Update on invasive carpophilus beetle (*Carpophilus truncatus*) infestation in almonds

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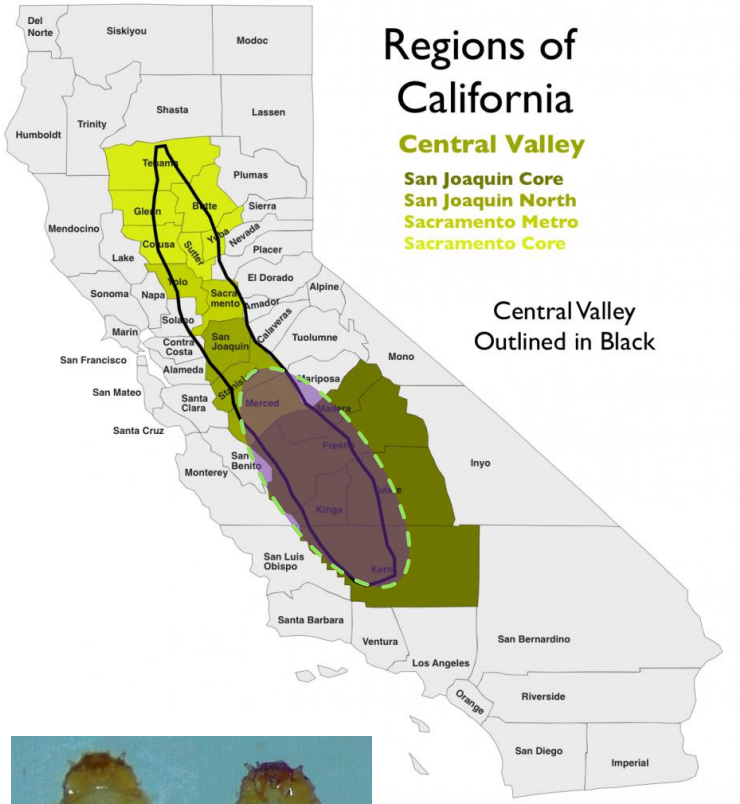
Agriculture and Natural Resources
UC Cooperative Extension

North San Joaquin Valley Almond Day
January 21, 2025, Modesto, CA

Background: Carpophilus beetle

- Invasive species attacking almond and pistachio kernels in CA; confirmed in 2023.
  - Multiple counties in San Joaquin Valley
- A type of sap beetle, *Carpophilus truncatus* (Coleoptera: Nitidulidae), infests almond, pistachio, and walnut.
- Since 2013, this beetle has caused economic damage to almonds in Australia (2-5% avg., 30-50% in some cases) (Madge 2022)
- Recently detected in other countries: Italy, Argentina
- Both adult and larva infest the healthy nuts after the hull split stage of the nut development in the field
  - *C. truncatus* is the only species of carpophilus attacking healthy nuts



~5 mm long

~2.5 mm long

Sap beetle group – Nitidulidae (General ID)

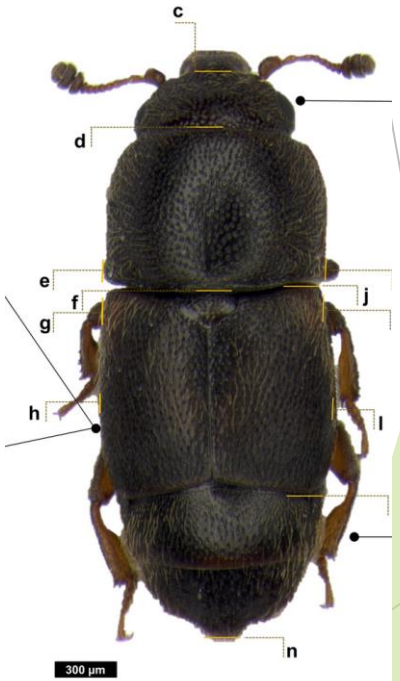
- Small and ovular body
- Carpophilus: clubbed antennae at the tip
- Secondary pests except CB

C. truncatus is the only species causing direct damage to healthy nuts

Confused sap beetle or flower beetle:
Carpophilus mutilatus

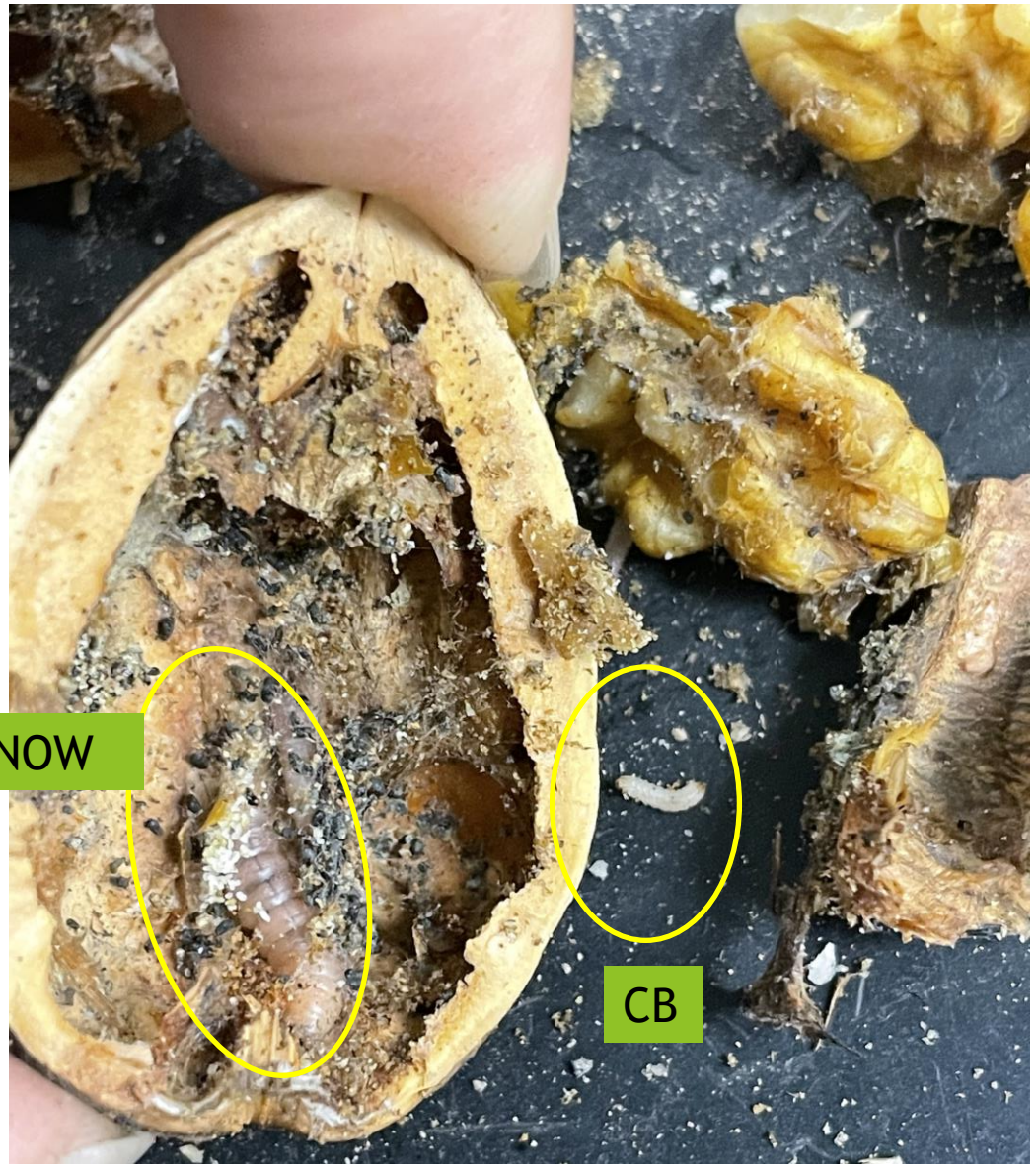
Dried fruit beetle,
Carpophilus hemipterus

Freeman sap beetle:
Carpophilus freemani



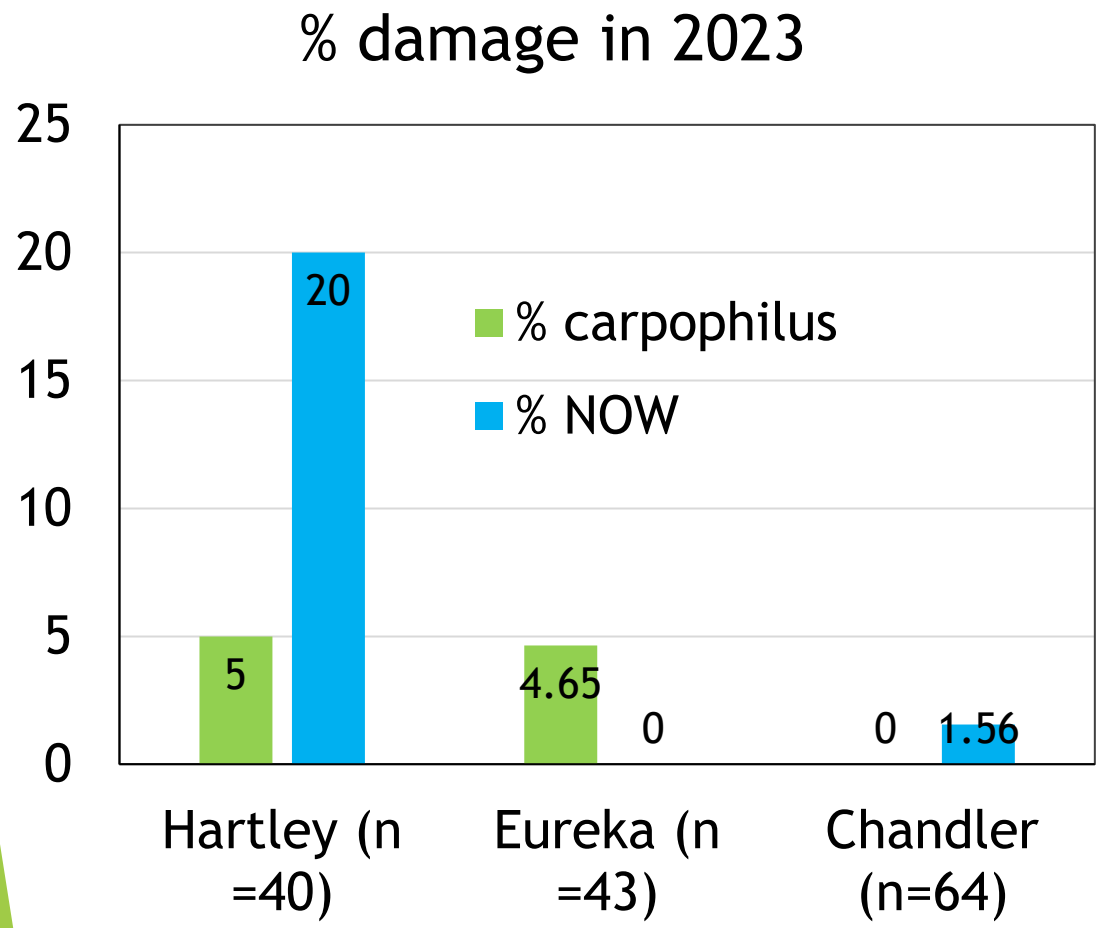
Carpophilus beetle:
Carpophilus truncatus

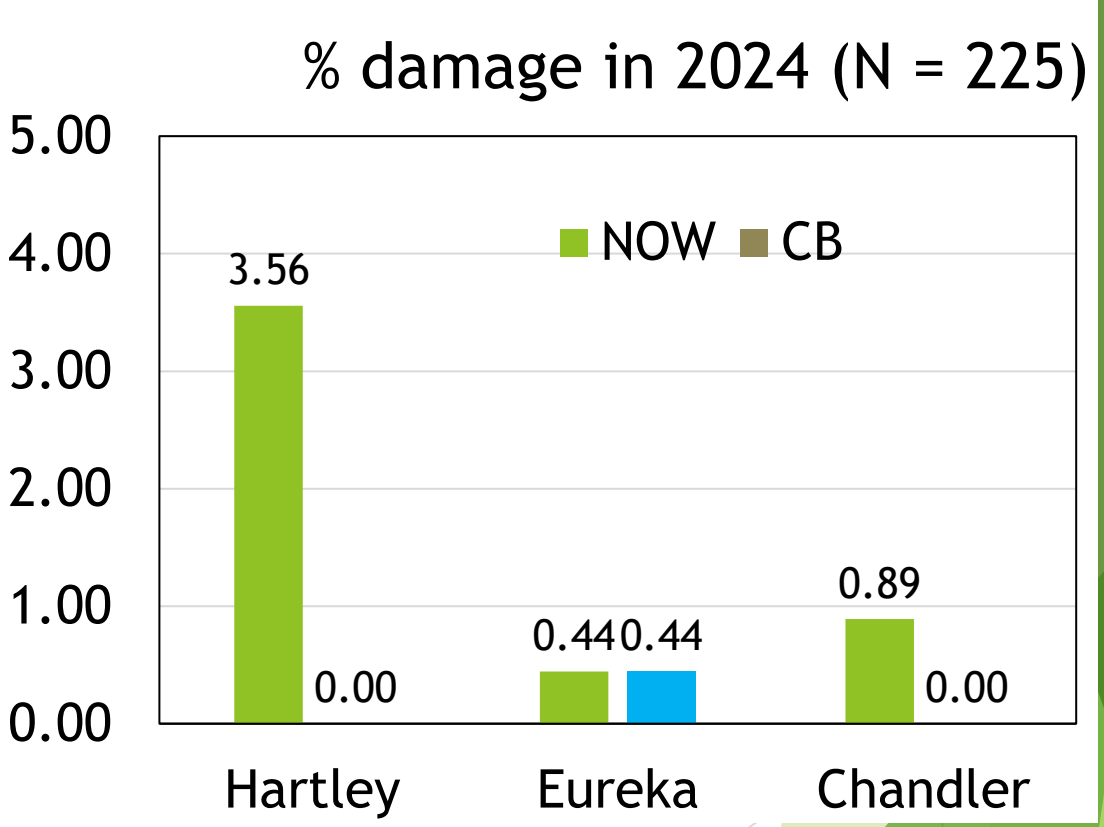
Carpophilus beetle infestation in walnuts (First Report in CA)



Found in Hartley, Eureka varieties (Stanislaus County)

