Integrated management of *Naupactus godmanni* and citrus thrips in citrus

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Seminaro Manejo Integrado De Plagas Emergentes En Citricos

March 25, 2026

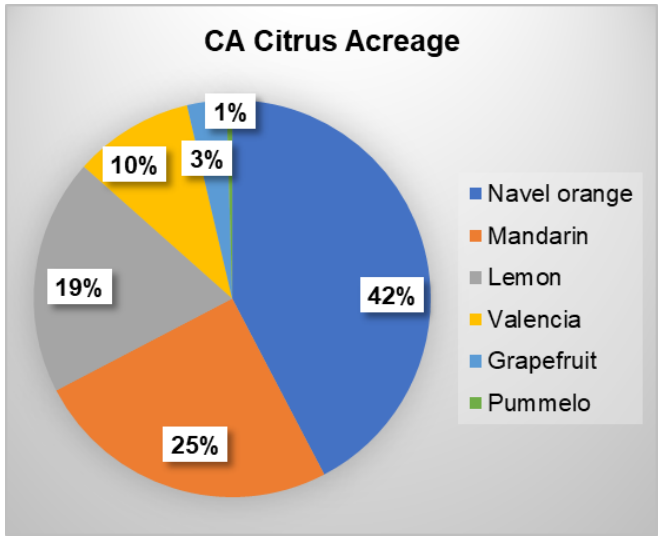
University of California
Agriculture and Natural Resources

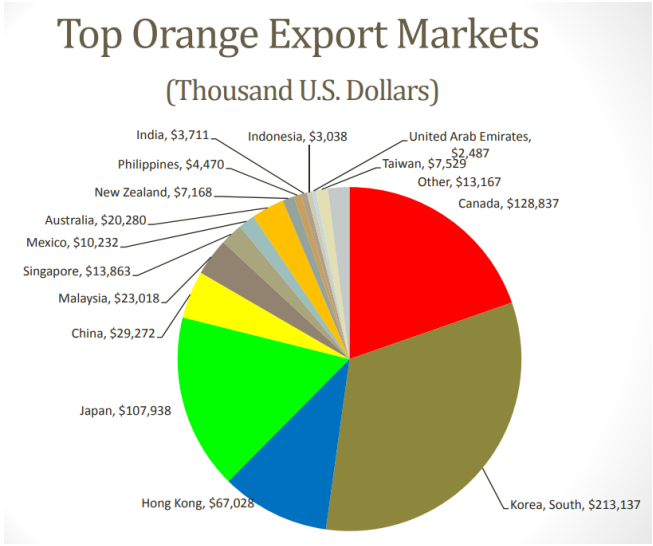
Outline

- Background
- California's experience in Fuller rose beetle management
- Citrus thrips
  - Damage
  - Monitoring
  - Management and the challenges

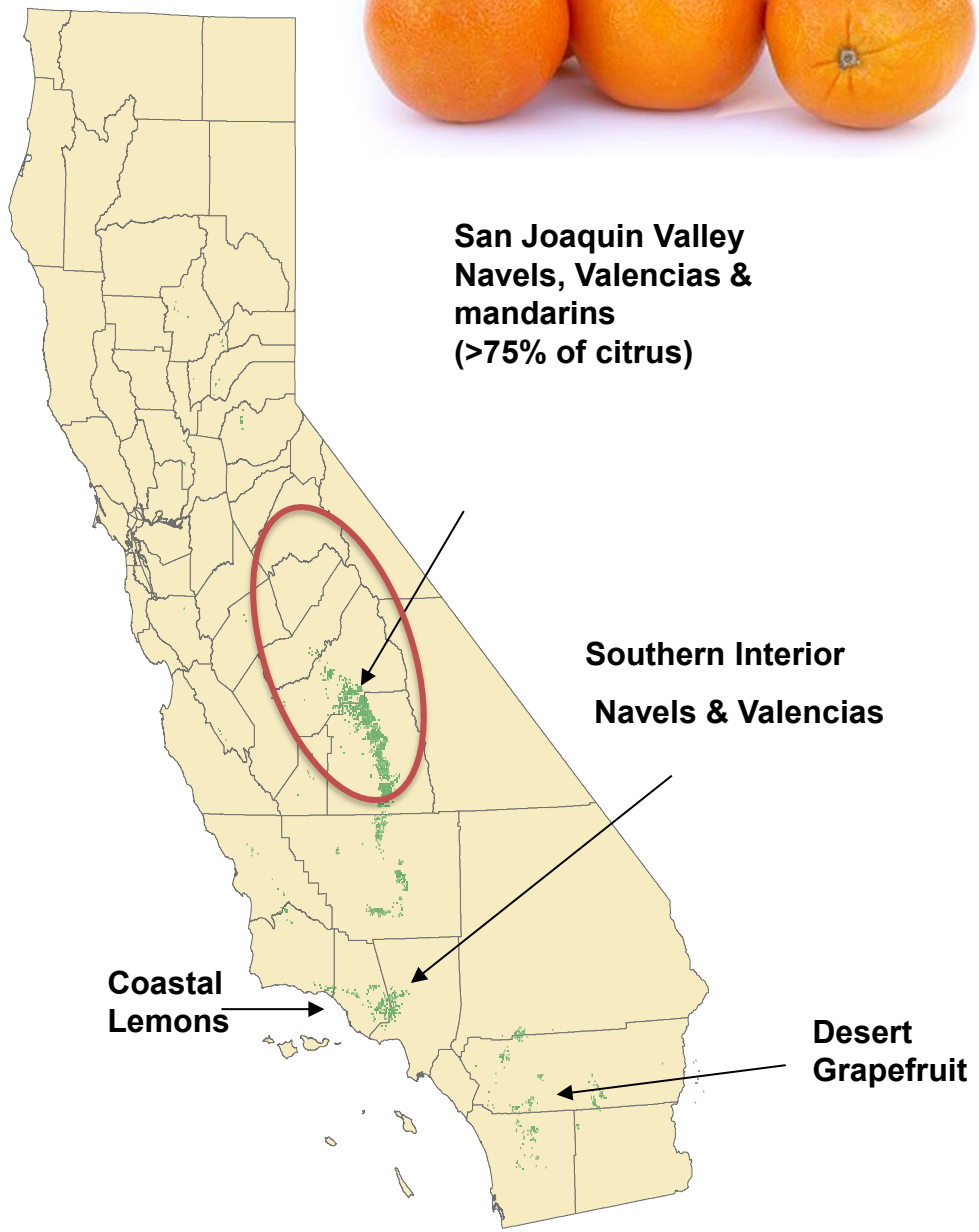
California Citrus

- Citrus is grown in four distinct regions.
- 268,376 acres (108,608 hectares) citrus in CA (CDFA 2022). 210, 356 acres in is the SJV region.
- ~7.8 million tons fresh citrus/year with a farm gate value of ~$2.6 billion
- Unblemished fruit free of surface scar is valued the highest.





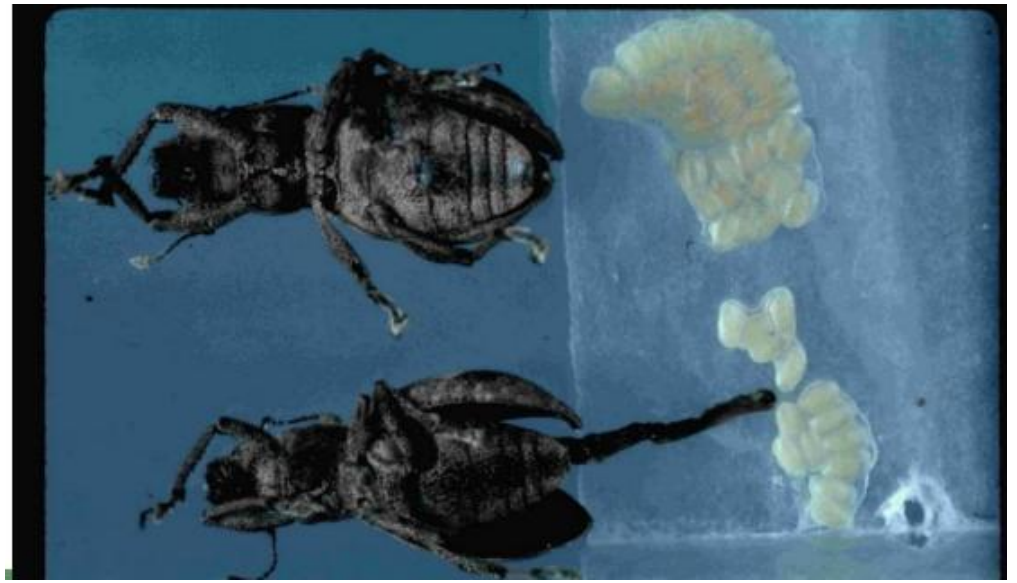
2/3 of export volume is shipped to Asian markets.



Fuller rose beetle

- ***Naupactus godmanni* (syn. *N. cervinus, Patomorus cervinus*)**
- **Small gray beetles with a weevil snout, slow moving and flightless**
- **Parthenogenic (no males) and have one generation per year**
- **Hosts: citrus, cherries, apple, persimmon, potatoes, strawberries, and ornamentals**

FRB egg masses



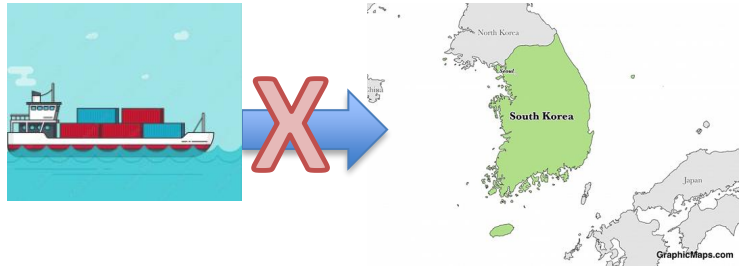
Ovipositor can extend and lay eggs in tight places

Trade barrier pest – Fuller rose beetle eggs

Fruit infested with FRB eggs can be rejected for shipment or rejected upon arrival. Although not a pest for California citrus growers, FRB is an export concern as a trade barrier pest.

