator of mealybug infestation?
    a. Sooty mold-covered leaves and fruit
    b. Scale-covered leaves
    c. Wax/silk threads on trunks, twigs, leaves, and fruit
    d. All above
2. Which life stage of the citrus mealybug can move?
    a. Crawlers
    b. First instars
    c. Second instars
    d. Females
    e. All

Seasonal phenology in SJV

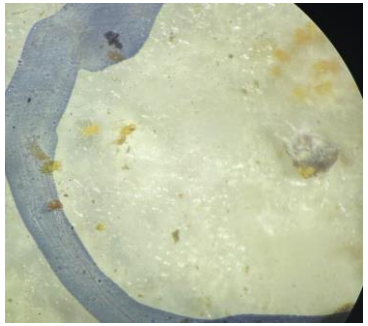
- When and where are they present in a tree? How are they moving?
- How many generations are there in a season?
- Can we use pheromone trap cards to monitor males?

How are mealybugs moving?

- 13 trees in a block with known populations in 2021 monitored in Tulare co
- Double-sided sticky tape traps – trunk, inner branches
- Traps changed weekly and number of crawlers/adults counted to determine seasonal population



Females caught on trap



Crawlers caught on trap

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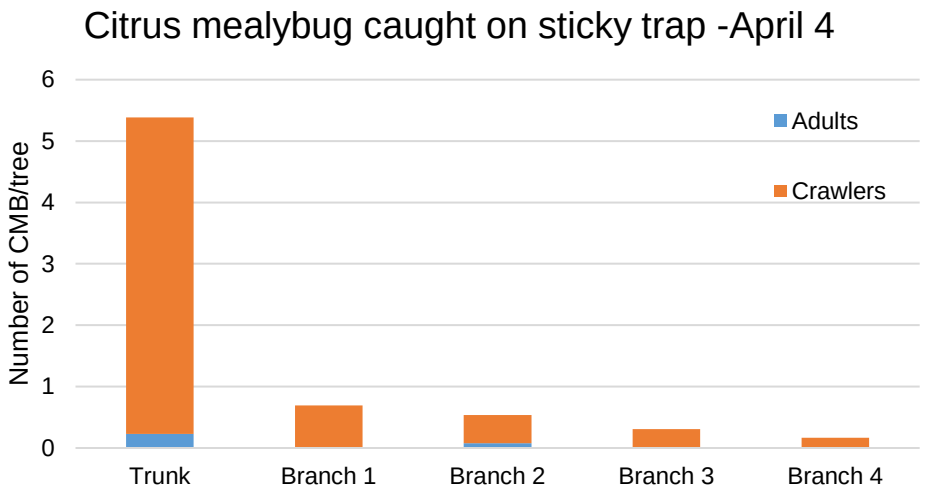
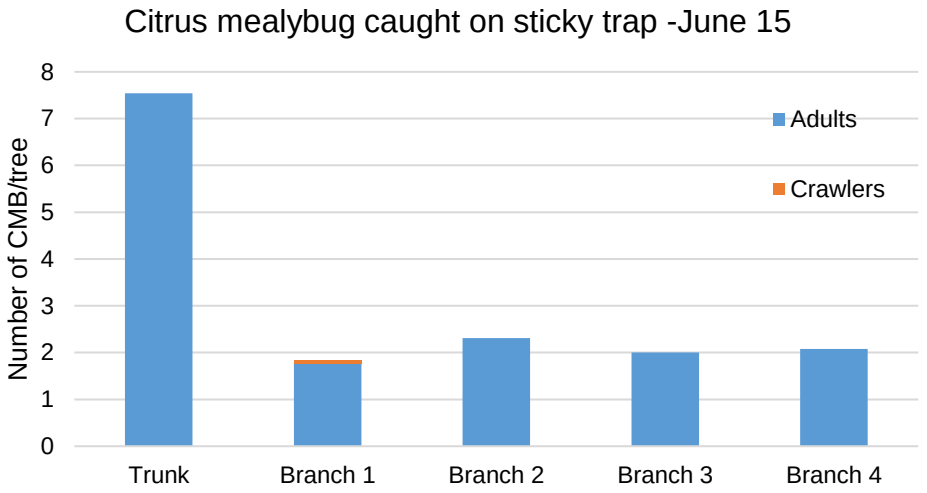
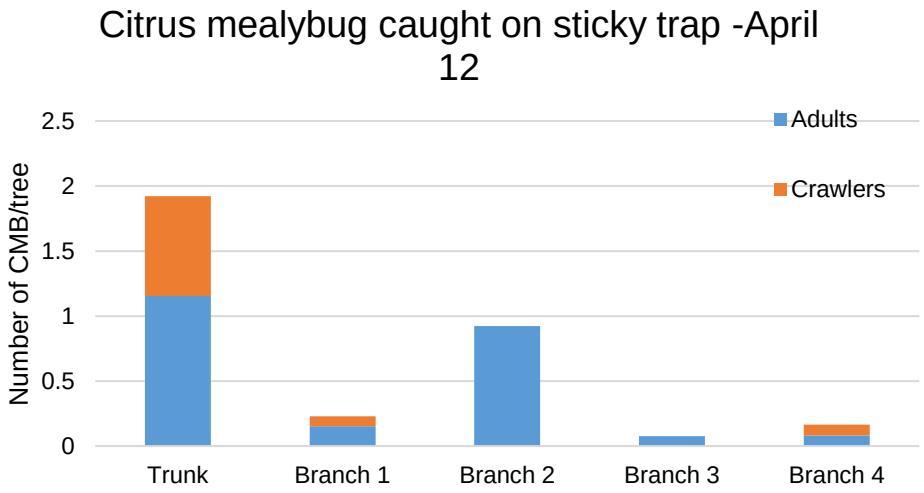
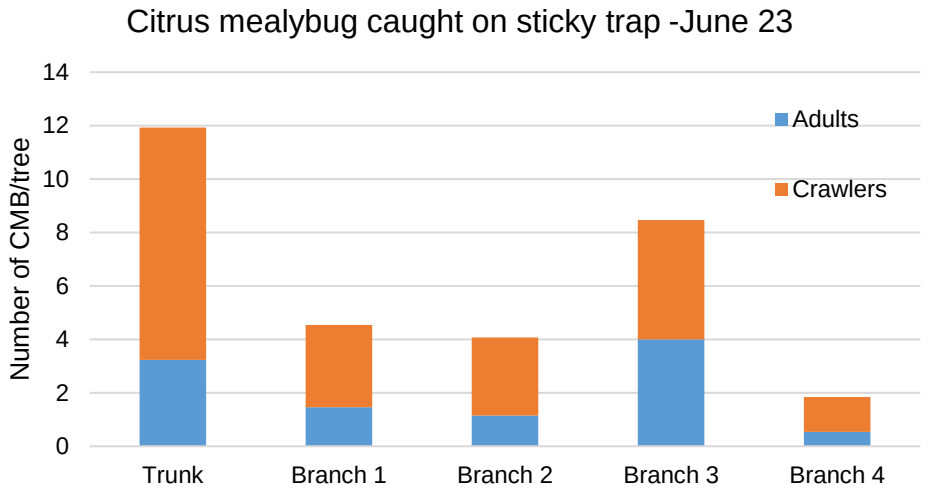
Within the tree canopy – its everywhere!