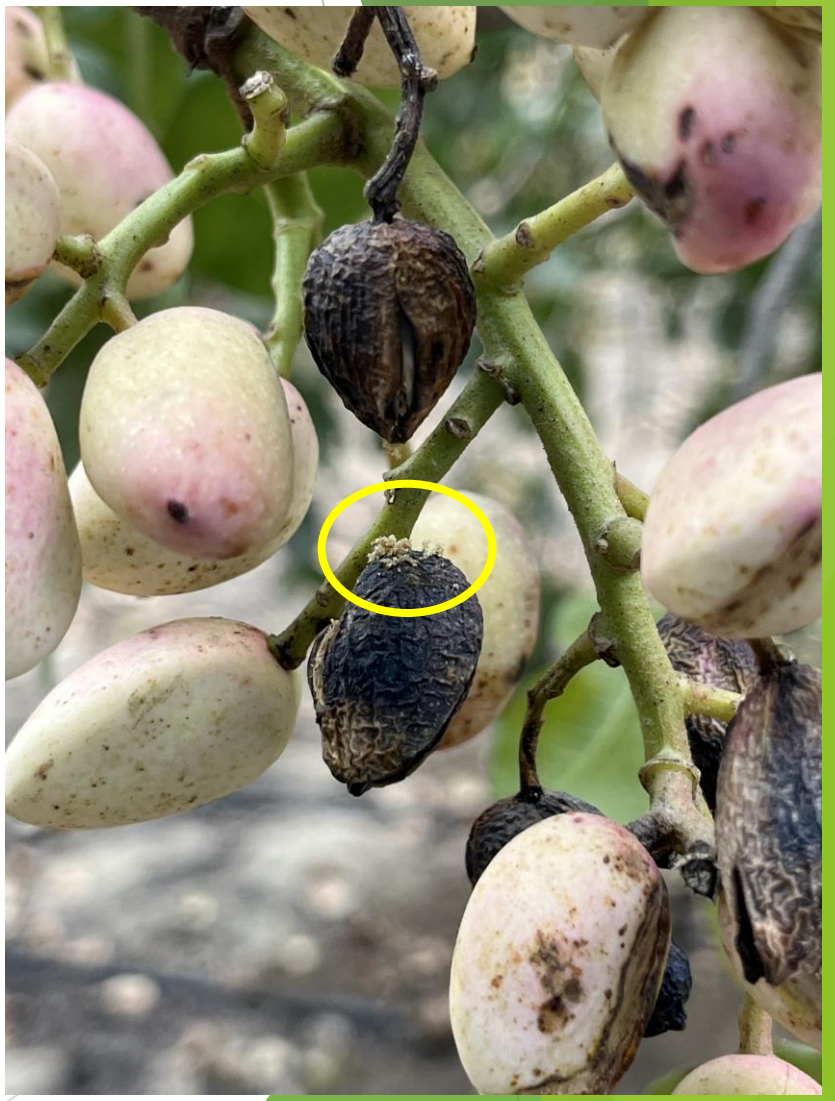
Carpophilus beetle infestation in walnuts (First Report in CA)





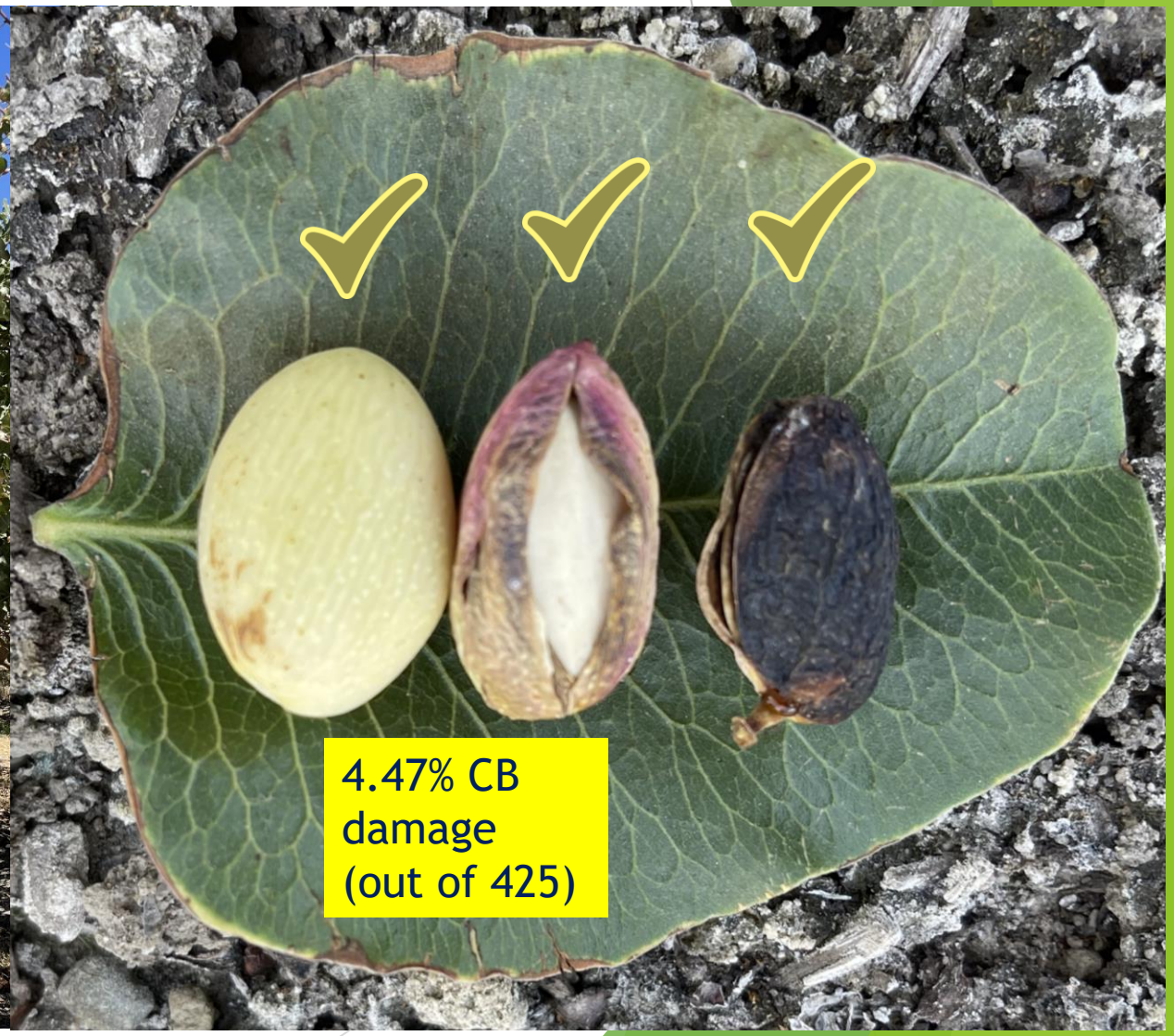
Tightly sealed varieties of walnuts seem to be less susceptible to CB infestation.

In pistachio, *Carpophilus truncatus* damage (Kings County, 2023)



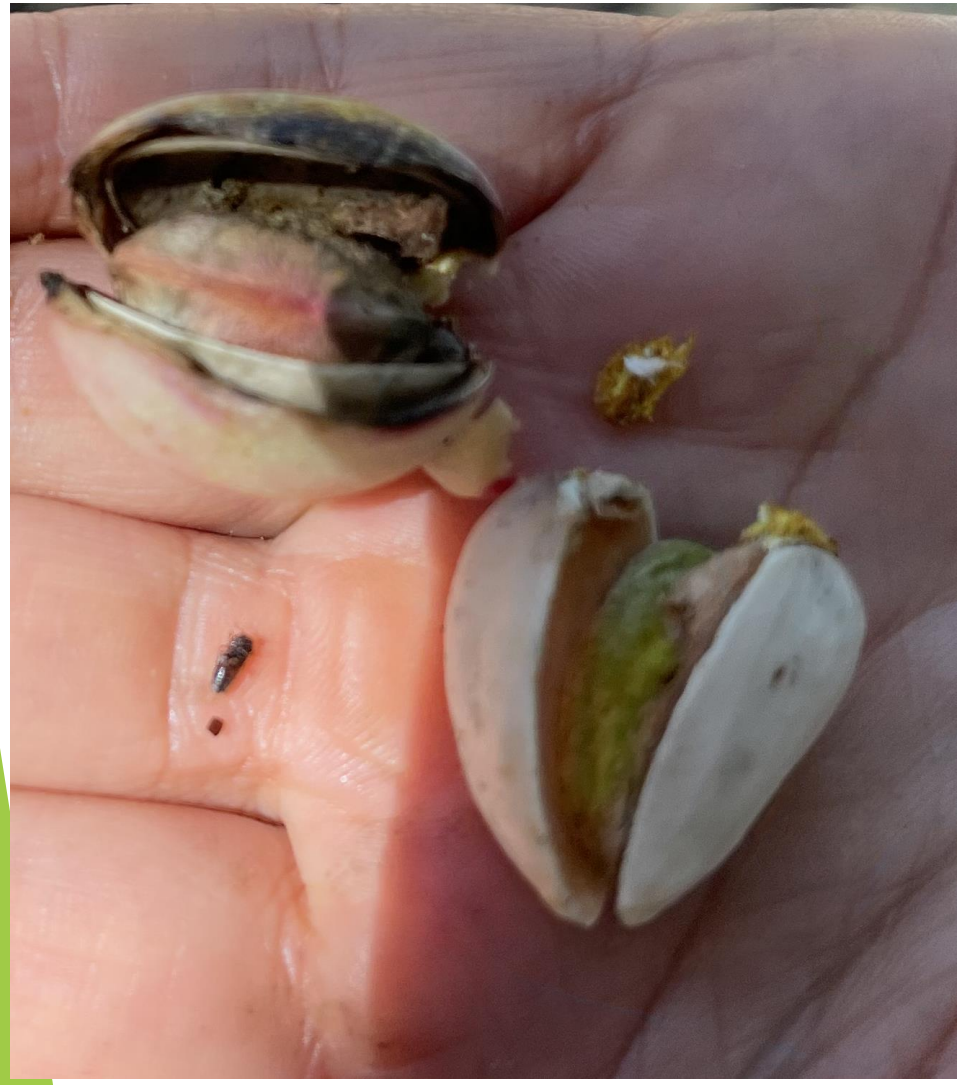
Photos credits: Sarah Meierotto, UC Riverside

In pistachio, Carpophilus beetle damage (Stanislaus & Merced, Mid-September 2024)



Photos credits: Jhalendra Rijal, UC ANR

In pistachio, *Carpophilus truncatus* damage (Stanislaus & Merced, 2024)