FRB adult depositing egg

If FRB eggs are found at county/USDA APHIS inspection, load rejected



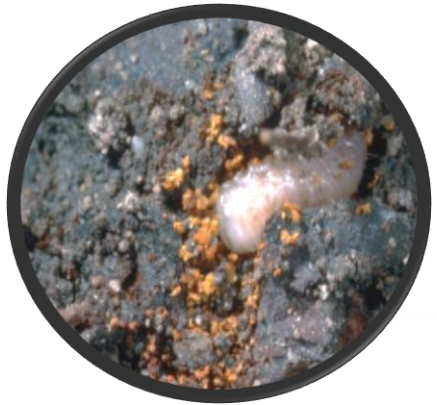
If FRB eggs are found on arrival – shipment rejected

Evolution of the FRB Problem in California

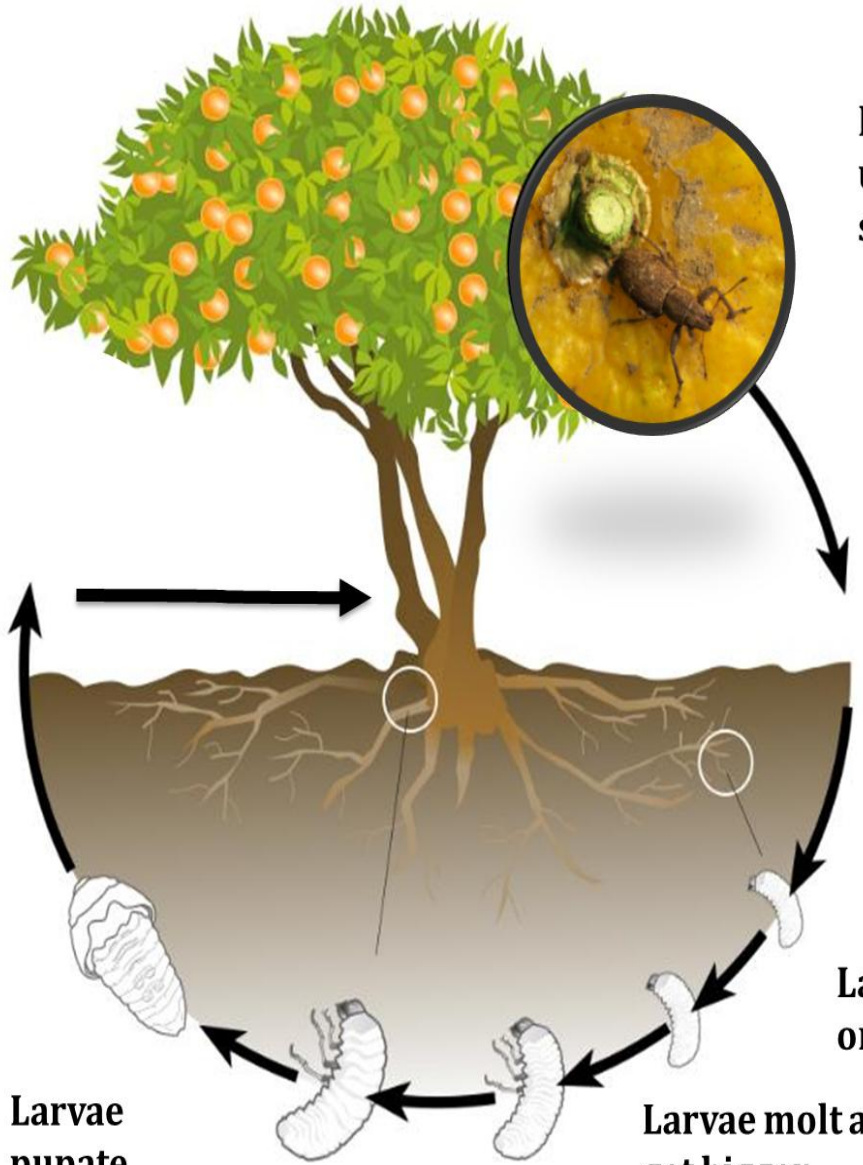
- **Serious concerns from Korea during the 2011-12 shipping season**
- **Blanket methyl bromide fumigation allowed for 2012-13 season but not for foreseeable future.**
- **Korea anticipated California growers to disinfest fruit before shipping**
- **Research on FRB re-started during 2011**
  - **Dr. Joesph Morse – FRB Biology, trunk sprays**
  - **Dr. Beth Grafton Cardwell: foliar sprays**

Life cycle of FRB

Adult emerges and climbs up the tree



Larvae pupate



Larvae molt and get bigger 9 months

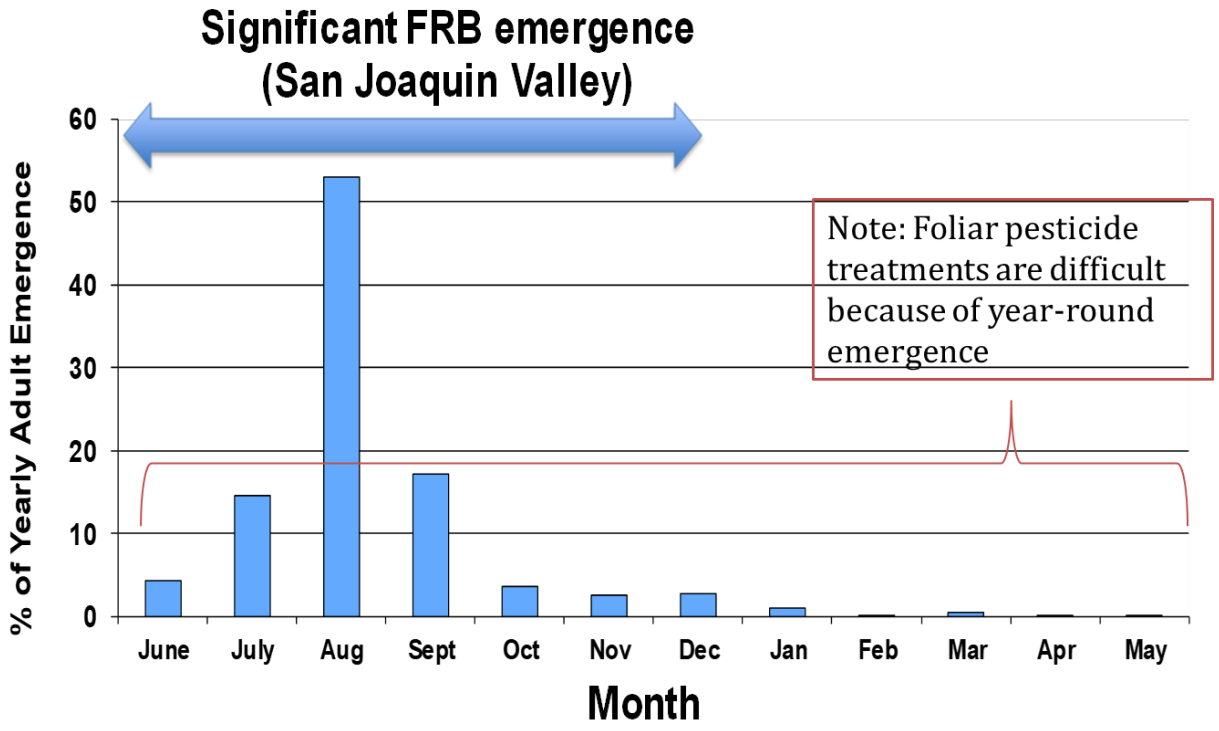
Larvae feed on roots

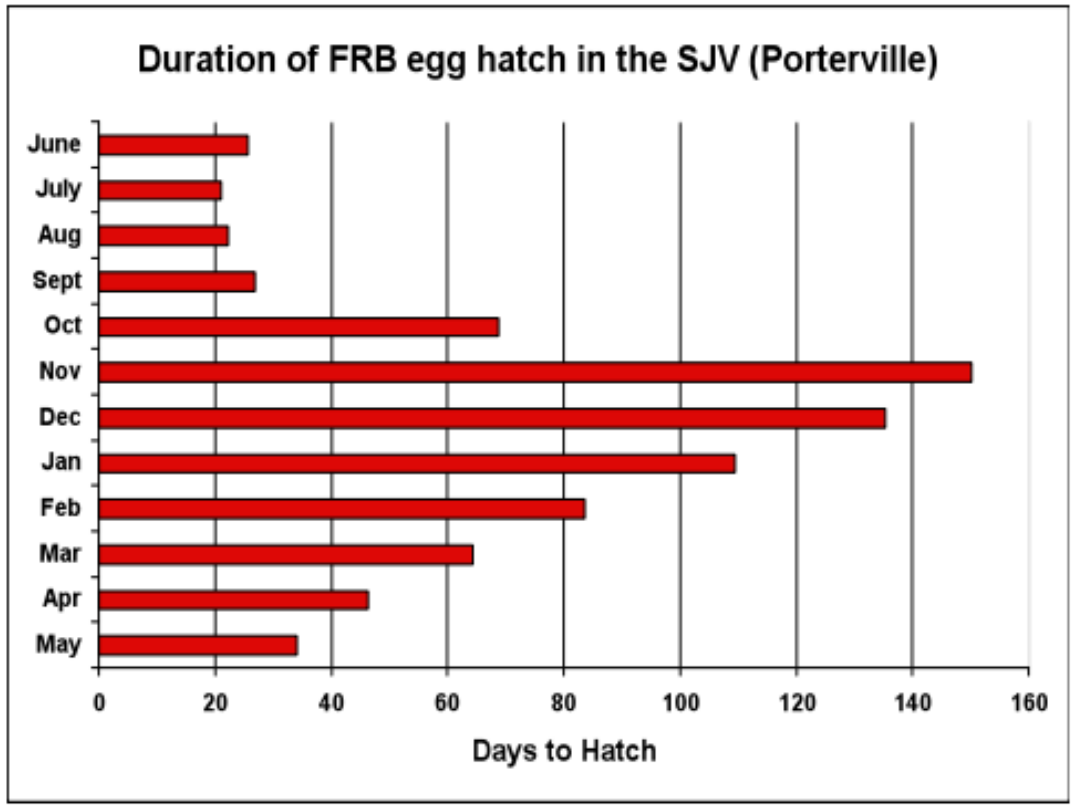
1st instar larvae drop to the ground

Eggs laid under the sepals

Because adults emerge year-round, it is difficult to apply targeted management to eliminate them from orchards. Peak emerge in the San Joaquin Valley (84%) occurs from July to September. Adult control to reduce fruit contamination.