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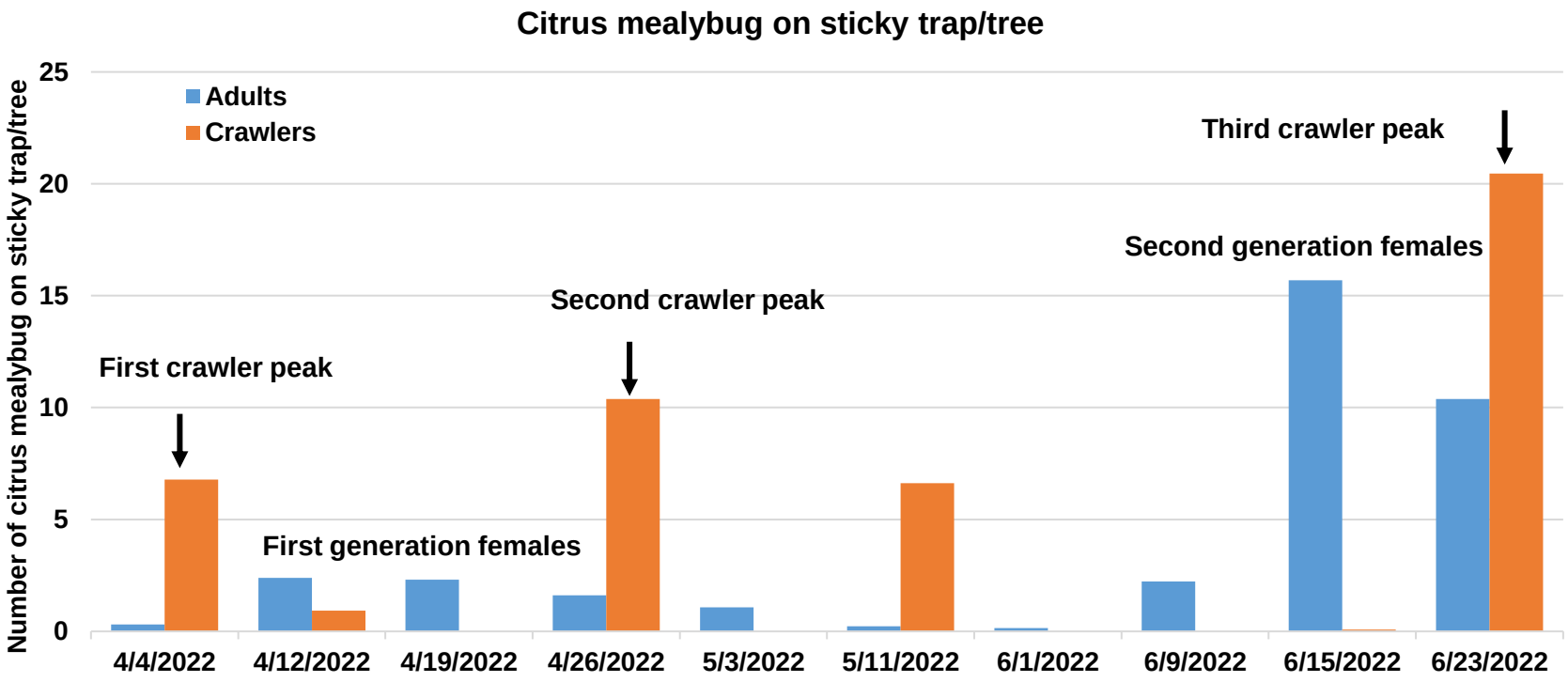
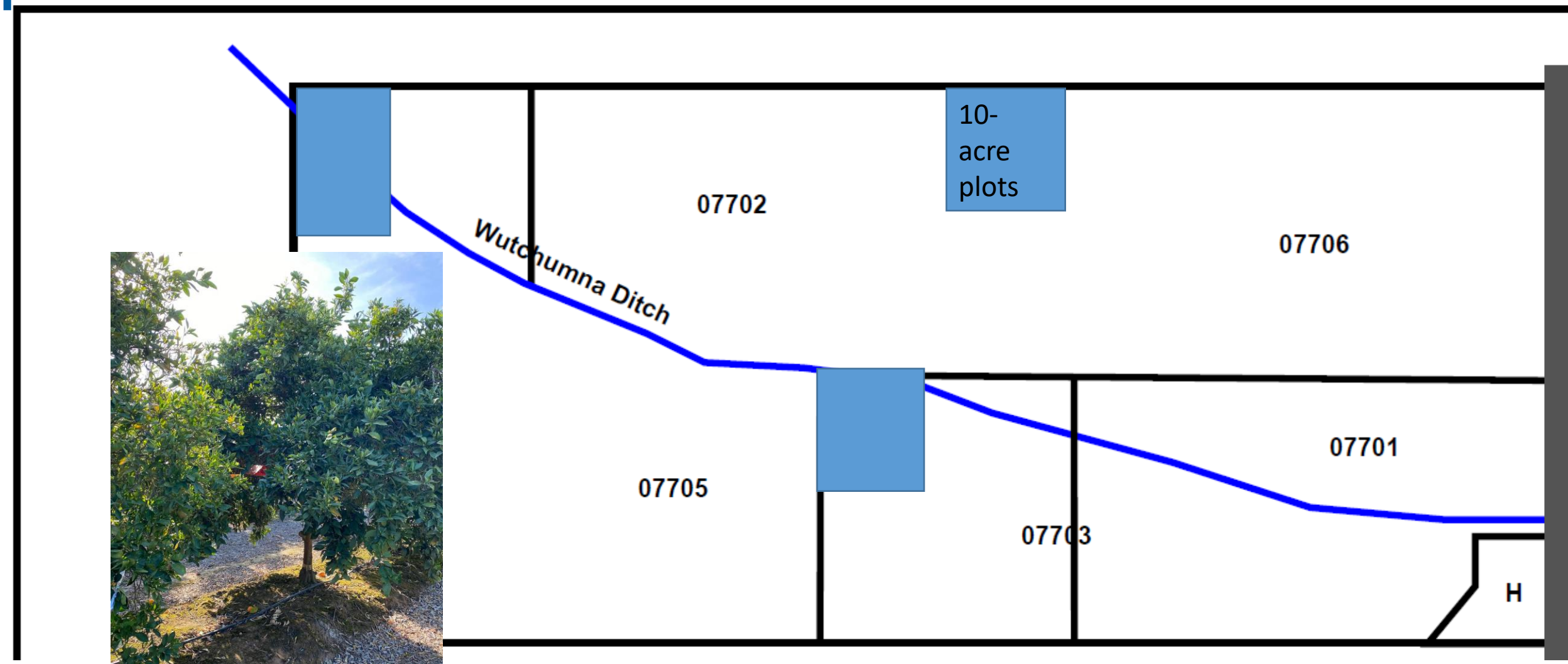