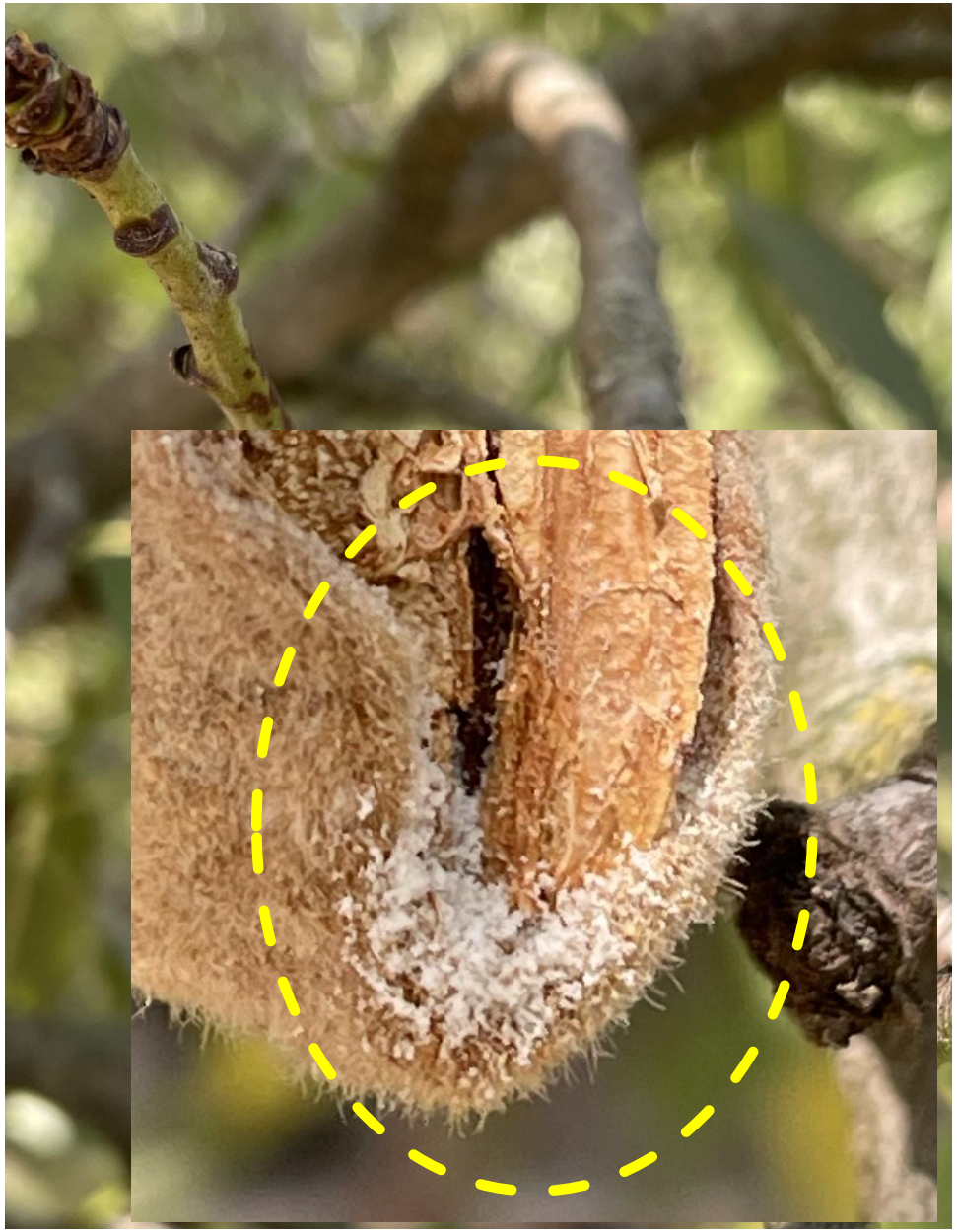


Photos credits: Jhalendra Rijal, UC ANR

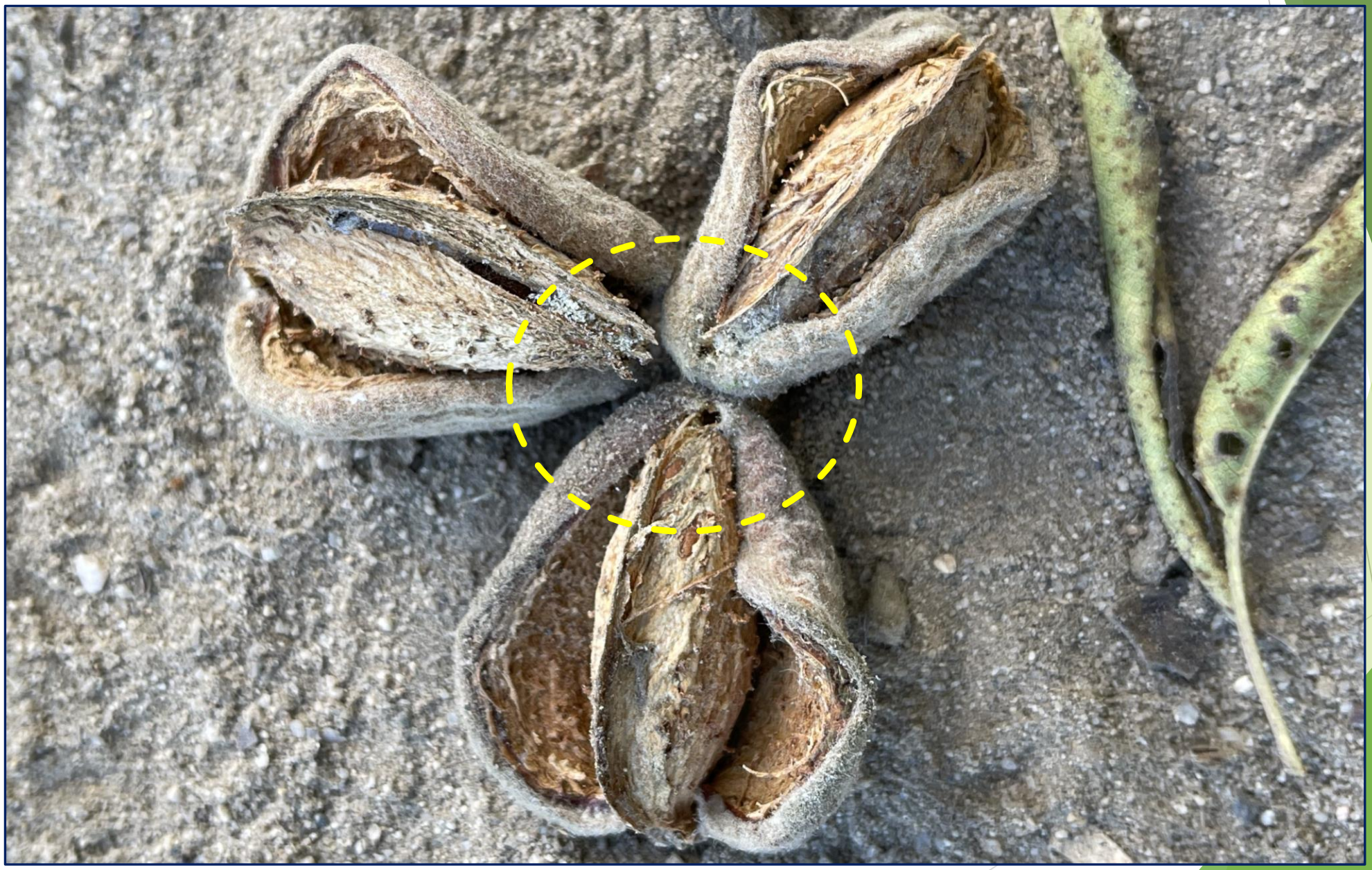
CB damage in almonds - kernel

Photo: Houston Wilson

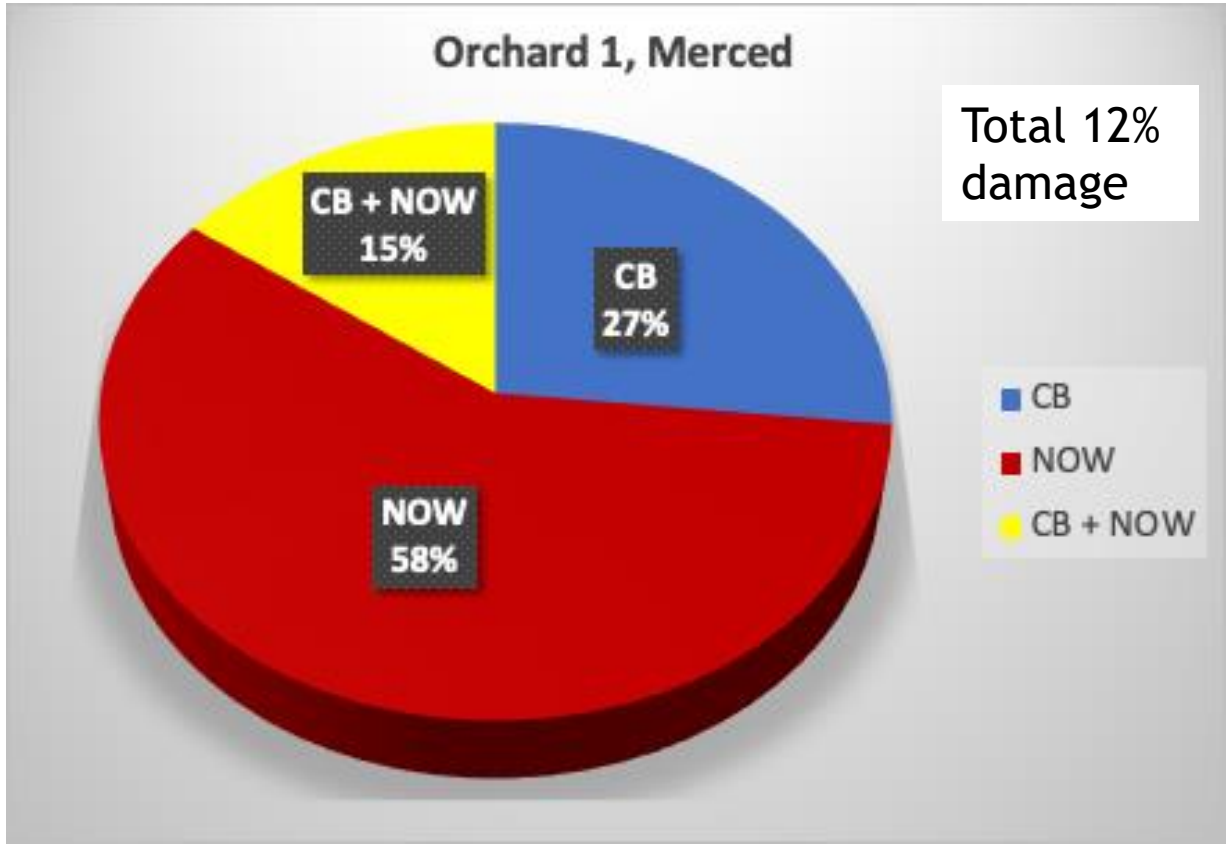
CB damage in almonds – hull/shell

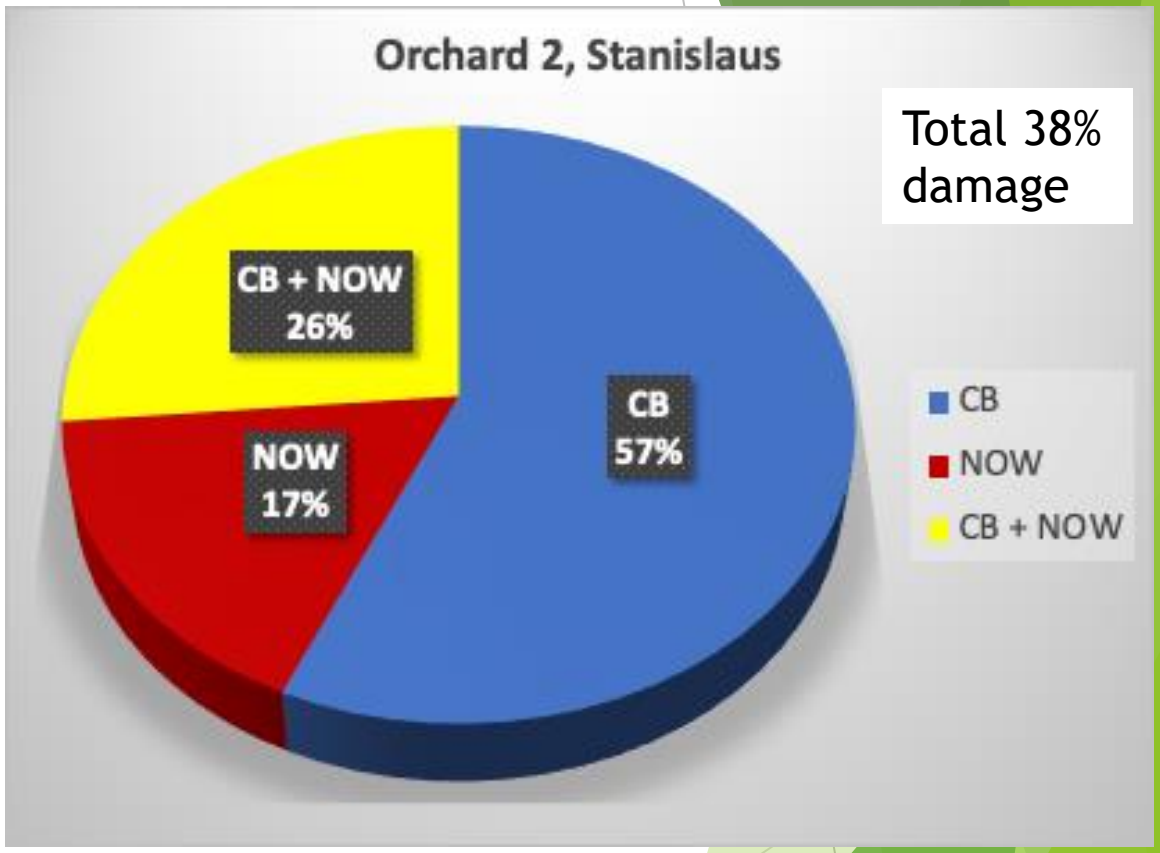


CB damage in almonds – hull/shell



Carpophilus beetle infestation in almonds-2023

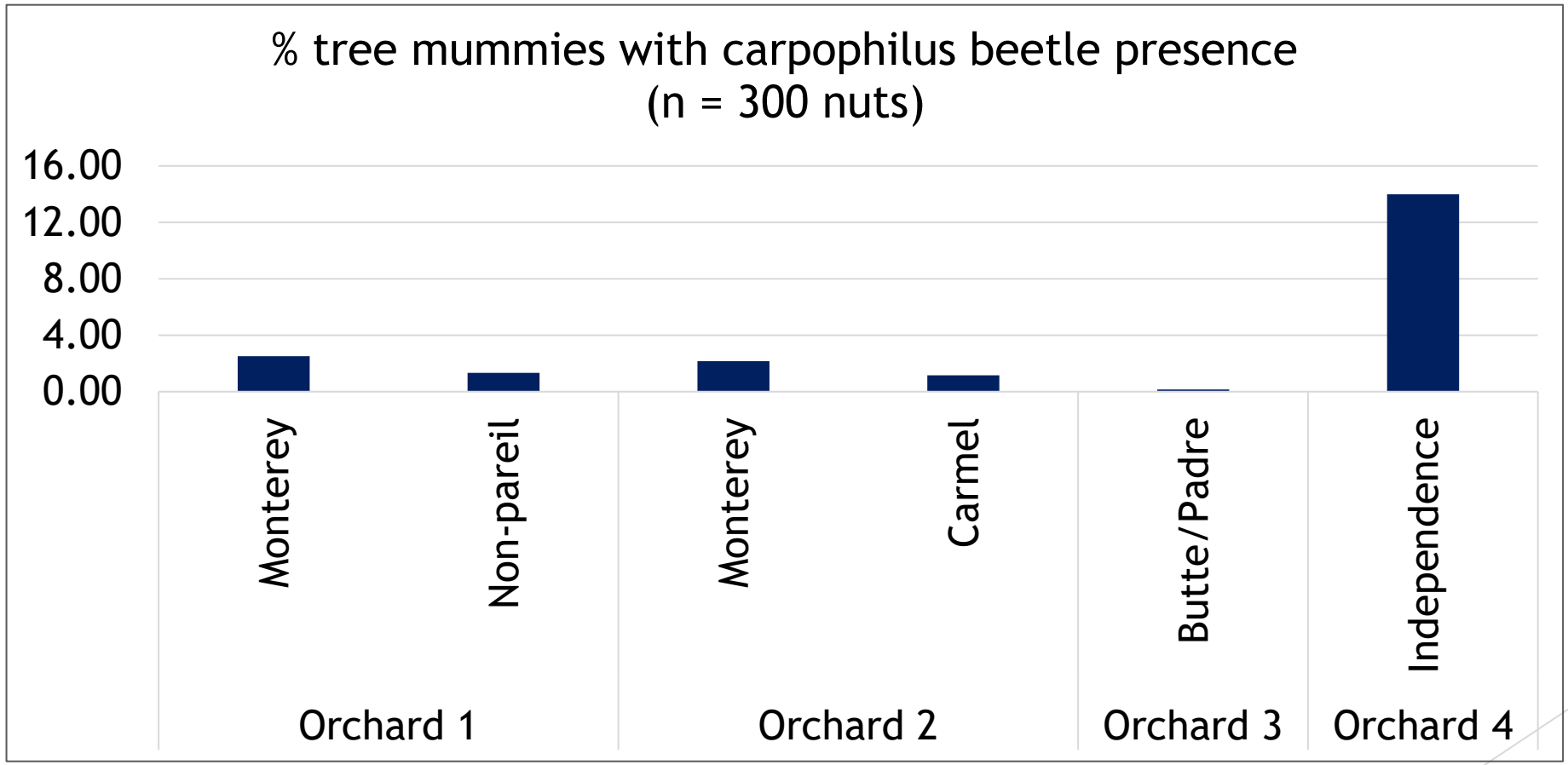




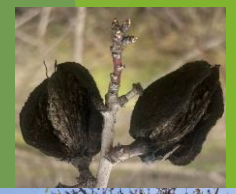
- 2 orchards, 2023 season; Windrow samples (Merced 2)
- Just after the harvest -tree samples (Stanislaus)
- Four samples/orchard; 75 nuts/sample