Year-Round Adult FRB Emergence





FRB biology and field ecology study by Joe Morse

After the weather cools down in October, eggs take longer to hatch. Foliar spray doesn't work on eggs.

Bifenthrin trunk sprays as a strategy for Fuller rose beetle (FRB) field control in 2013

Joseph Morse and
Beth Grafton-Cardwell

Editor's Note: Work on Fuller rose beetle is now a part of CRB's core program of Integrated Pest Management research with Drs. Morse and Grafton-Cardwell as lead investigators.

Fuller rose beetle (FRB) (Figure 1) goes by many different names (synonyms) in the scientific literature including *Naupactus godmani* (Crotch) (most correct), *N. cervinus*, *Pantomorus cervinus*, *Asynonychus godmani*, and several others.

FRB is seldom considered a serious pest in California but has re-emerged as problematic because it is considered a quarantine pest in important citrus export markets such as Korea (see the sidebar on page 31).

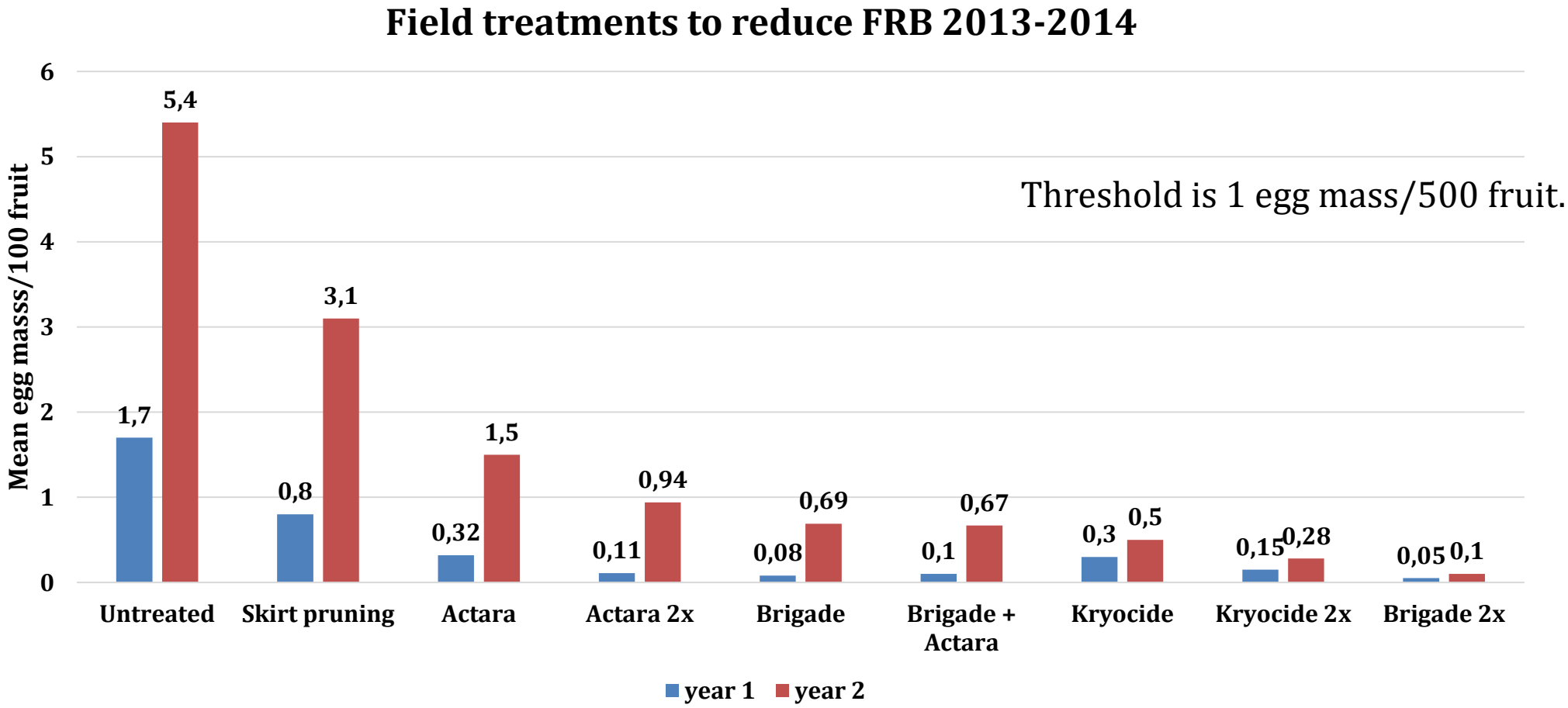
Initial research focused on developing treatments and testing efficacies of materials against fuller rose beetle mortality.

Brigade WSB trunk spray 0.5 lb AI/ acre 1 day after treatment

Cannot get this on fruit (domestic tolerance)

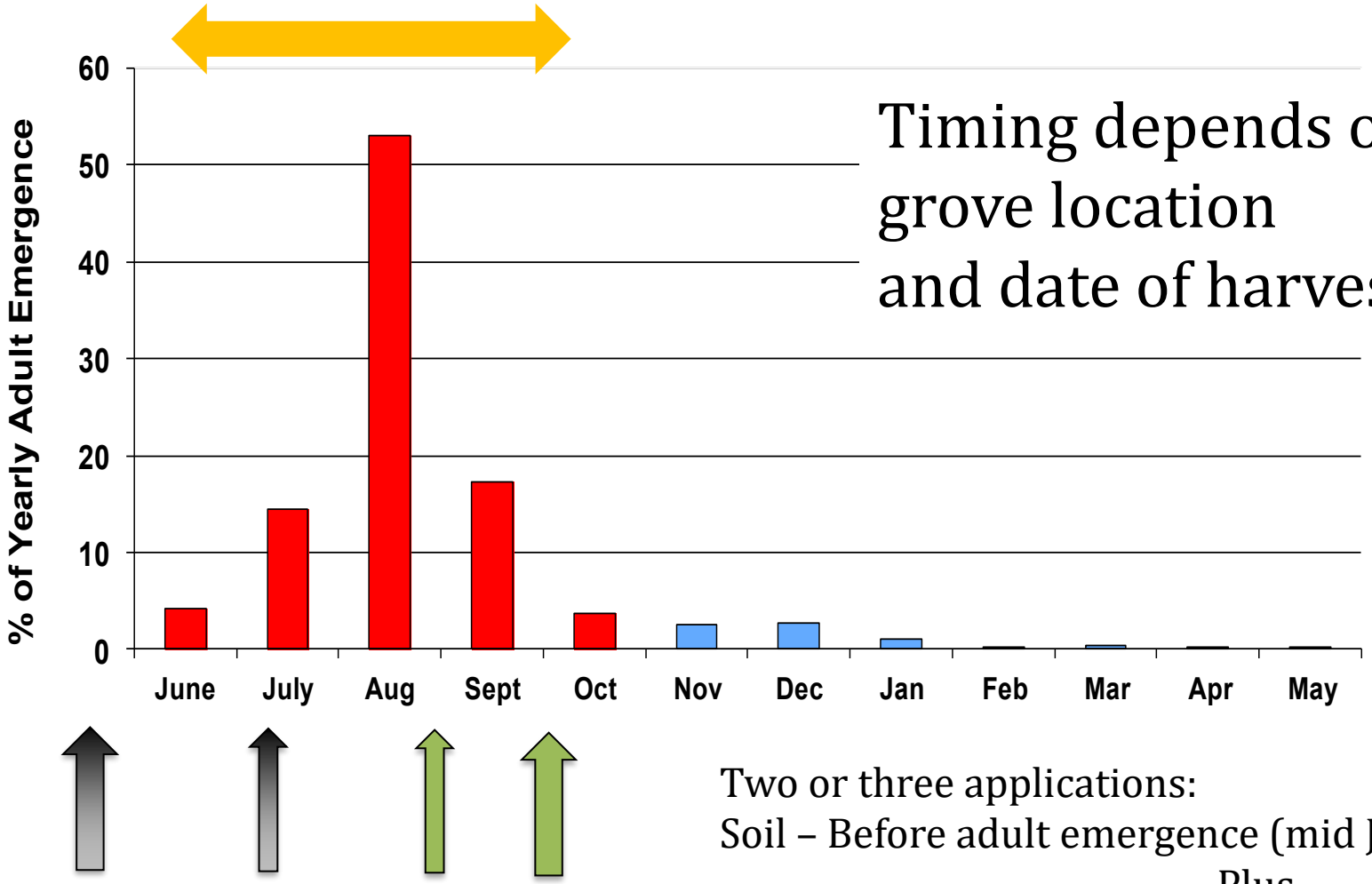
Bifenthrin applications near the base of the tree and trunk lowered FRB emergence but did not eliminate them (Morse et al. 2013)

It is very difficult to eliminate FRB adults from trees and prevent egg laying Two treatments do a better job than one treatment (Grafton-Cardwell 2014)



Brigade WSB is a 80 oz/acre ground treatment, Actara 25 WG 5.5 oz/acre and Kryocide 10 lb/acre are foliar treatments. All trees except untreated were skirt pruned.