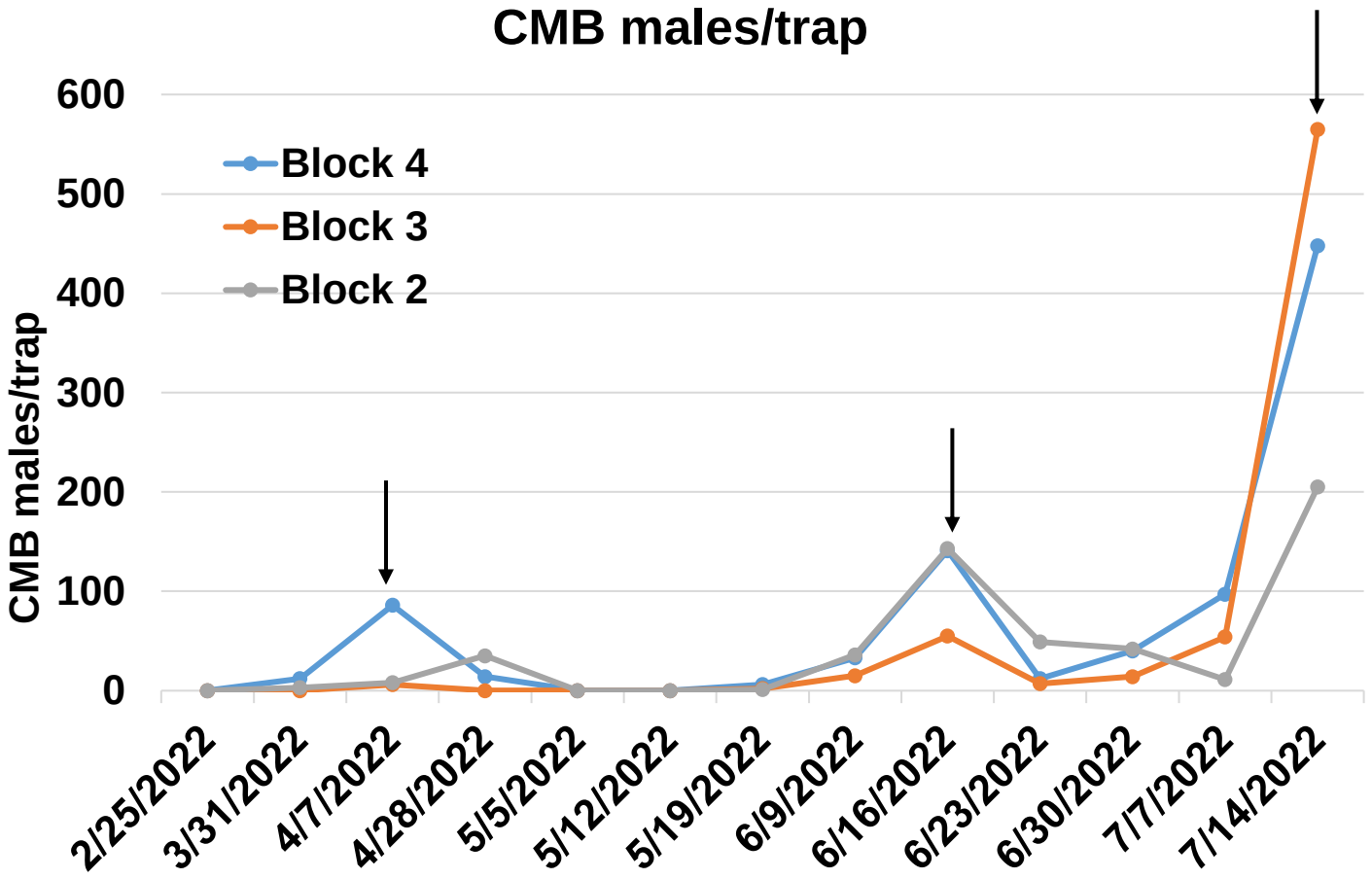
Population structure from April-June