Field damage assessment (Oct.-Nov., 2023)

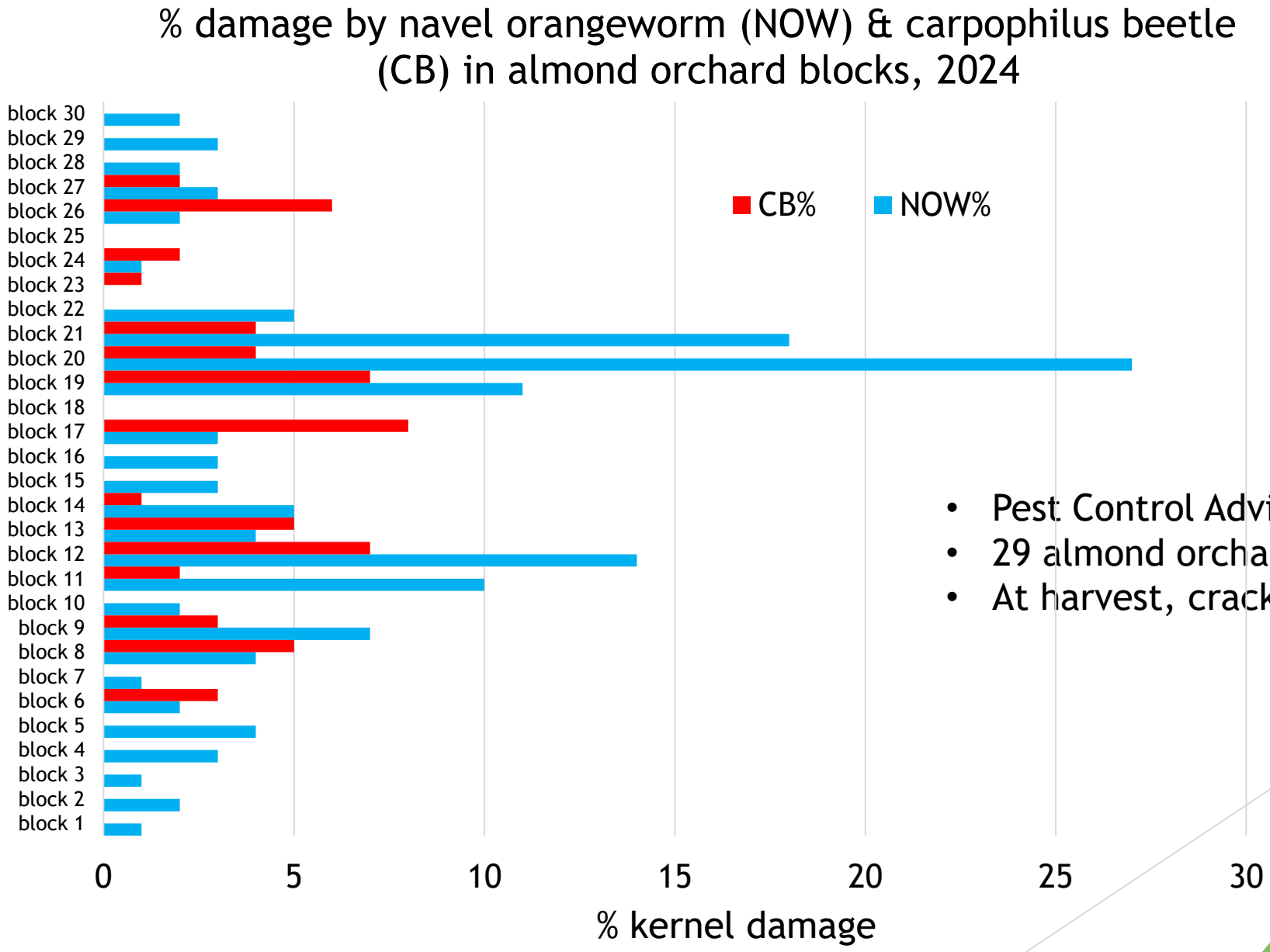
-Ct occurrence in multiple almond varieties. These numbers may not necessarily represent the relative susceptibility among varieties.



Also found in Sonora, Fritz



Carpophilus beetle infestation in almonds-2024



Avg. NOW=4.47%
Avg. CB = 2.0%

- Pest Control Advisor provided data
- 29 almond orchard blocks (Stanislaus/Merced)
- At harvest, crack out samples

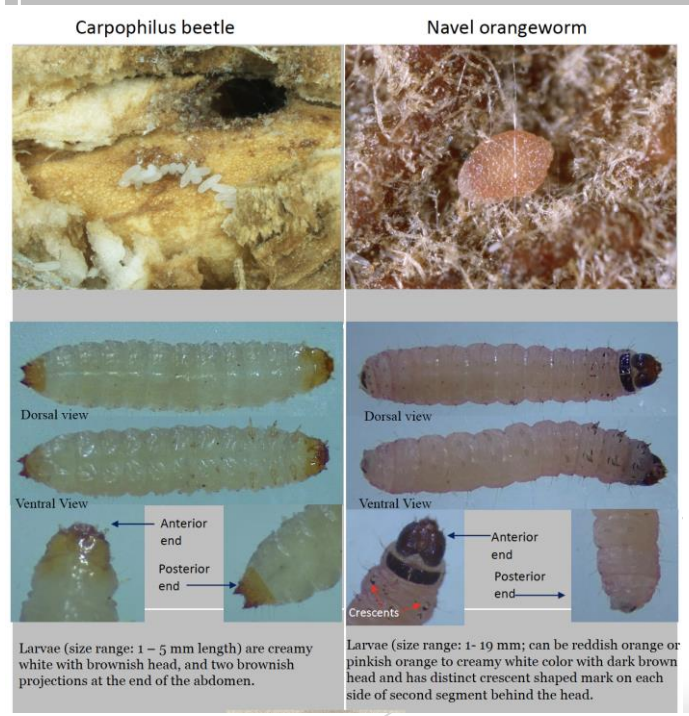
Comparing CB with other insects: life states, damage symptoms

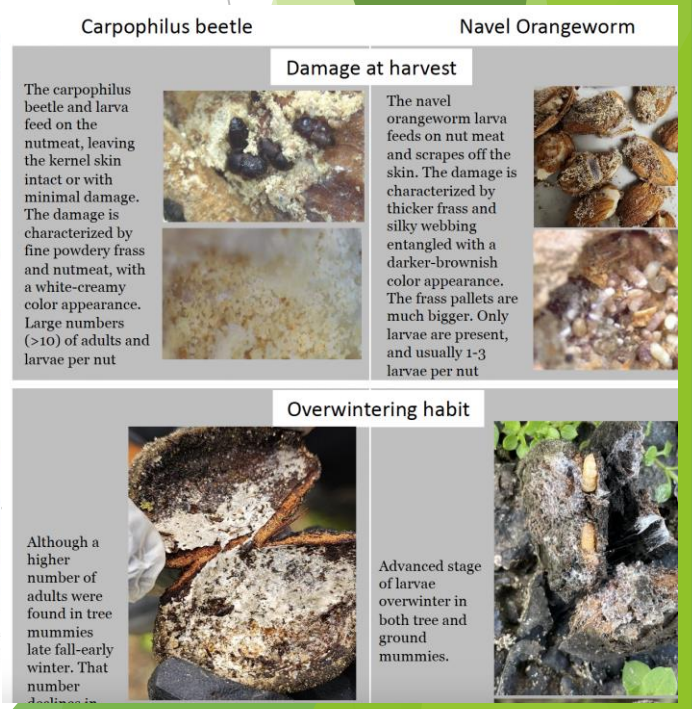
Visual guide:
Carpophilus vs NOW vs Ants

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

A visual guide to differentiate invasive carpophilus beetle (*Carpophilus truncatus*) and navel orangeworm (*Amyelois transitella*) and their damage in almonds

Jhalendra Rijal[1], Mahesh Ghimire[1], Houston Wilson[2], Sudan Gyawaly[1], and David Haviland[1]