2013-2023 FRB Management Program



Two or three applications:
Soil – Before adult emergence (mid June/early July)

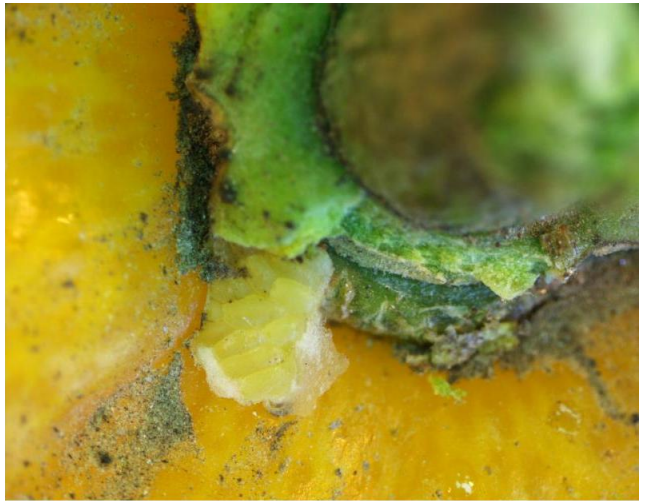
Plus

One or two foliar – After adult emergence (August and October)

How to tell if you have FRB in your grove?

Feeding damage

Sample for adult beetles using a beating sheet



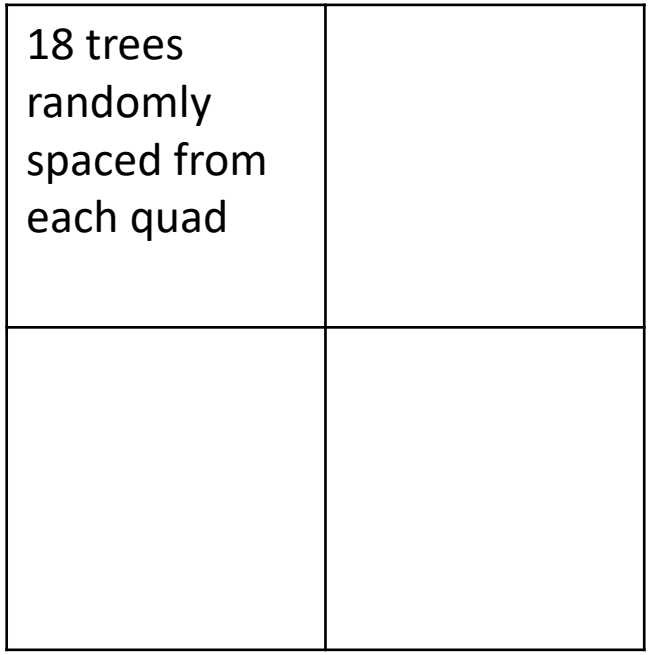
Live eggs – whitish or yellowish and plump

Dead or hatched eggs – dried out

California growers have followed FRB regulations since 2013-14 season. We are noticing a decline in FRB populations in citrus groves in the San Joaquin Valley.

Since 2023, USDA approved a sampling protocol

1. **Timing**: From Aug. 7 – Aug. 31 since that is the peak period of emergence.
2. **Sample** a total of 72 trees randomly.
3. **How**: Check suckers inside the tree for signs of FRB leaf chewing and if beetles are detected the tree is considered infested.
    i. If no beetles are found in the interior, shake two large outside branches over a light cloth and inspect for FRB. If any beetles are found, the tree is considered infested.
4. **Records**: (i) block identification, (ii) inspection date, (iii) name of inspector, and (iv) number of trees infested with beetles out of 72 trees inspected.
5. **Action**: ≤2 trees infested = eliminate the first FRB pesticide application. ≥3 or more trees infested = growers must make a pesticide application in August or early September. Second application is required regardless the sampling outcome.



FRB Management

Current recommendations (Field):

- Skirt pruning 24-30 inches above the ground
- Weed control to eliminate pathway
- Three options:
  - June application of Bifenthrin and Survey
  - Survey plus one foliar application
  - 2 foliar applications

Postharvest (if fruit is infested)

- Methyl bromide: 48 mg/l for 2 h control ca 85% FRB eggs (no longer approved option)
- Phosphine: 1,000 ppm for 48 hours, 95% mortality.
- Propylene oxide: 71 mg/liter for 24 hours, 99% mortality.
- Ethyl formate: 62 mg/liter for 5 hours, 97% mortality (not yet available in the US).

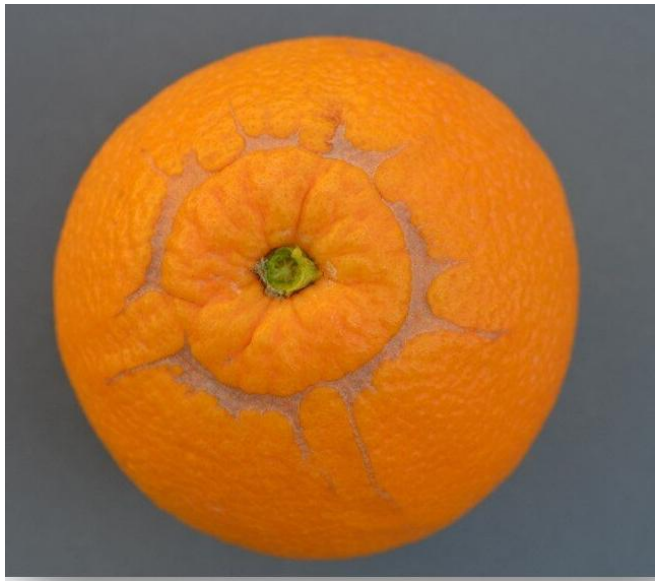
California's experience with FRB management

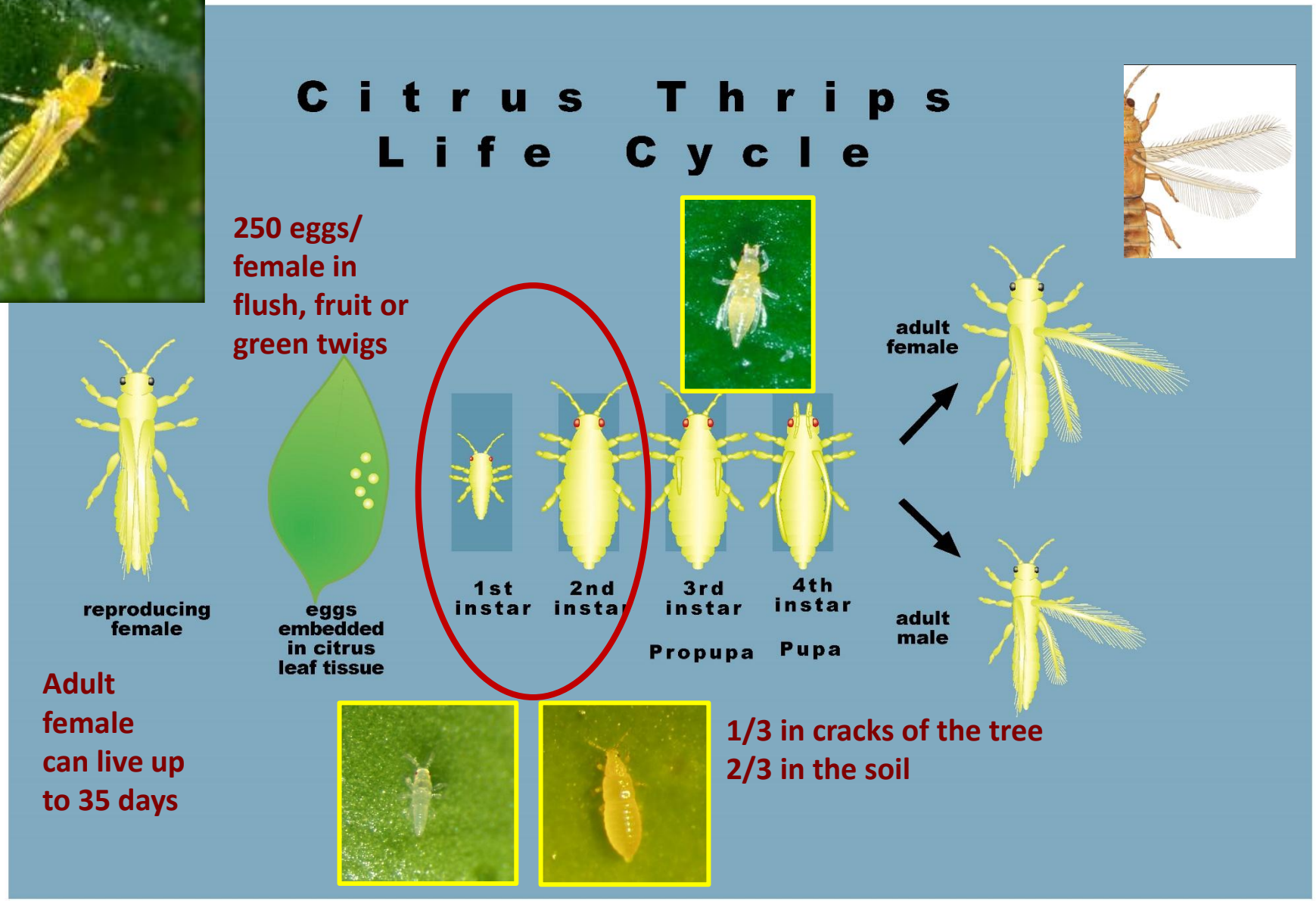
- Year-round adult emergence and egg laying makes targeted management difficult.
- Skirt pruning to a height of 24-30 inches above the ground early in the season before adults begin emerging and weed control limits the pathway.
- Bifenthrin applications applied before FRB adult emergence helps reduce the population pressure.
- Foliar applications should be applied after most of the beetles have emerged and before temperature cools down (between mid July-mid October) in California.
- Insecticide applications seems to have reduced the population pressure in citrus orchards