April	May	June



Studying male flight using trap-cards and pheromone lure





Trap optimization for monitoring CMB males – Ongoing study, Georgina Reyes, M.S. student, Fresno State Univ.

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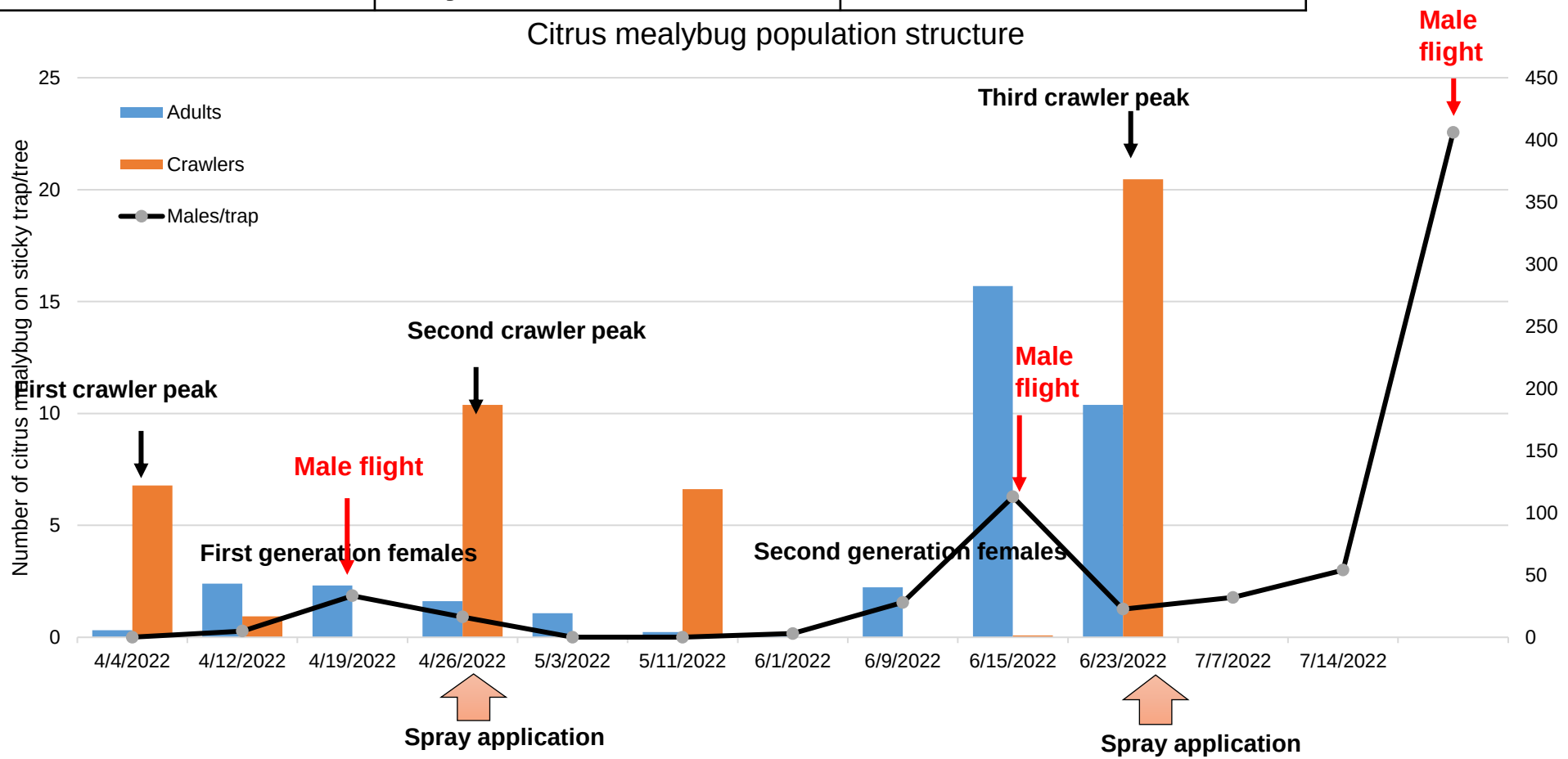