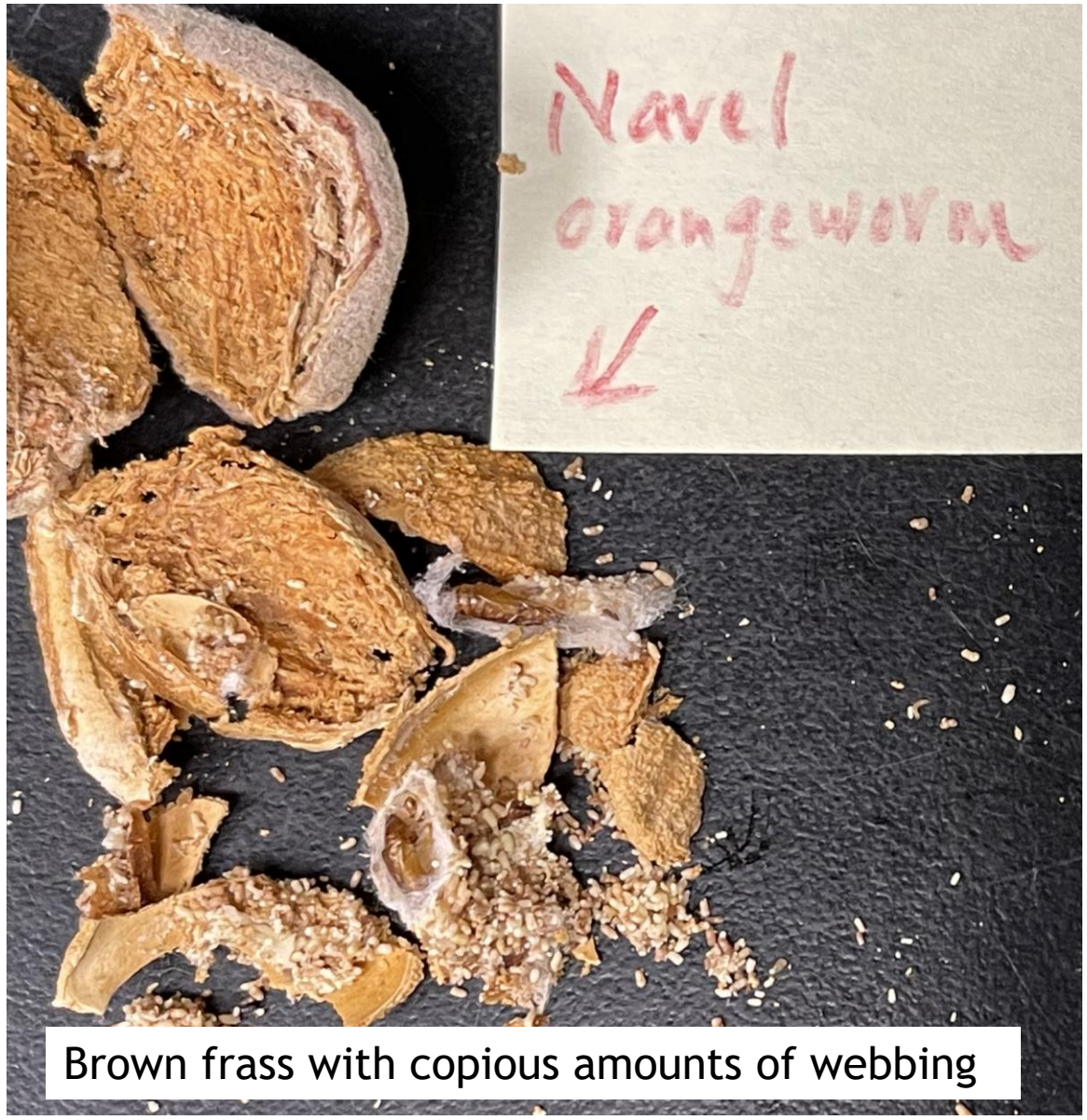


Carpophilus truncatus vs. ant damage

Ant – more superficial or completely gone

Ant: Clear white powder (loose) without any frass

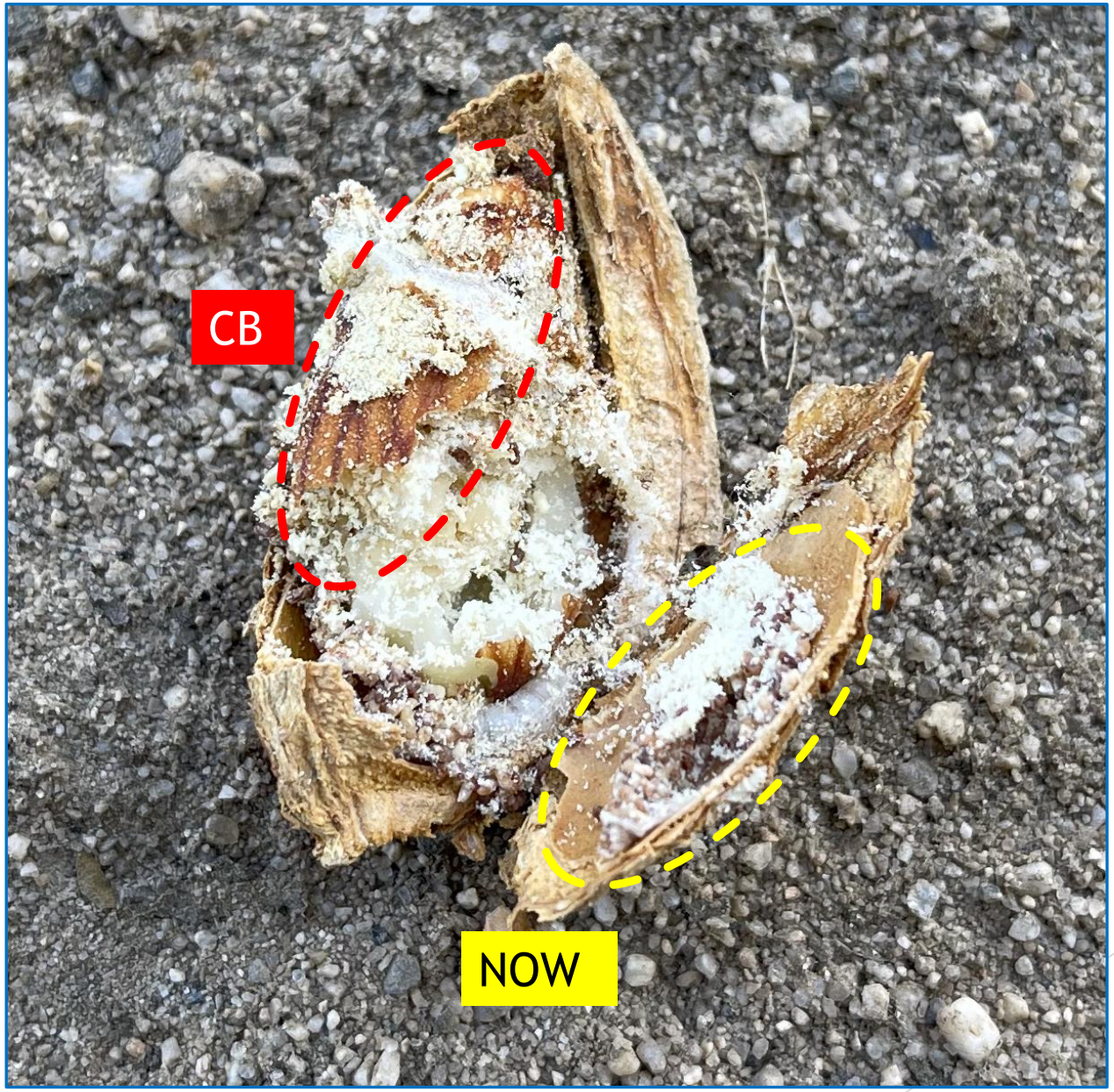
NOW damage vs. CB damage

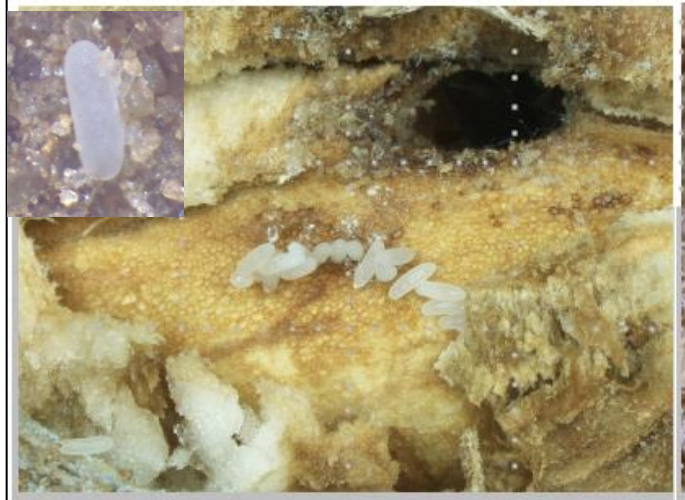
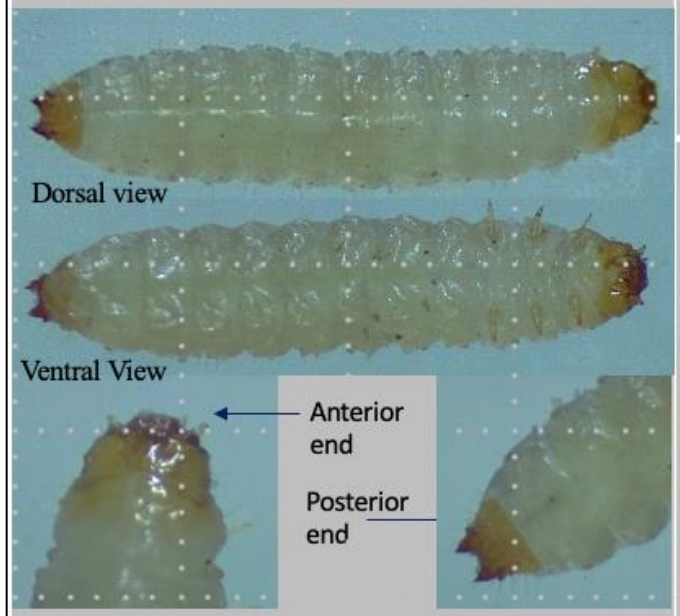
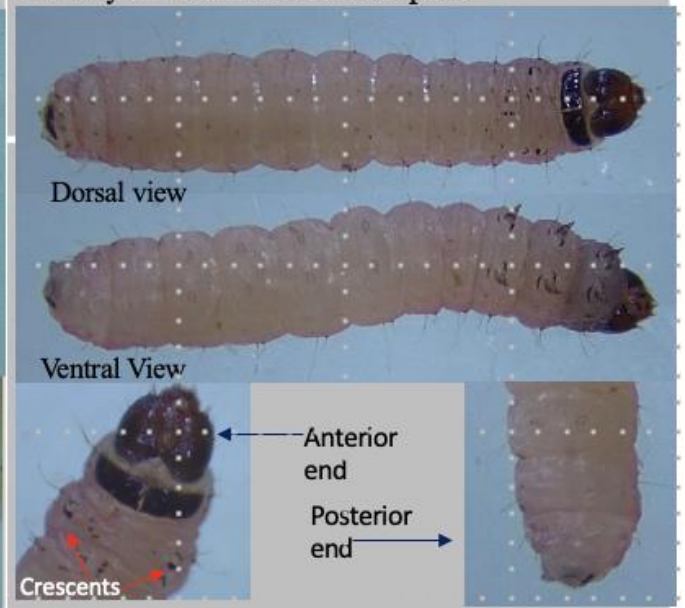


Brown frass with copious amounts of webbing

White/creamy frass – much finer powder mixed with webbing

CB + NOW damage



Carpophilus beetle	Navel orangeworm
	
Eggs (size range: 1.5 – 2 mm length) are creamy white	Eggs (size range: 0.5 – 1 mm length) are flat and oval; initially white which turns into pink
	
Larvae (size range: 1 – 5 mm length) are creamy white with brownish head, and two brownish projections at the end of the abdomen.	Larvae (size range: 1- 19 mm; can be reddish orange or pinkish orange to creamy white color with dark brown head and has distinct crescent shaped mark on each side of second segment behind the head.

Biology/Ecology & IPM Strategies

Ct life history

Egg (~1.5 mm long)

Larva

Pupa

Adult

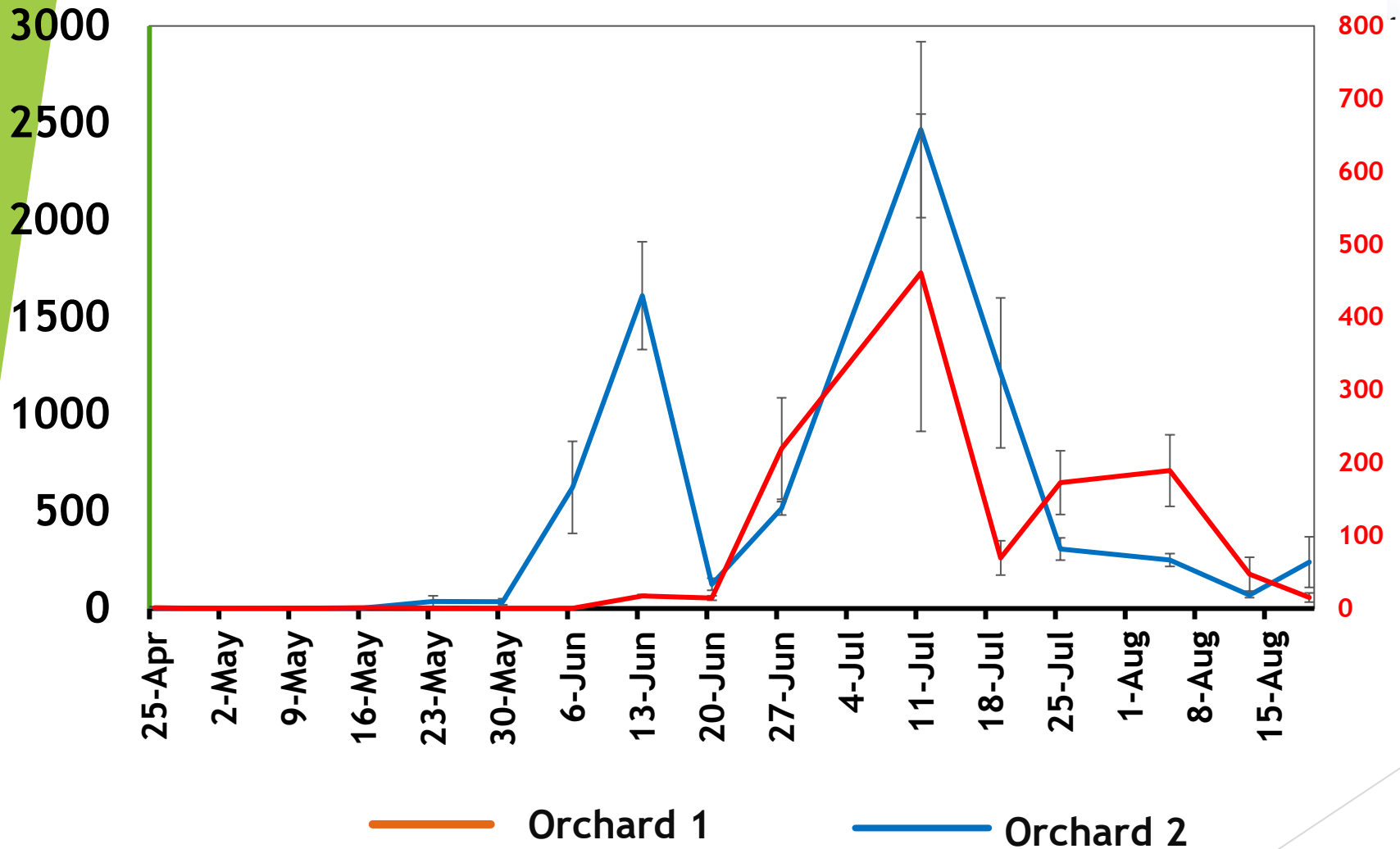
~2.5 mm long

No. of generations??

Pupa, egg photos: Agriculture Victoria, Australia

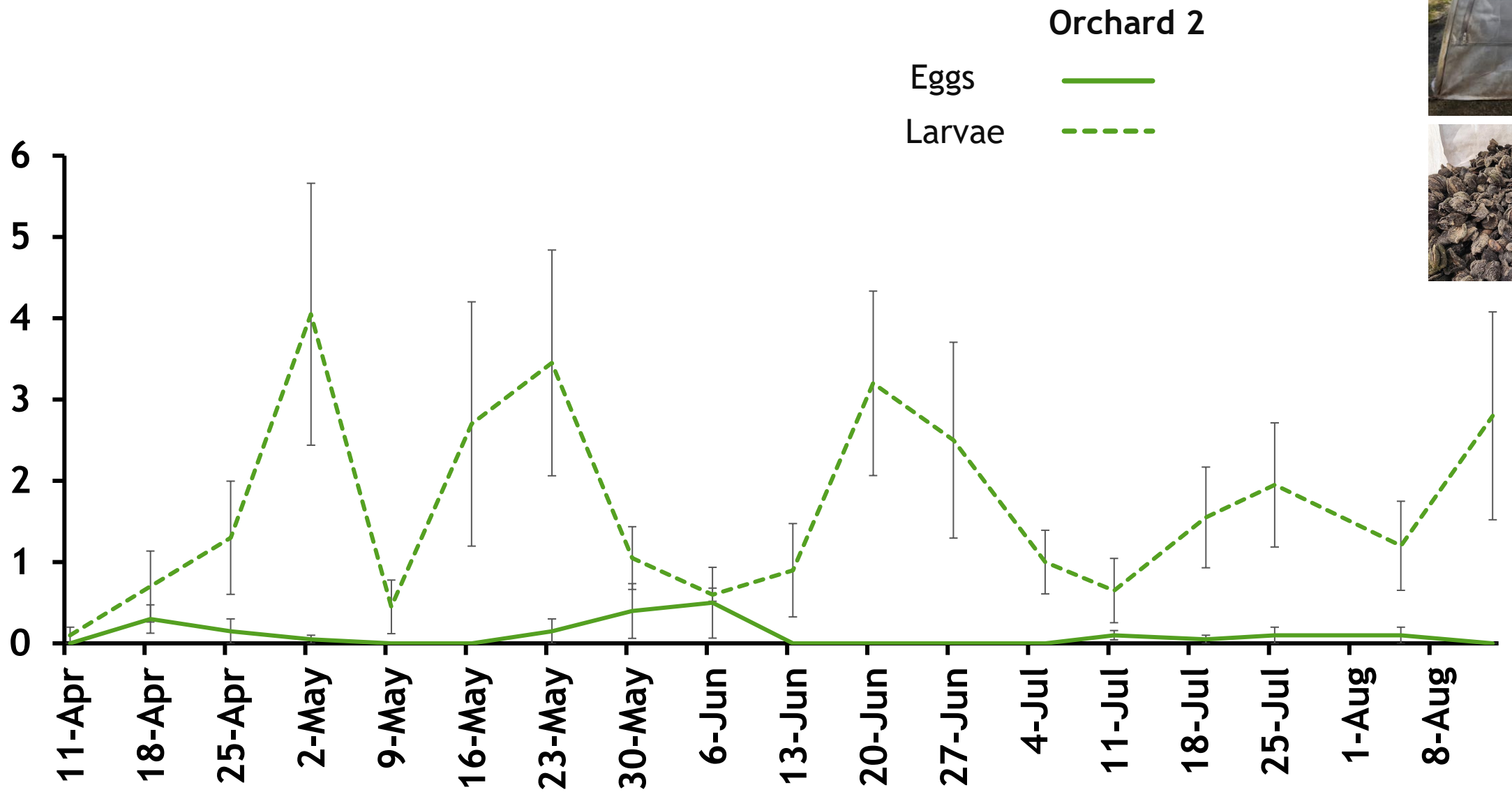
Carpophilus Adult Emergence from Mummy Nuts

Weekly Mean (±SE) Adult Carpophilus spp. Captures per cage



Carpophilus Eggs and Larvae in Mummy Nuts

Weekly Mean (±SE) Eggs and Larvae count per nut per cage



Detection and monitoring of CB

1. Traps:

- There are no effective commercial monitoring traps/lures available at this point. Research Ongoing.
- *C. truncatus* specific pheromone (with co-attractant) has been tested in Australia
- In California, we initiated monitoring in September 2024