Citrus Thrips Biology, Monitoring, and Management



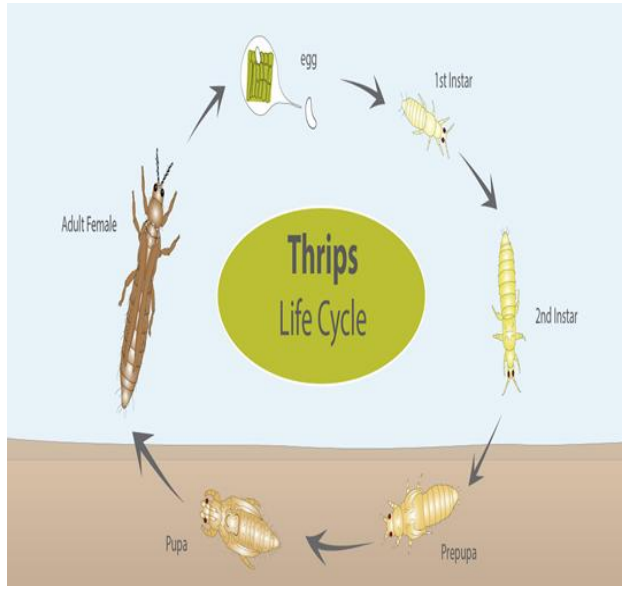






Citrus thrips

- *Scritothrips citri* (Thysanoptera: Thripidae)
- Small insect (<1mm in length)
- Yellow body, fringed wings
- Feeds on young flush, leaves, and fruit

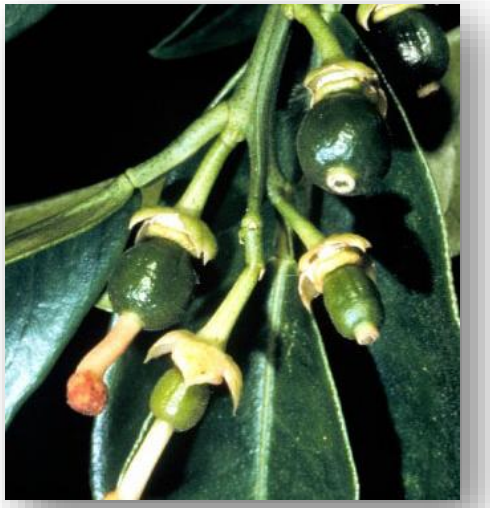


How do thrips cause damage?

- Citrus thrips are thigmotactic (like to crawl into tight spaces such as under the sepals of young fruit).
- They use their mandible to puncture the epidermal cells, then they drink up the fluid with their straw-like stylets
- As fruit grows, damaged rind tissue moves outward – presenting a ring of scarred tissue called “ring scar”
- Stylar end damage is also common, especially on mandarins

Citrus thrips attack leaves and very young fruit

For management: focus on protecting young fruit from 1st and 2nd instar thrips (2-3 generation) to minimize severe scarring

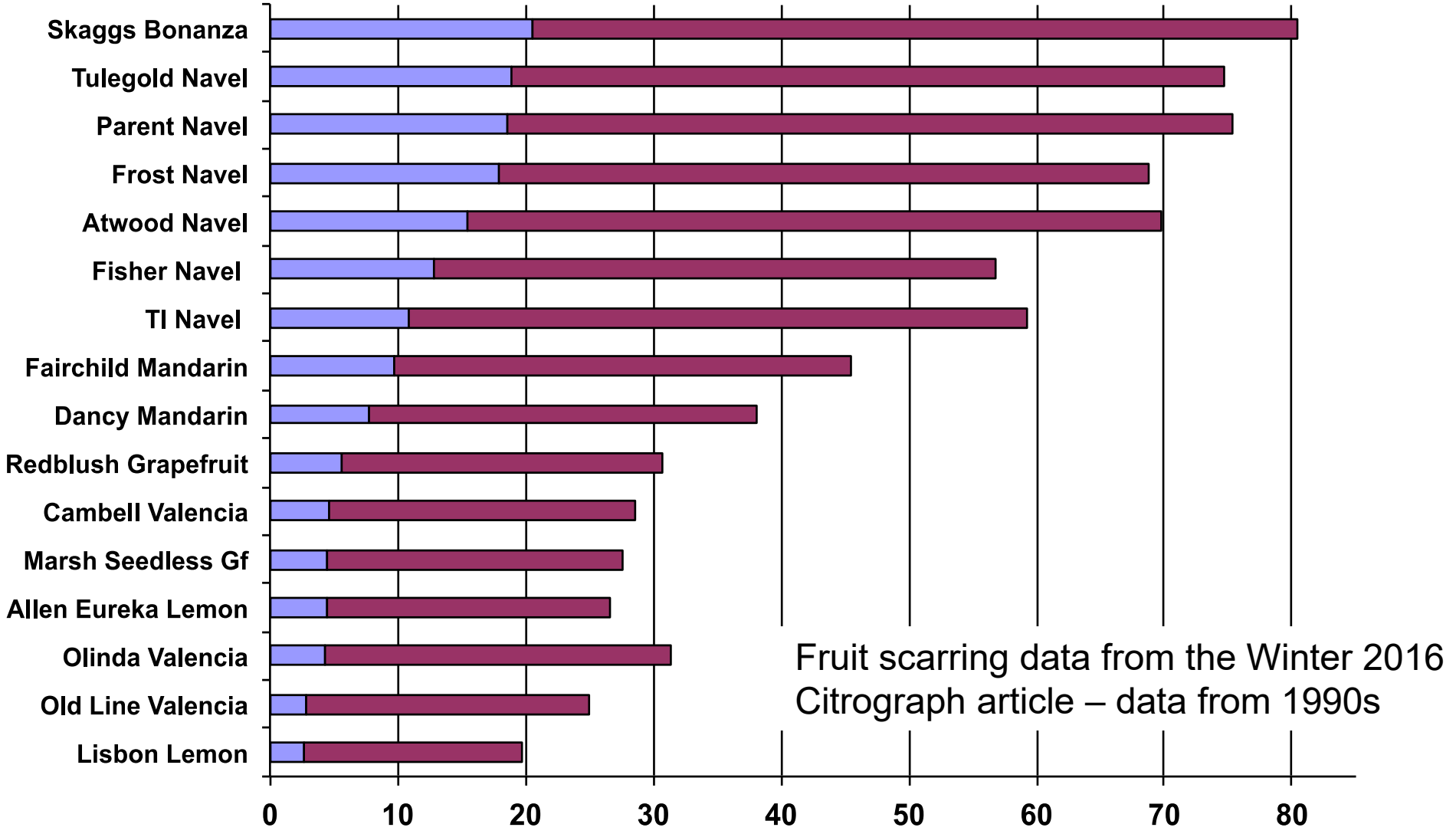


Photographic guide to scarring

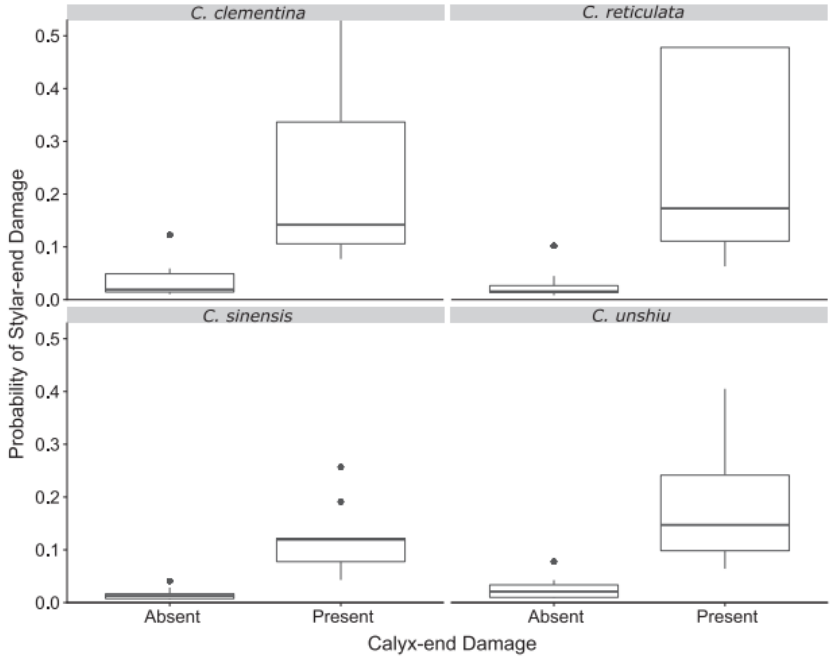
Some citrus varieties are more susceptible to citrus thrips damage. Navel oranges are most susceptible.

Fig. 2. Average Severe (Blue) and Total Citrus Thrips Fruit Scarring

Over 5 Years on 16 Varieties of Citrus



Stylar end damage is more common on mandarins.



Thrips damage can look different in mandarins, can start at the styler end and cause deformed fruit.

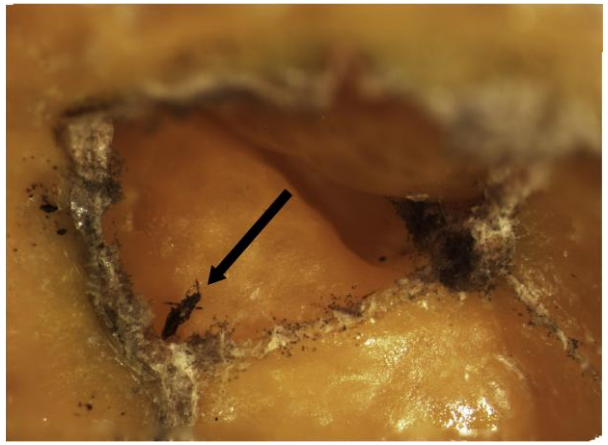
Stylar end scarring and fruit deformation is common if calyx end scarring was also present (Mueller et al. 2019).

Multiple thrips species can be found, but citrus thrips are the major pest

Major pest

Citrus thrips
Scirtothrips citri

Bean thrips
Caliothrips fasciatus



Western flower thrips
Frankliniella occidentalis

Other thrips species reported in citrus

- Kelly's citrus thrips – AU, NZ, Europe, Turkey, Israel
- Greenhouse thrips – worldwide in greenhouses, outdoors – Florida, Southern CA
- Onion thrips –worldwide
- Hawaiian flower thrips - Hawaii
- South African citrus thrips
- Chilli thrips – India, Japan, Taiwan (S. dorsalis)

Citrus thrips have become an increasingly challenging pest to manage.