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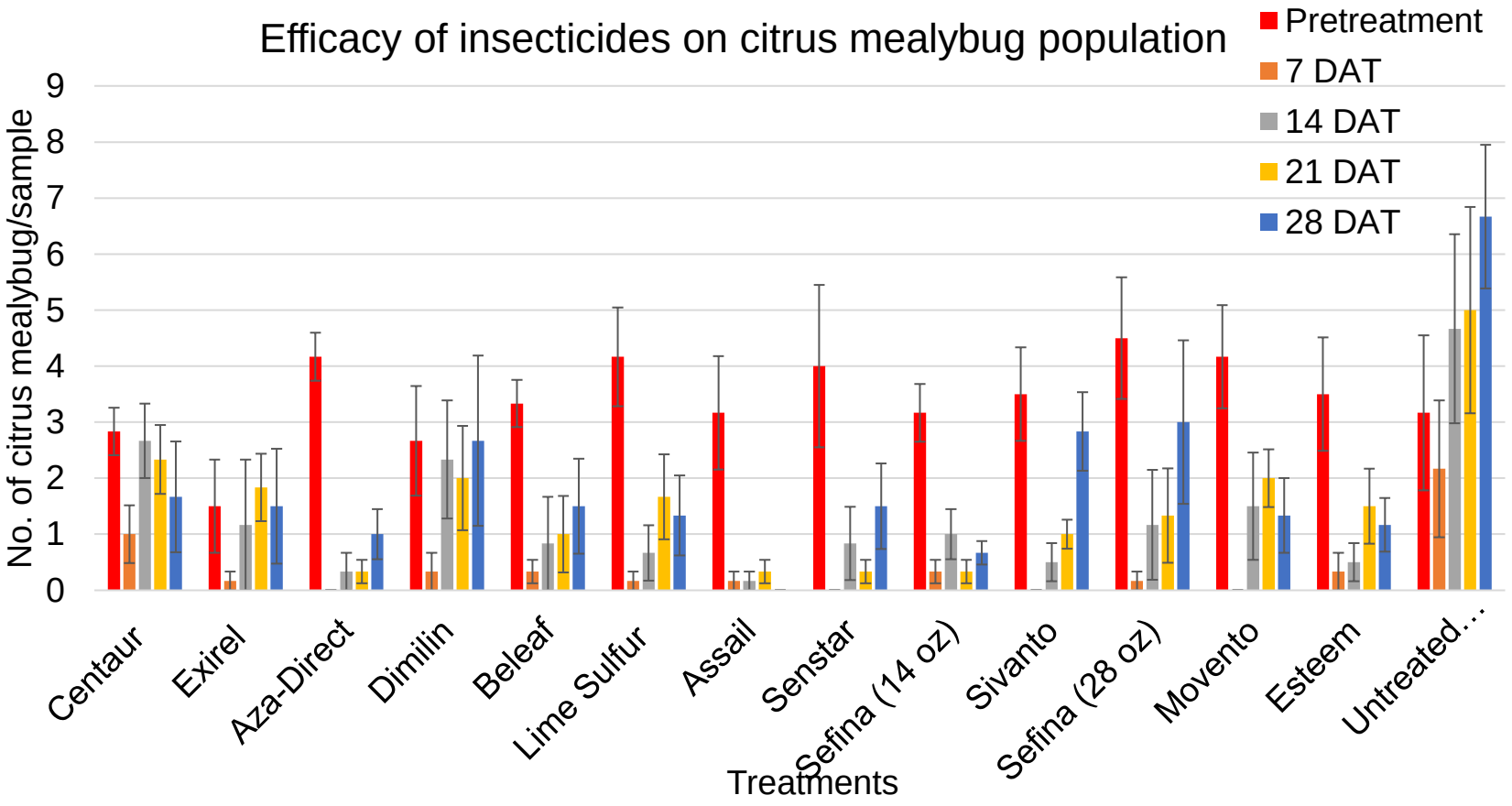
Management: Chemical control

Near future solution to growers.

- Field trial in a block with known mealybug infestations
- Screened 13 materials registered for citrus
- Application using backpack sprayer
- Post-treatment count every week for 4 weeks
- Application made on March 29

Chemical control



High GPA, adjuvant, and oil used for better coverage.

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Biological Control

Cryptolaemus montousieri

Mealybugs are historically known to be controlled by natural enemies.

Barret and Lloyd 1958

- Predators: Mealybug destroyer, brown lacewing, green lacewings, minute pirate bugs etc.
- Several parasite species are present in coastal and southern CA region.
- The augmentative release of mealybug destroyer is recommended, but it doesn't tolerate hot temperature or cold winters.
- Literature suggests the best release time is when mealybug ovisacs are present

Cultural control

- Maintain good sanitation within the orchard - remove old infested fruits/branches when possible
- Scout the field looking for early signs of infestation – check trunk, inside canopy fruits, sooty mold covered leaves, fruit at harvest
- Prune trees so that branches are not touching, open-up canopy – mealybugs like dense foliage

Mealybug IPM context

- Citrus mealybug in an increasing concern for citrus growers in SJV
- Knowledge on pest biology and seasonal phenology can direct management actions
- Scouting/monitoring is season dependent
- 4-5 generations may be present in the SJV
- Sanitation may help reduce human mediated transport
- Scout to determine early signs of infestation
- Spray application when necessary – aim through coverage as mealybug is inside canopy pest

Food for thought

- How does current IPM practices for two key pests in SJV, citrus thrips and California red scale affect mealybug IPM?
- What natural enemies are present in the SJV that could aid to mealybug control?
- Will mealybug destroyer establish under SJV weather conditions?

Questions 3 and 4

1. Which life stage of mealybugs should spray applications target?
    a. Immatures
    b. Eggs
    c. Adults
2. For pesticide application, the spray application should aim for
    a. Outer canopy coverage
    b. Through coverage
    c. Inner canopy coverage

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