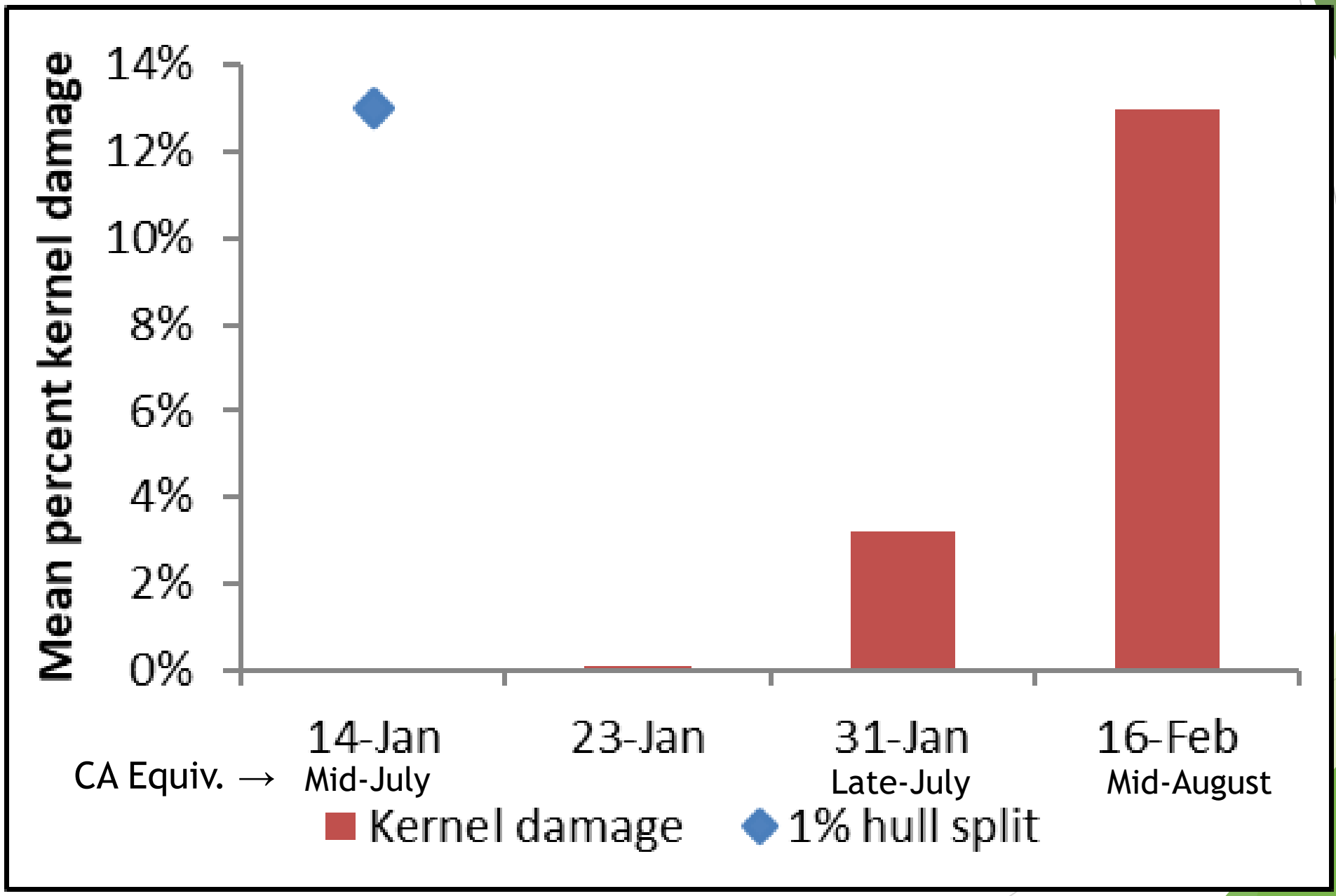
Detection and monitoring of Ct

2. In-Season Nut sampling:

Hull split

Around harvest

Timing of sampling nuts is important



Data shown from almond orchards in Australia

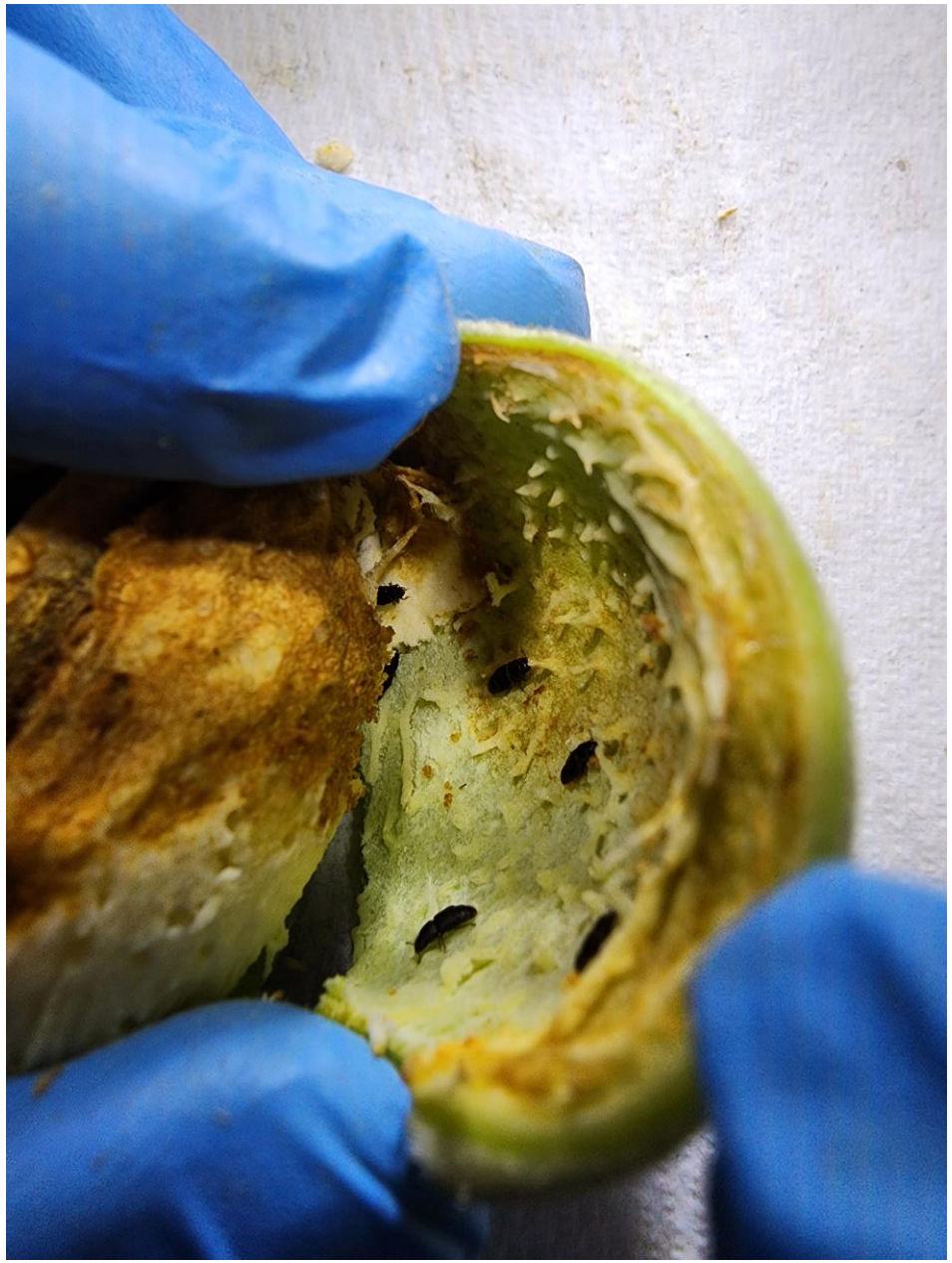
However, in California we began to see beetle activity right away at 1% hullsplit

Hort Innovation
Strategic levy investment
ALMOND FUND

CB in freshly split nuts and mummy nuts during hullsplit

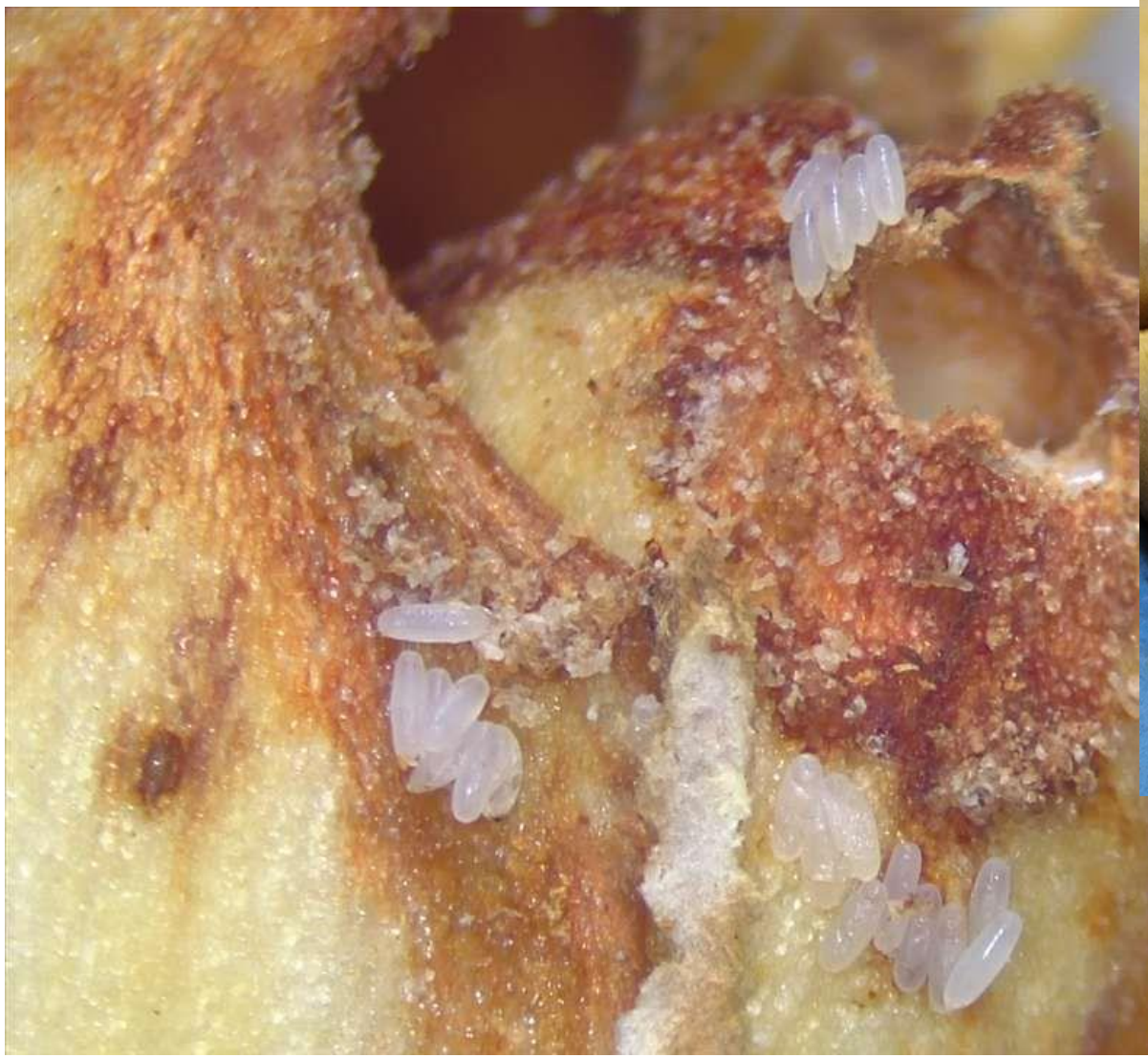
Photos: Jhalendra Rijal, UCCE; 10 July, 2024, Stanislaus Co.

CB in freshly split nuts



Photos: Mahesh Ghimire (Rijal lab, UCCE)

CB eggs



Photos: Mahesh Ghimire (Rijal lab, UCCE)

- Eggs are tiny (size range: 1.5 to 2 mm long), oblong, creamy white.
- Can be found anywhere in the nut.

Detection and monitoring of CB

3. Mummy nut (tree & ground) sampling

Understanding CB in California

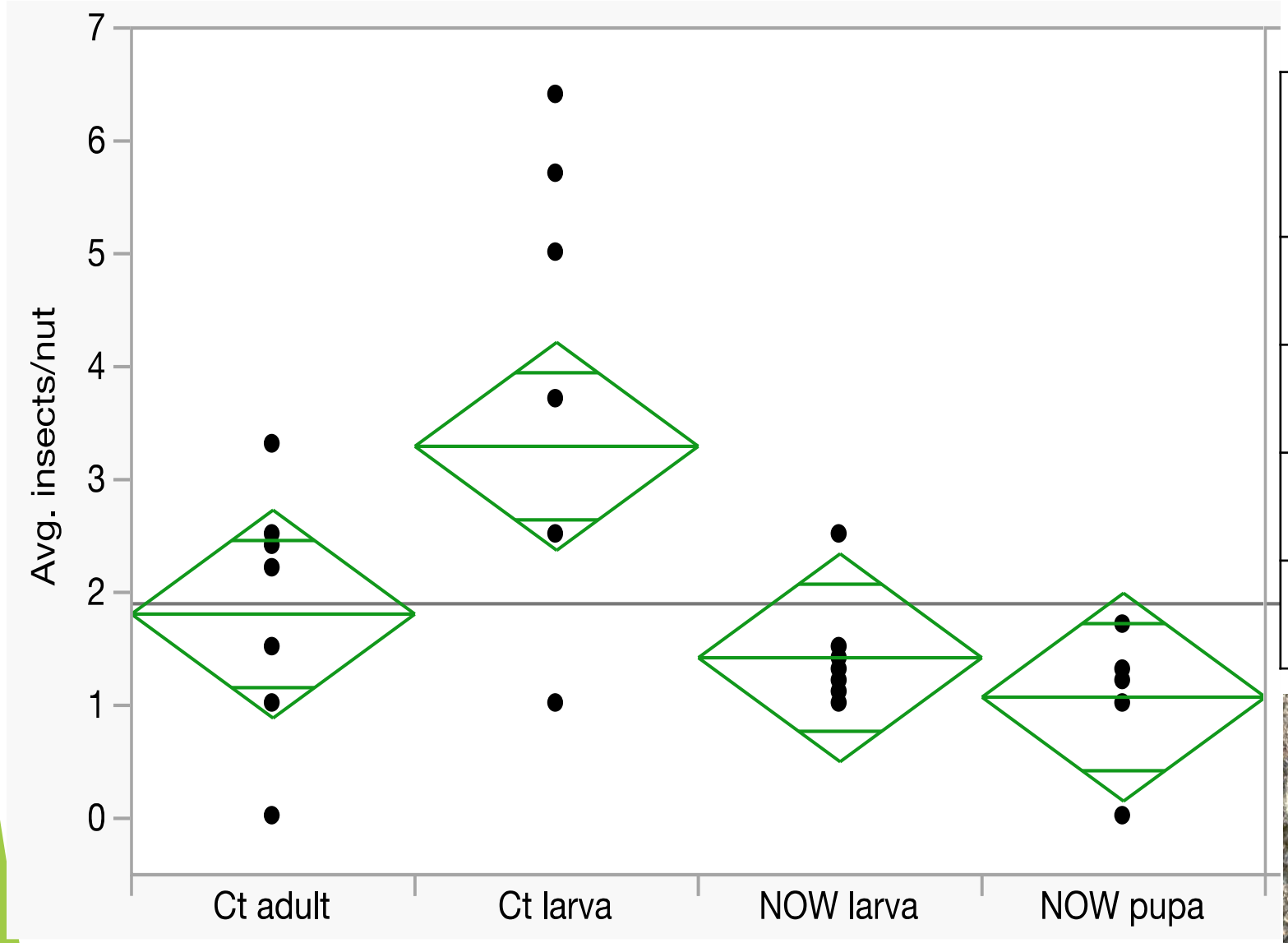
- Damage characterization and overwintering biology
  - Overwintering ecology
  - Damage distribution within the orchard and tree canopy
  - Insecticidal trials