Citrus Thrips Reduce California Production

OCTOBER 3, 2023 / CALIFORNIA CORNER, PESTS

Citrus thrips damage
(Photo by Jack Kelly Clark)

California citrus growers faced significant citrus thrips challenges this season due to the unprecedented rainfall, California Citrus Mutual (CCM) reported. The unusual weather pattern led to uncontrollable conditions in the field.

California citrus estimates down due to thrips

September 28 , 2023

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JOSH PLUMLEE
Crop Consultant, PCA/CCA
Nutrien Ag Solutions,
Lindsay Branch
Tulare County

What pests are you currently seeing the most and what steps are you taking to combat them?

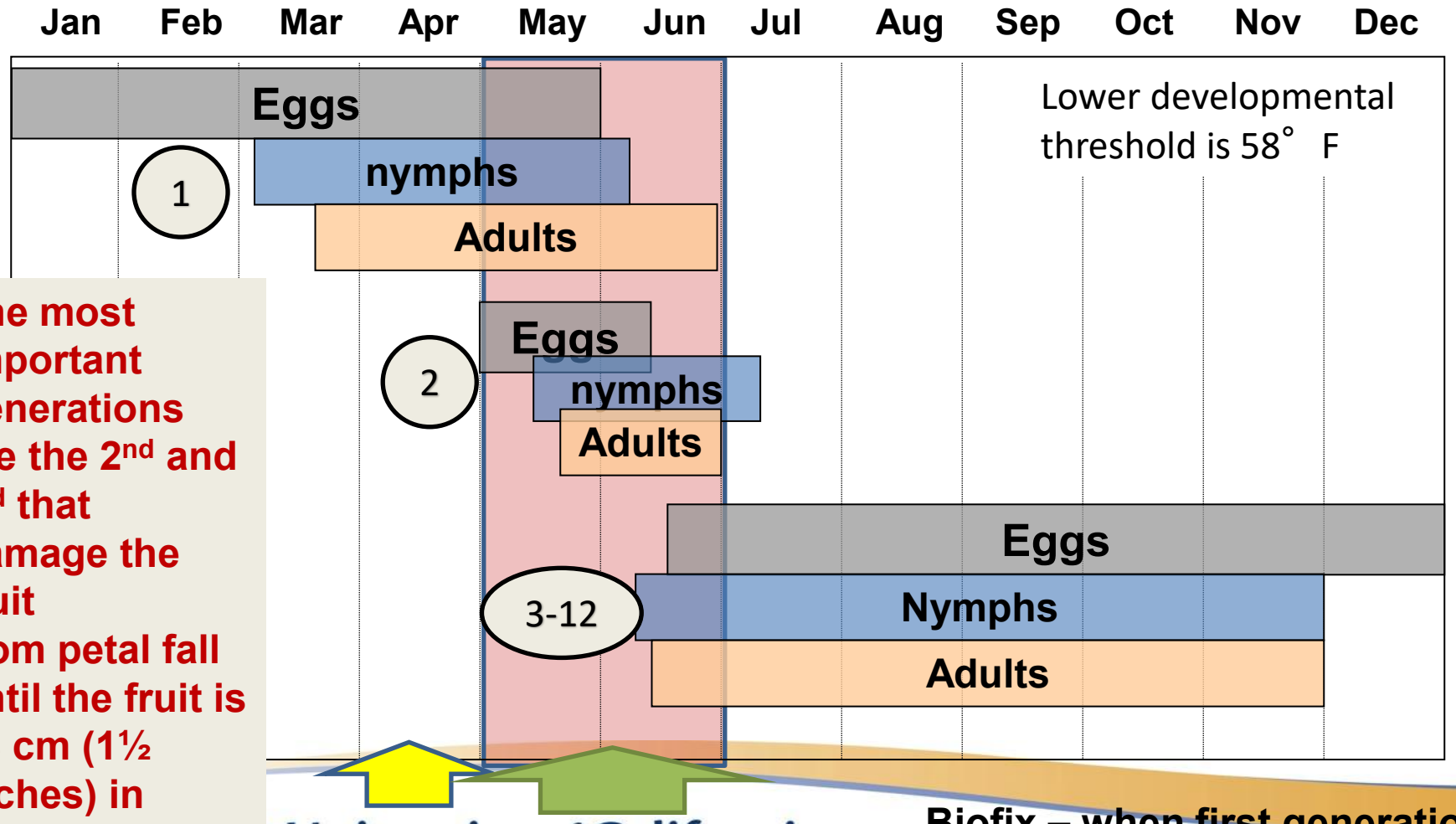
There were three primary pests that dominated my 2022 season: citrus thrips, California red scale (CRS), and citrus mealybug. Thrips populations were high for many growers in Kern, Tulare and Fresno counties. Reduced pesticide efficacy and supply chain issues added to the challenge. Ultimately, I found that combining chemistries provided the best opportunity for extended control. The challenge then became doing so in an economical manner for the grower. It was a difficult thrips season for many, and without new chemistries, it isn't likely to get any easier in the years to come.

BRYAN HARDEN
Director of Pest Management,
Booth Ranches
Tulare County

What pests are you currently seeing the most and what steps are you taking to combat them?

The past couple of years have been a challenge with thrips. Chemical control has been inconsistent. Years like these make clear the importance of monitoring each block twice a week. This allows us to catch a product failure before significant scarring occurs and to re-treat if necessary.

Citrus thrips seasonal cycle in the San Joaquin Valley



The most important generations are the 2nd and 3rd that damage the fruit from petal fall until the fruit is 38 cm (1½ inches) in diameter

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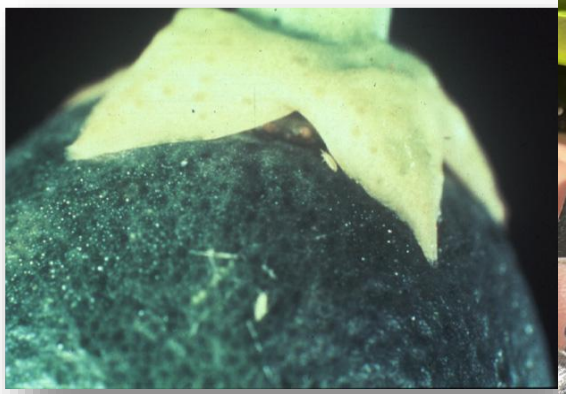
Agriculture and Natural Resources

Biofix – when first generation is consistently observed
2nd generation - 156 degree days after biofix

Monitoring
Citrus Thrips – IPM Guidelines



- Start at petal fall and sample 100 fruit 2x per week in each block
- Sample healthy green outside fruit
- Sample between 10 am and 2 pm
- Sample the stem end for 1st and 2nd instars (note if adults are present)
- Sample from petal fall until the fruit reaches 1 ½ inches
- Calculate the percentage of fruit infested with thrips
- Differentiate between citrus thrips and flower thrips

YouTube Video: Monitoring for citrus thrips in orchards

How do I tell citrus thrips from flower thrips?

1st instar citrus thrips

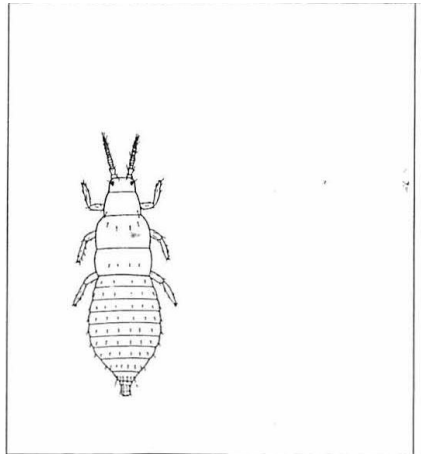
2nd instar citrus thrips

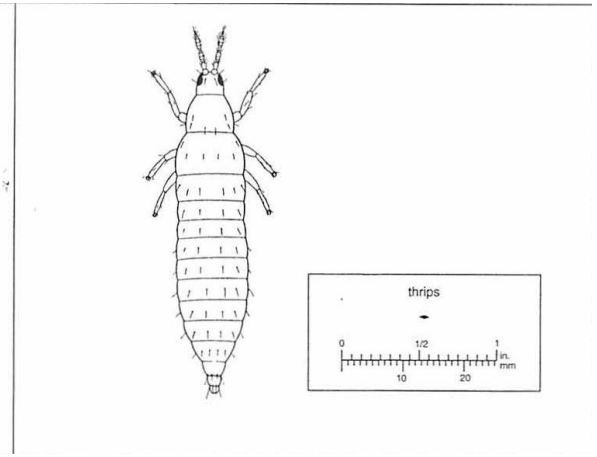
Adult citrus thrips

1st instar flower thrips

2nd instar flower thrips

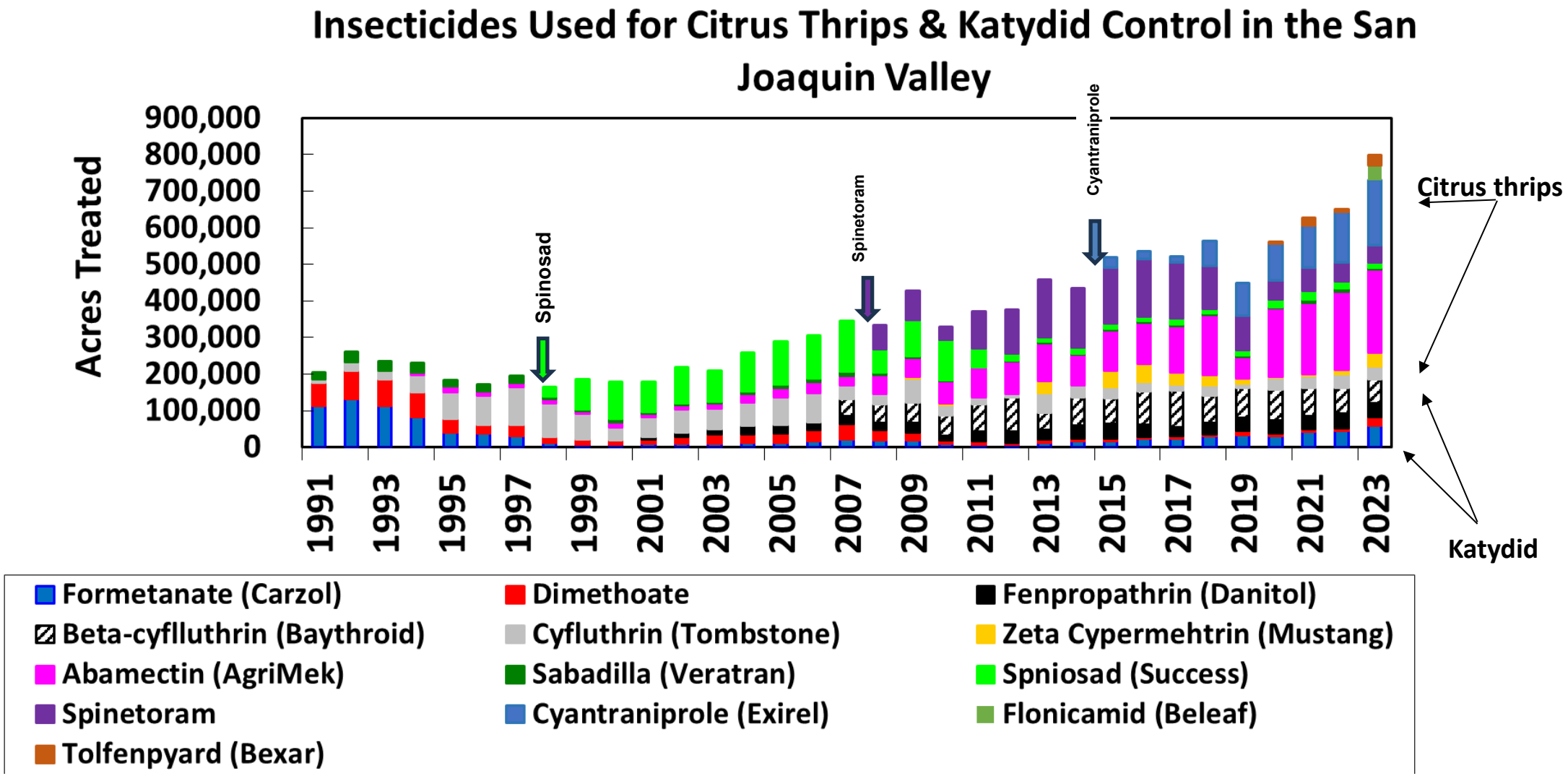
Adult flower thrips





Citrus thrips	Flower thrips
Second instar: Short, plump abdomen, with waist	Second instar: Longer, cigar-shaped abdomen
No hairs on the tip of the abdomen	Hairs on the tip of the abdomen
Adult: yellow color, wing covers body Found on young leaves and fruit	Adult: yellow-dark brown color, wing doesn't cover body Found among flowers and nectar
Very active, especially during sunny weather	Sluggish and move in an S-shaped pattern – especially the 2nd instars

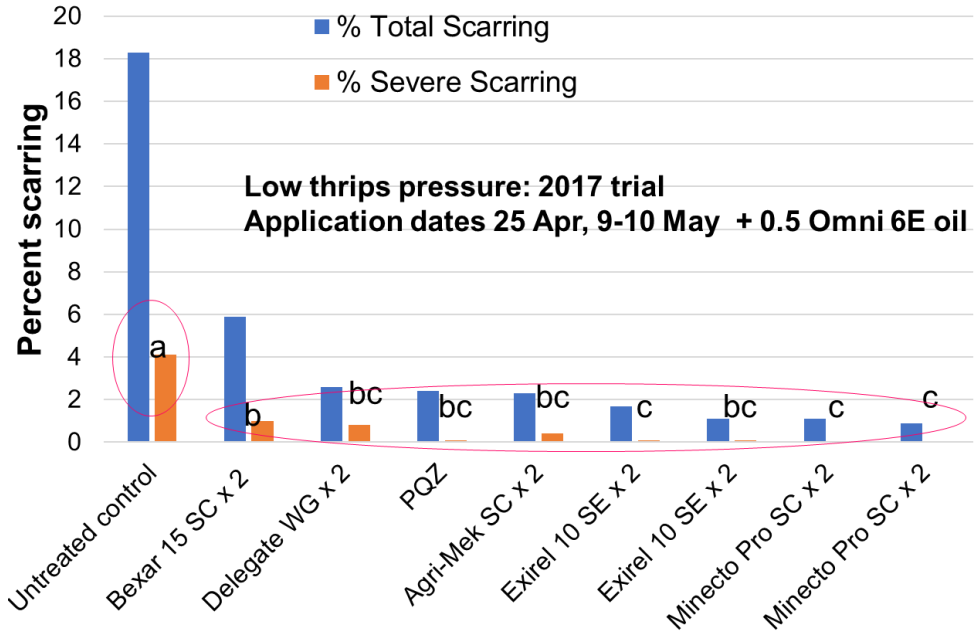
Pesticide usage in SJV for managing thrips has been increasing.



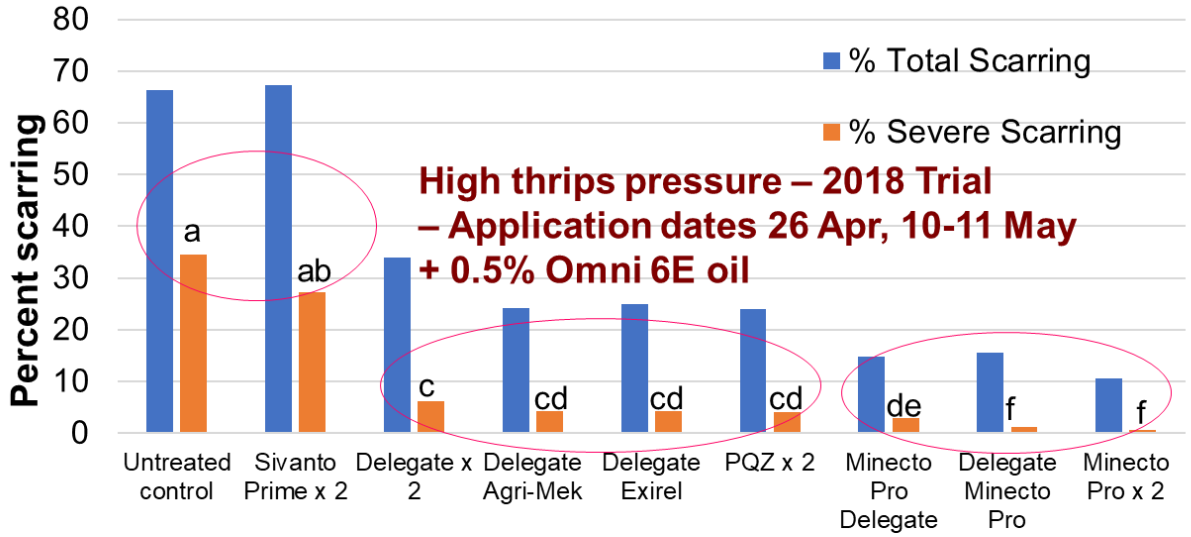
Minecto Pro = Agri-Mek + Exirel AIs

It’s all a numbers game!

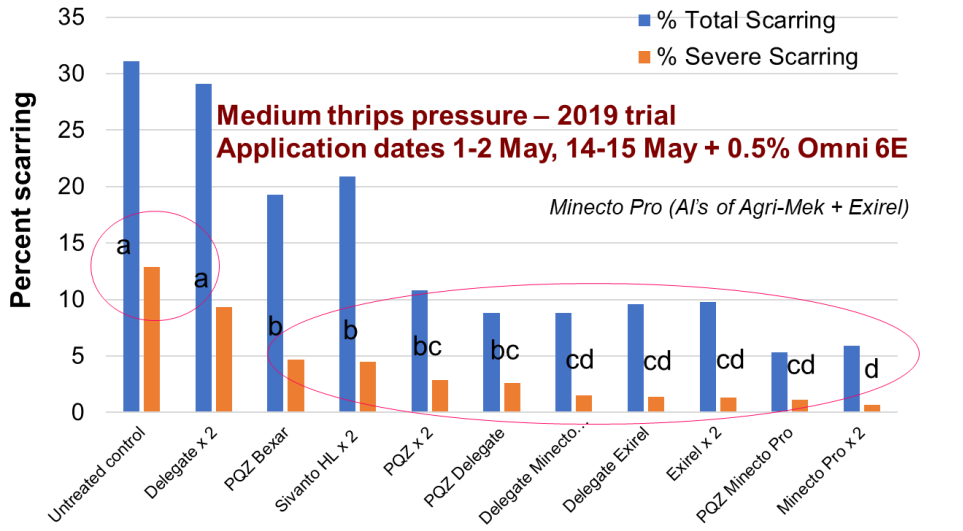
- Pesticide trials over the years have shown that thrips pressure at and weeks after petal fall matters. Many pesticides work at low thrips pressure, but fail when too many thrips are present.



When thrips pressure is low, all treatments brought thrips scarring ≤ 1%.