CB overwinters in mummy nuts (Photos taken Jan.-Feb, 2024, Stanislaus)

CB overwinter as adults in mummy nuts on the ground

Field damage assessment:

-Heavy feeding damage can be an indicator of increased pest density



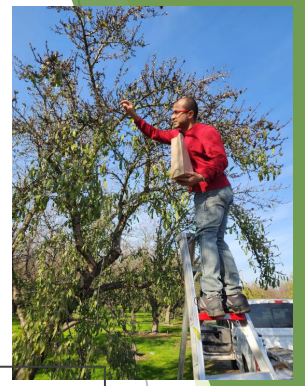
From windrow samples

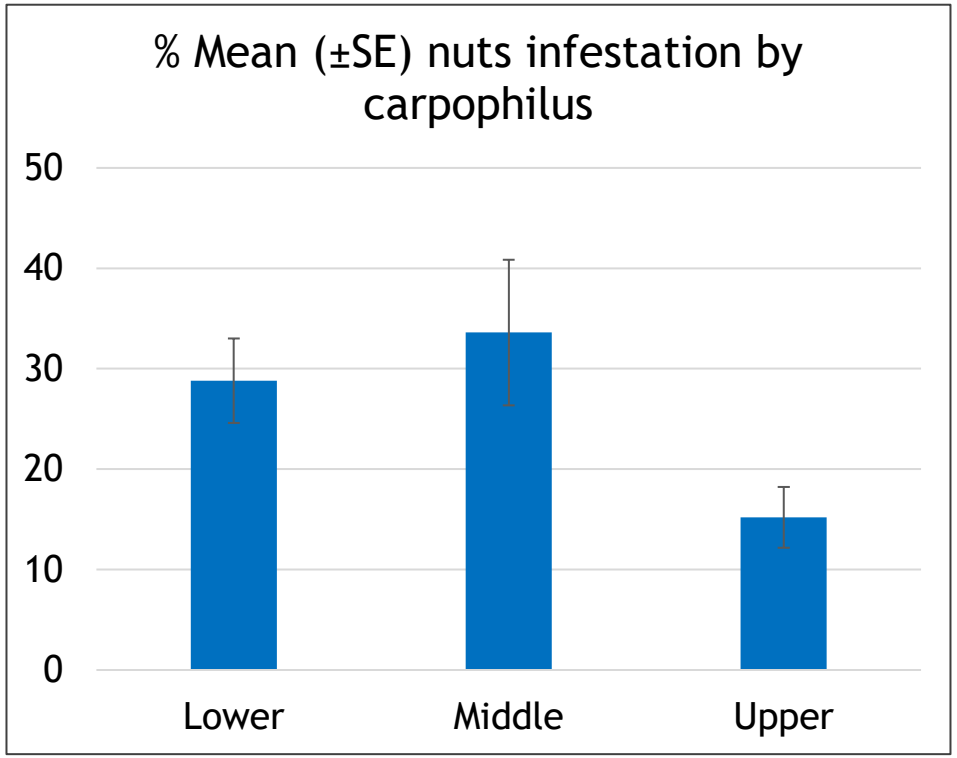
P = 0.0087

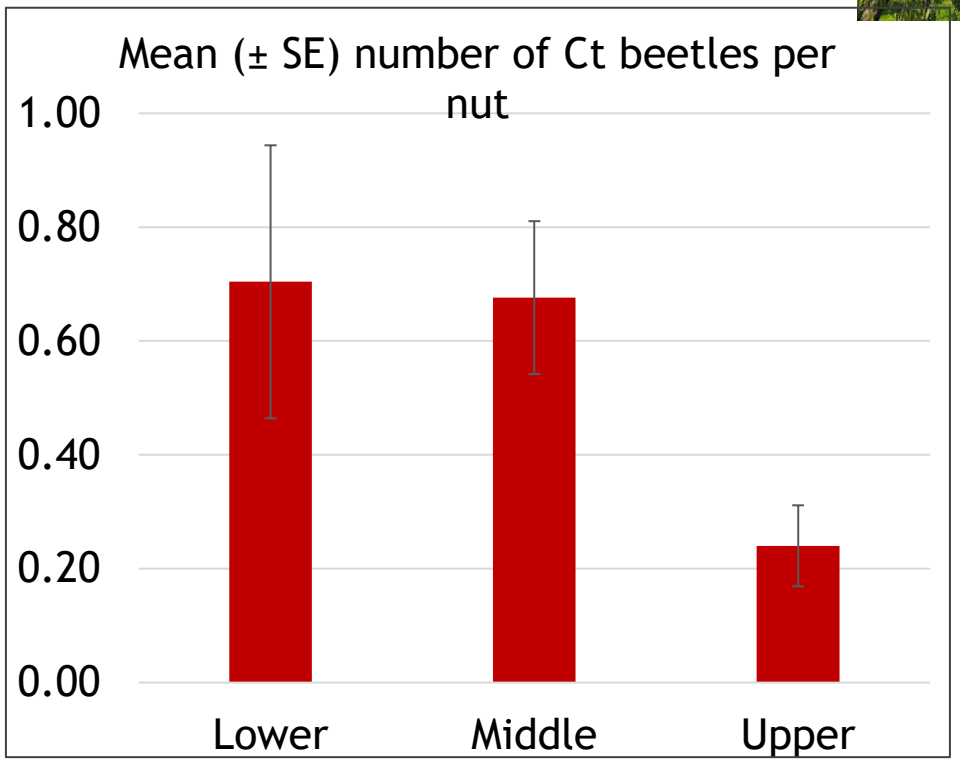
Category	Mean (insect/nut)	Mean Separation (Tukey)
Ct larva	3.29±0.36	A
Ct adult	1.80±0.78	AB
NOW larva	1.41±0.16	B
NOW pupa	1.06±0.17	B

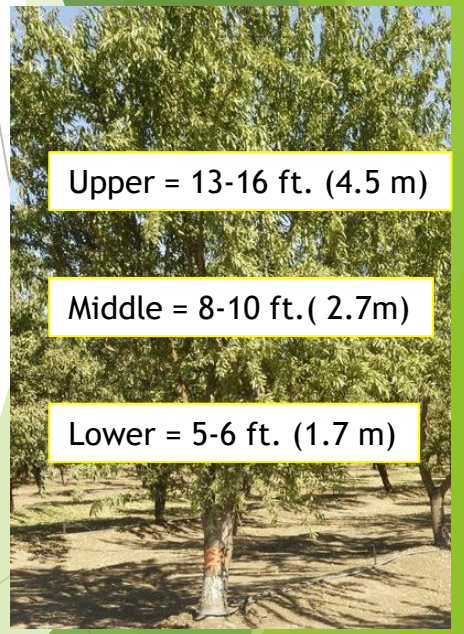
Vertical distribution of CB within the tree canopy:

-The lower and middle layers of the tree canopy had greater infestation rate and the Ct population





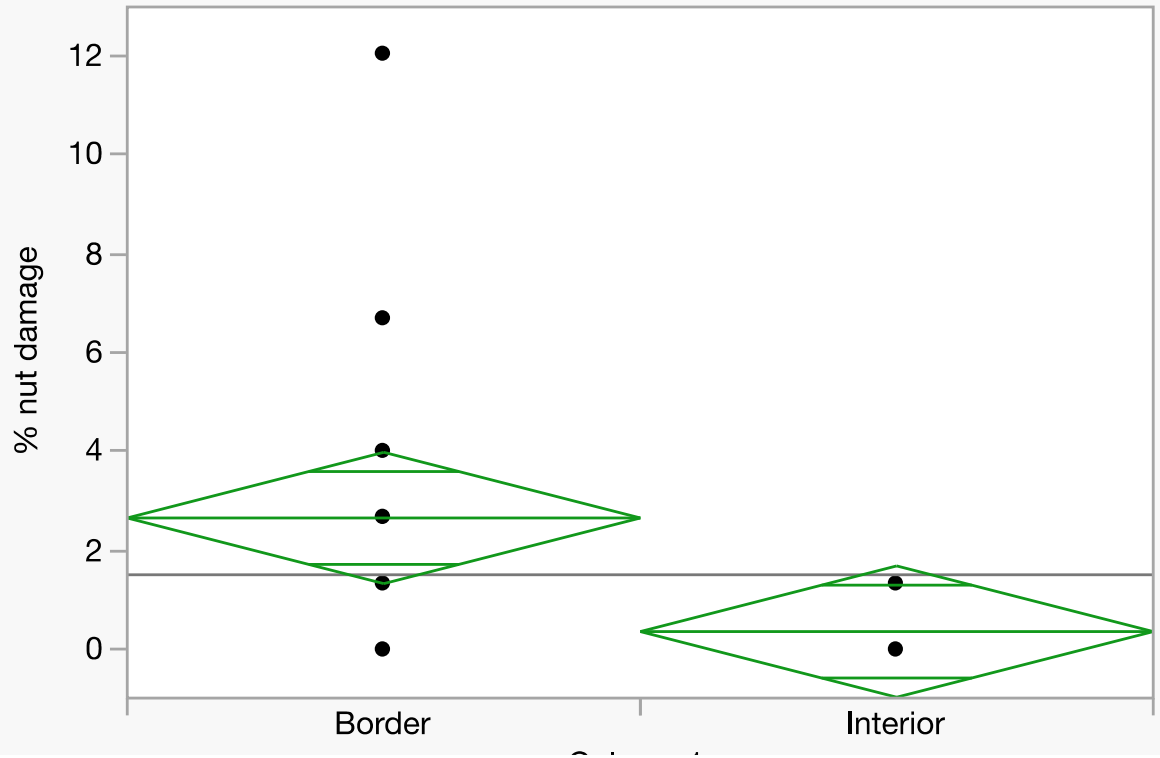




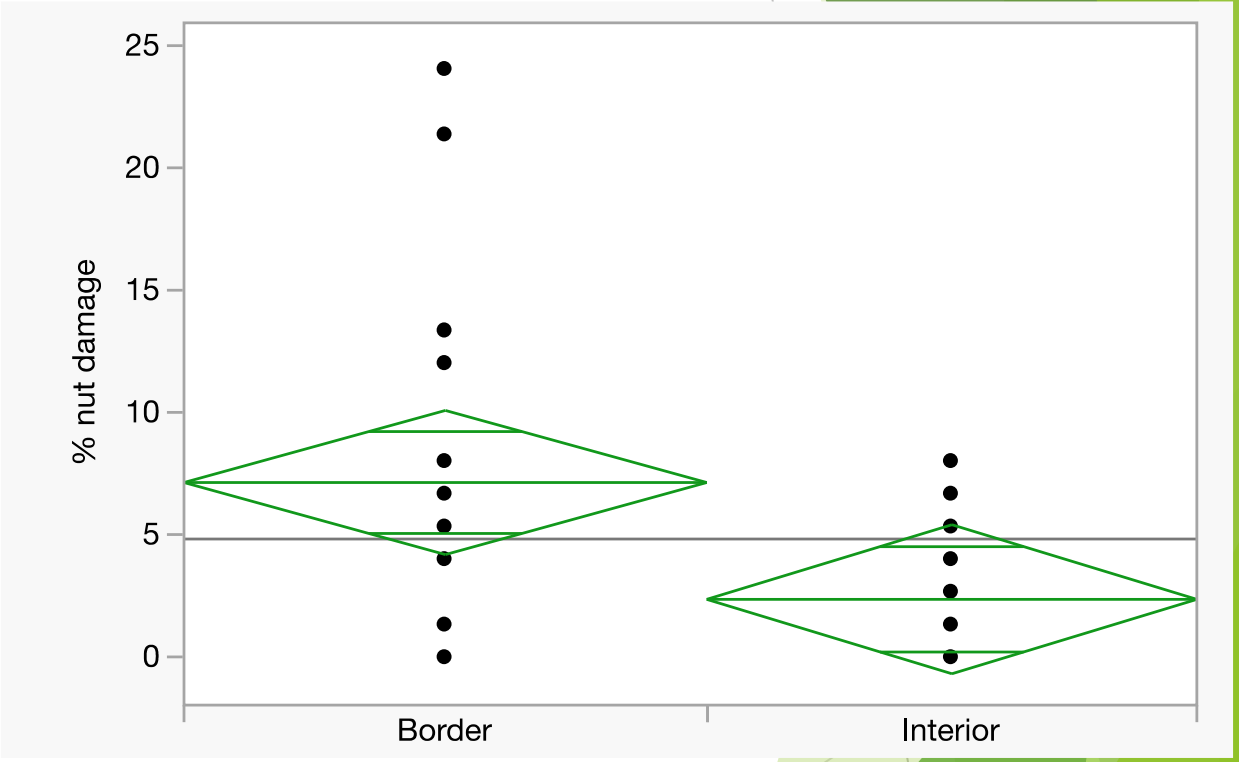
- Tree mummy nuts sampling
- 25 sample nuts/layer
- 10 random trees/orchard

Within the orchard distribution

-Orchard edge tends to have more damage than interior



Orchard 1 (n =16)



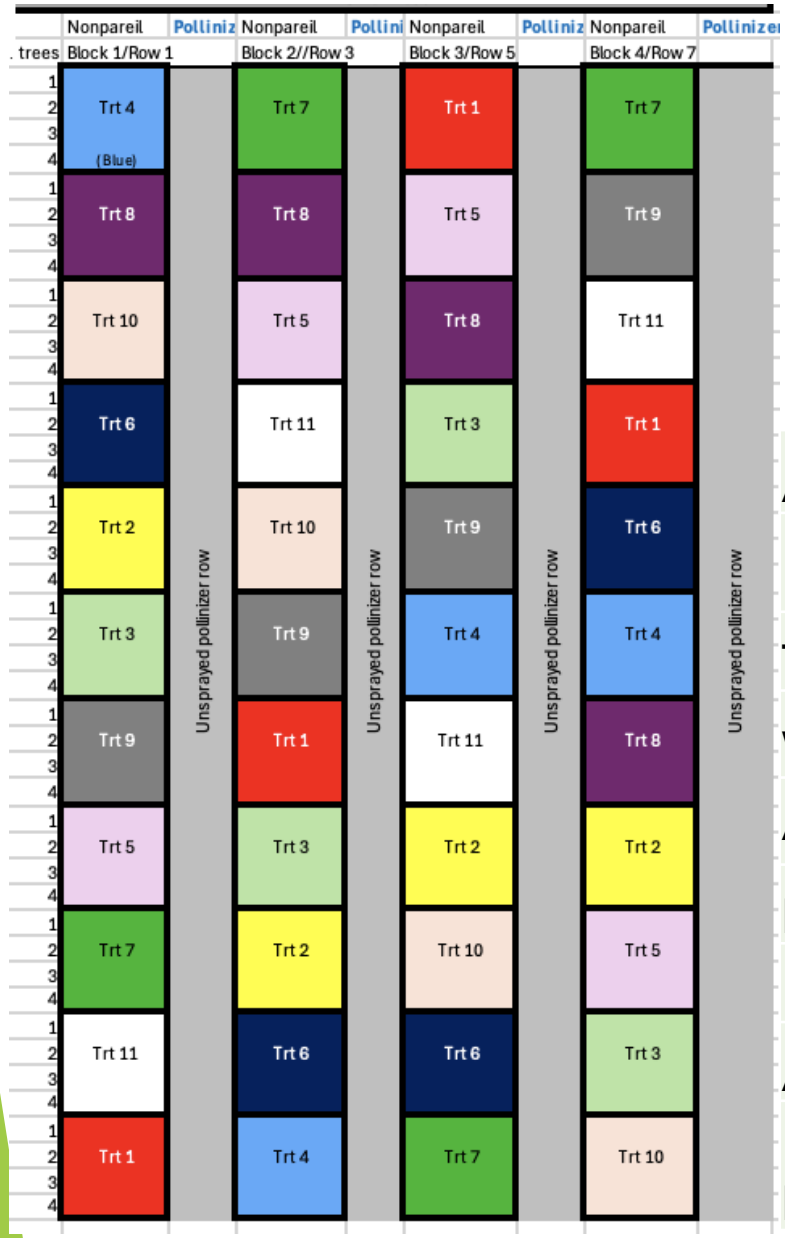
Orchard 2 (n =14)

- Tree mummies sample collection, December-February; combined two varieties
- 75 nuts/sample (14-16 sample/category)

Ongoing study….

Insecticide Trial

2024 CB Insecticide Trial Results (Almonds)

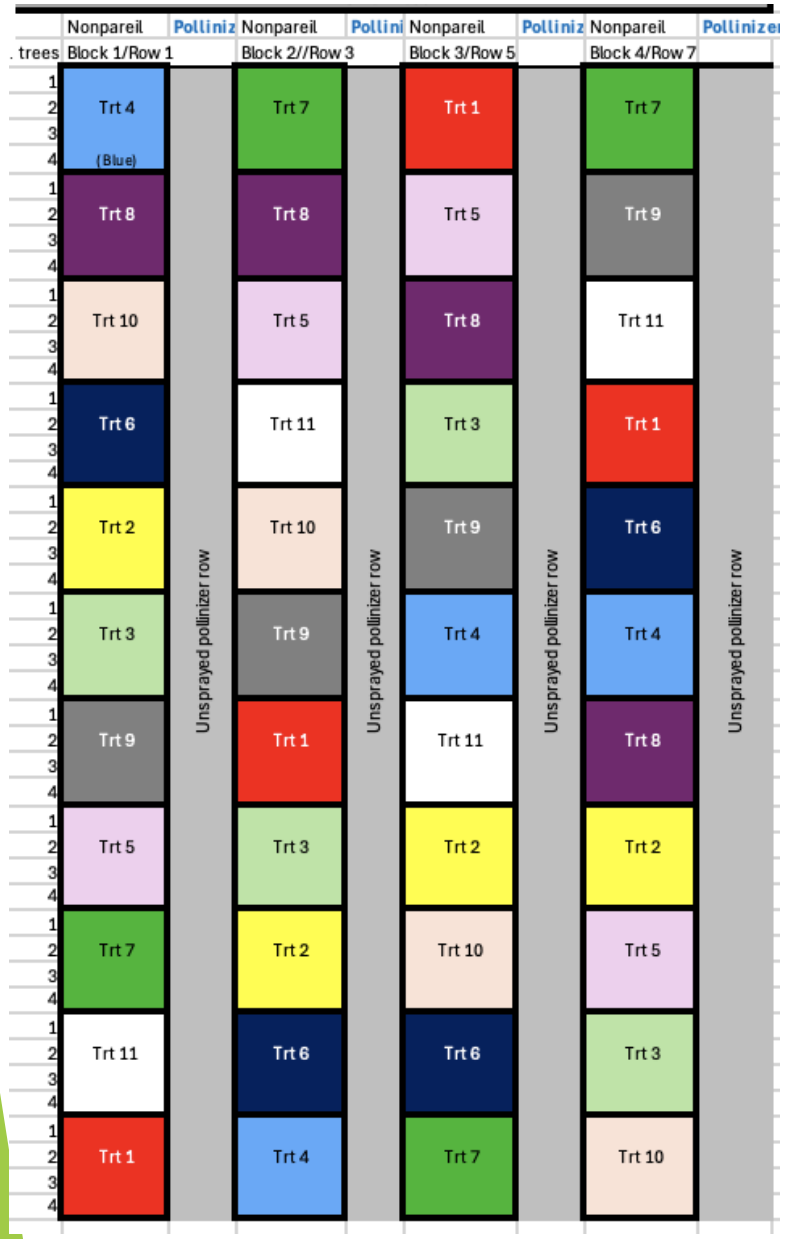


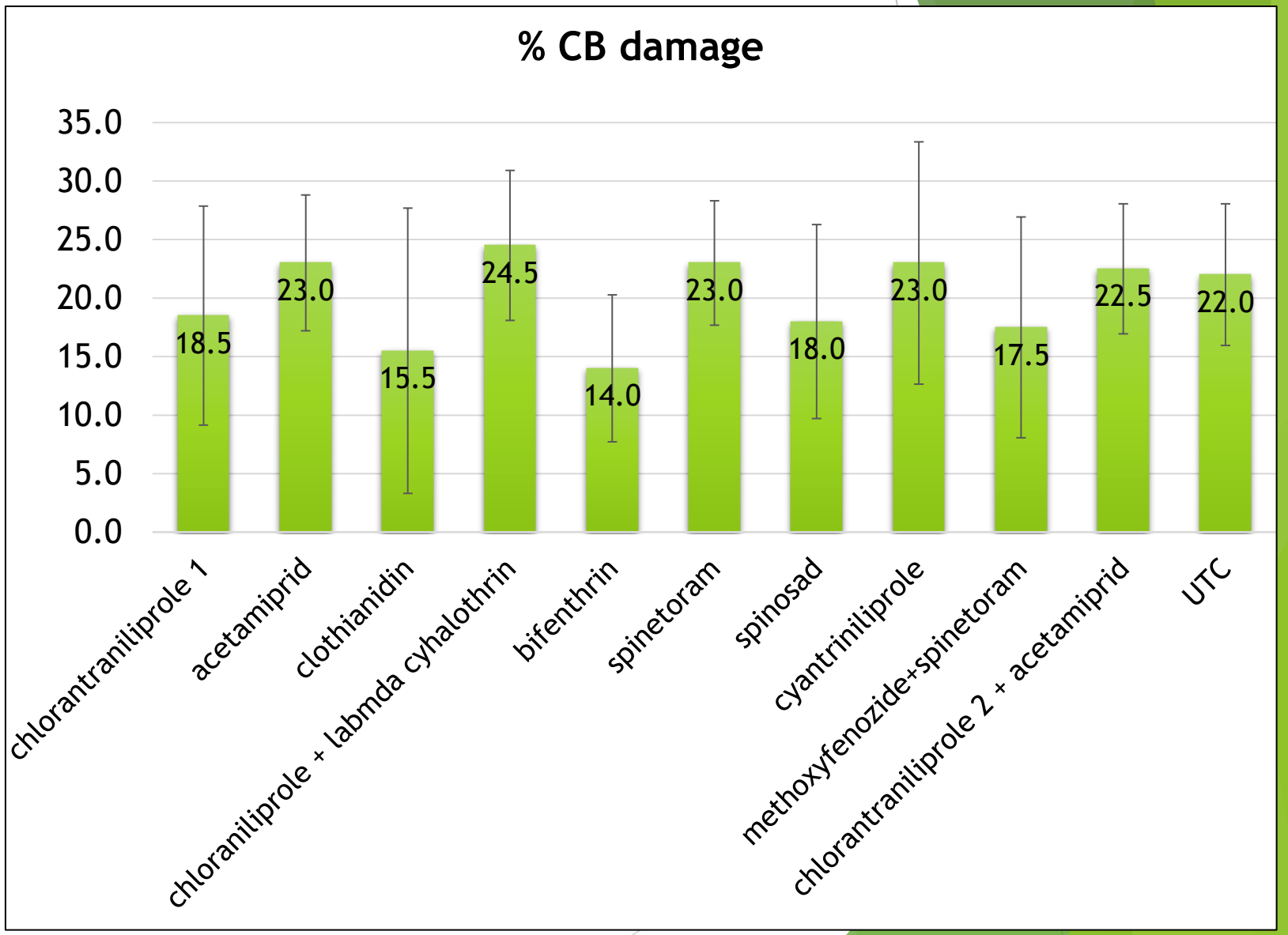
Application criteria:

Machine:	Tractor PTO-powered sprayer
Tractor speed:	1.6 miles/h
Water volume:	143 gallons/acre
Adjuvant:	non-ionic organosilicon surfactant @0.125%
Experimental unit:	4 consecutive Nonpareil trees
Exp. Design:	RCBD with 4 blocks/replication
Application:	A (July 10) at hullsplit, B (July 24)
Evaluation:	Taken 50 nuts from two middle trees from 6-10 ft height

Collaboration:
Dr. Barat Bisabri

2024 CB Insecticide Trial Results (Almonds)

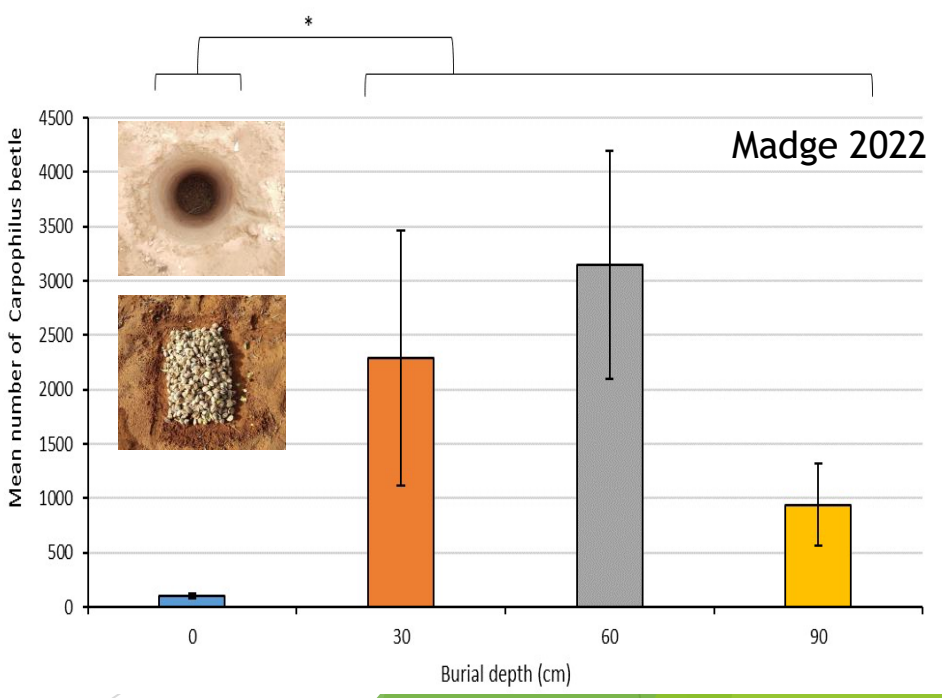




No statistical difference

Carpophilus beetle management – orchard sanitation is the key

- Mummy sanitation is the foundation for managing this pest – similar to navel orangeworm
- Ground mummies are even more important for Carpophilus beetle overwintering.
- For flail mowing, blow all possible nuts from berms, drip lines etc, and shred them properly.
- Insecticidal control seems limited, primarily due to challenges with spray coverage/timing/beetle behavior.



Discing/Burying nuts does not help!

Summary

- *Carpophilus turncatus* (CB) is a newly confirmed pest, but the infestation seems to be widespread
- CB can attack nuts directly when they are on the tree, particularly after the hullsplit
- CB is capable of doing high levels of damage.
- Monitoring traps are not available yet, but inspecting nuts after hullsplit and mummy nuts helps.
- Effective mummy sanitation is the best-known method to manage this pest.
- The efficacy of commonly used insecticides in almonds at hullsplit is unclear.
- Continue to explore this pest's biology and management tools.

Thank You!

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