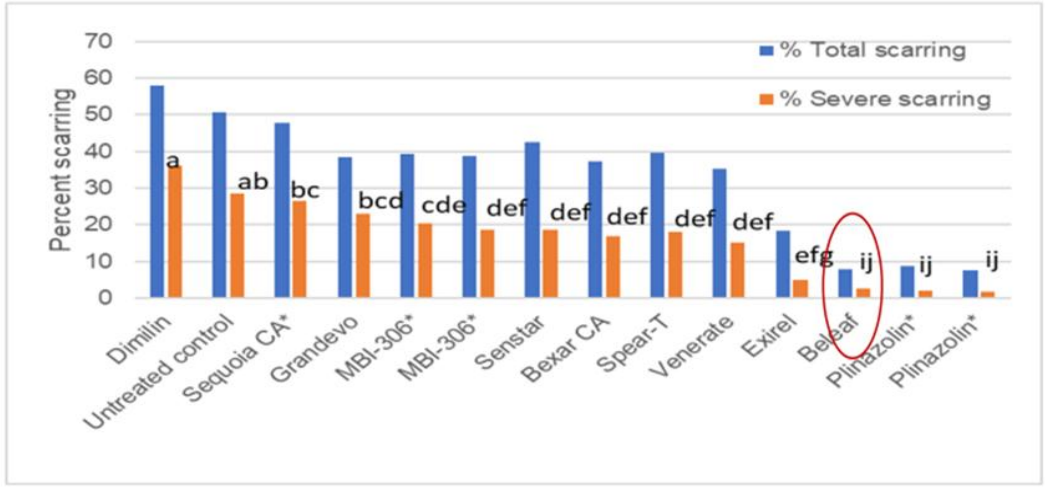


At high thrips pressure, treatments with Minecto Pro did the best!



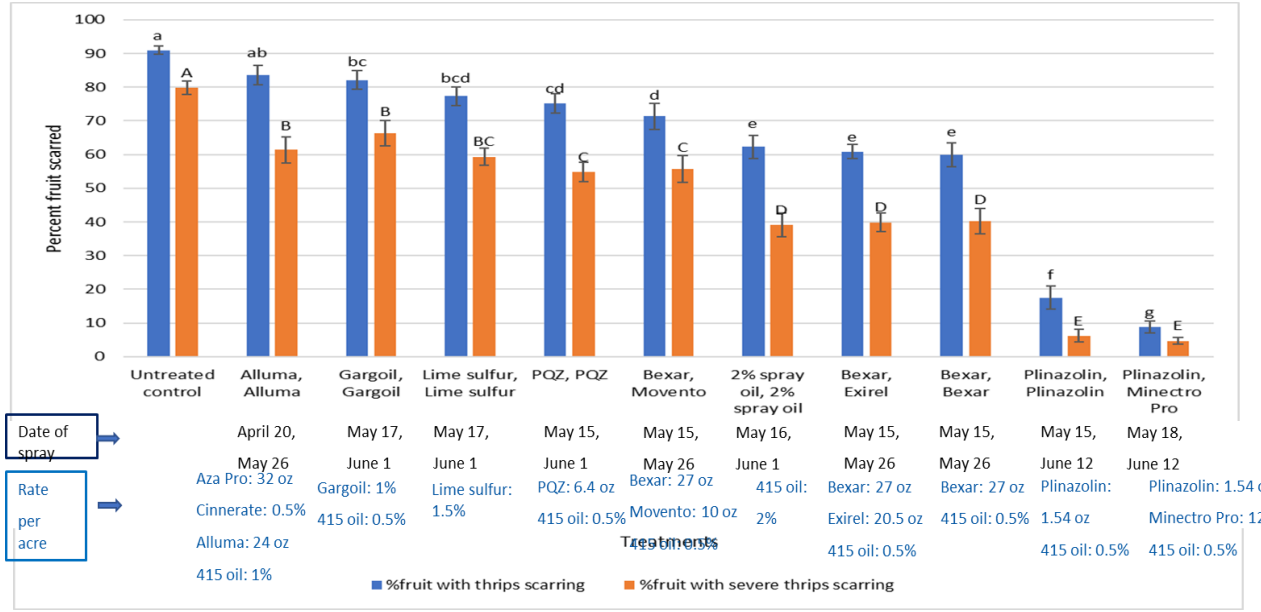
Delegate did not work at all on its own. But worked well if paired with Exirel, or Minecto Pro

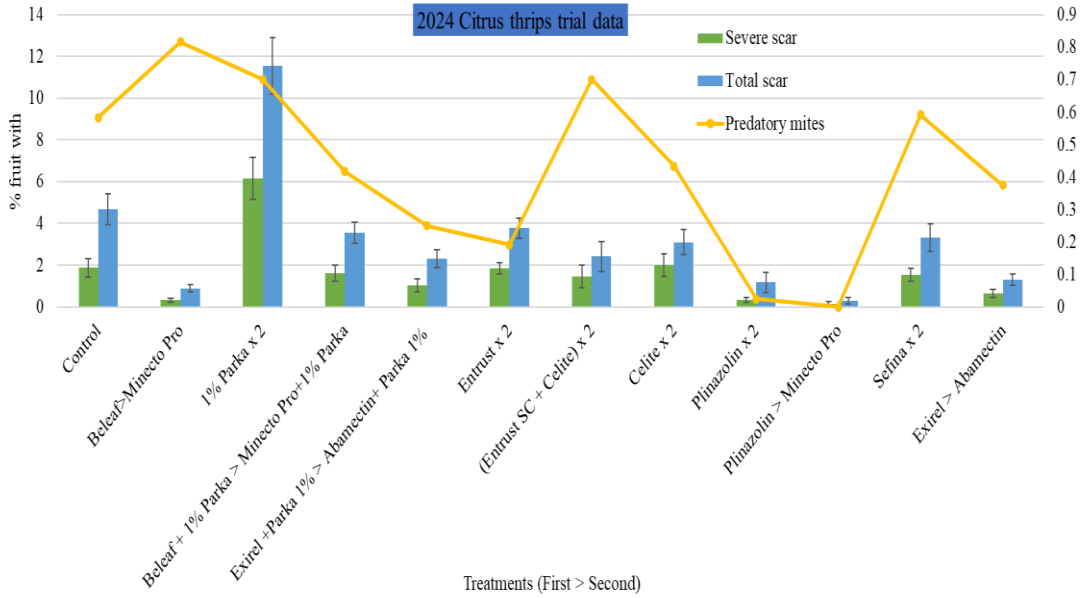
High thrips pressure – 2022 Trial
– Application dates 27-28 Apr, 12-13 May + 0.5% Omni 6E oil



Thrips pressure was high in 2022. Plinazolin performed the best, followed by Beleaf and Exirel.

In 2023, all treatments had high damage. In 2024, population pressure was low and damage was less.





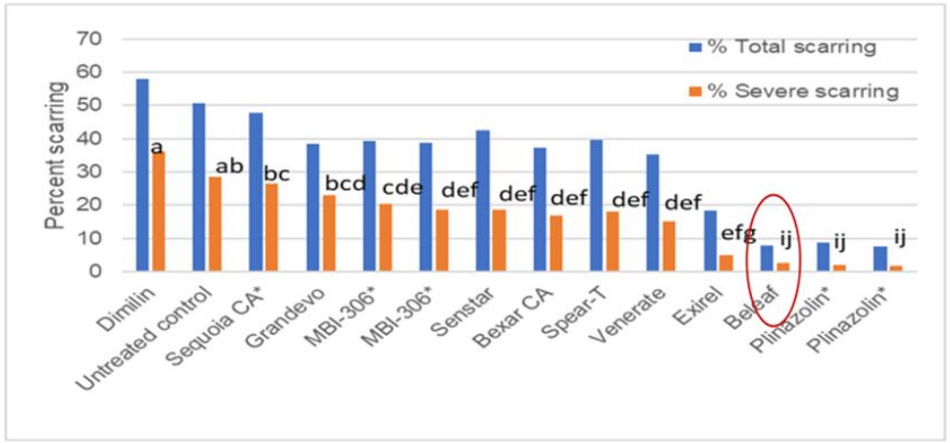
If it is a numbers game, what about threshold?

There isn't an established/definitive threshold for thrips. Because it is a pest that causes cosmetic damage, young fruit right after fruit set is the most susceptible to feeding damage. Navel oranges, clementines are more susceptible than Valencia oranges.

Adults present on fruit at petal fall, no rain in the forecast, less than 1 predatory mite/leaf – thrips immatures are a day or two behind. SPRAY!

The new active ingredient, Isocycloseram, is effective in reducing thrips damage even after a single application.

High thrips pressure – 2022 Trial
– Application dates 27-28 Apr, 12-13 May + 0.5% Omni 6E oil



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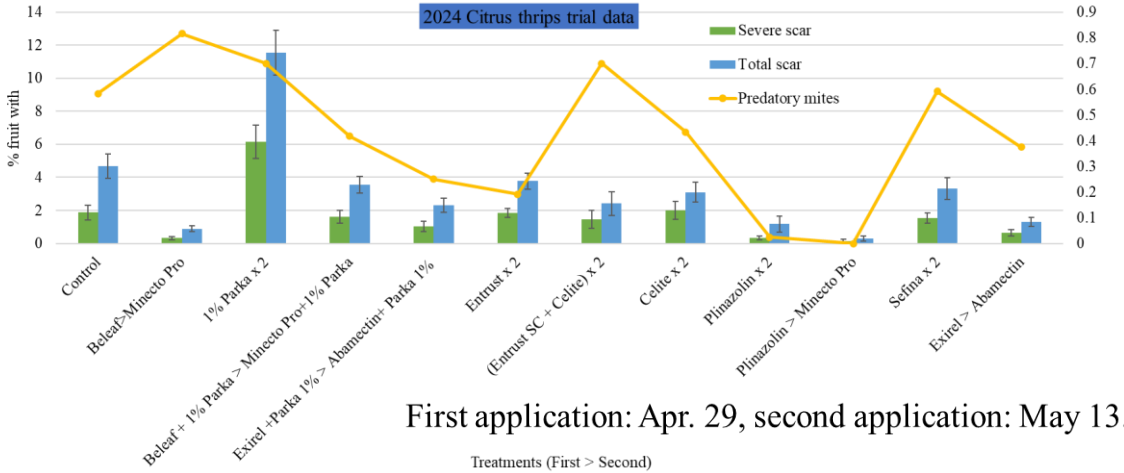
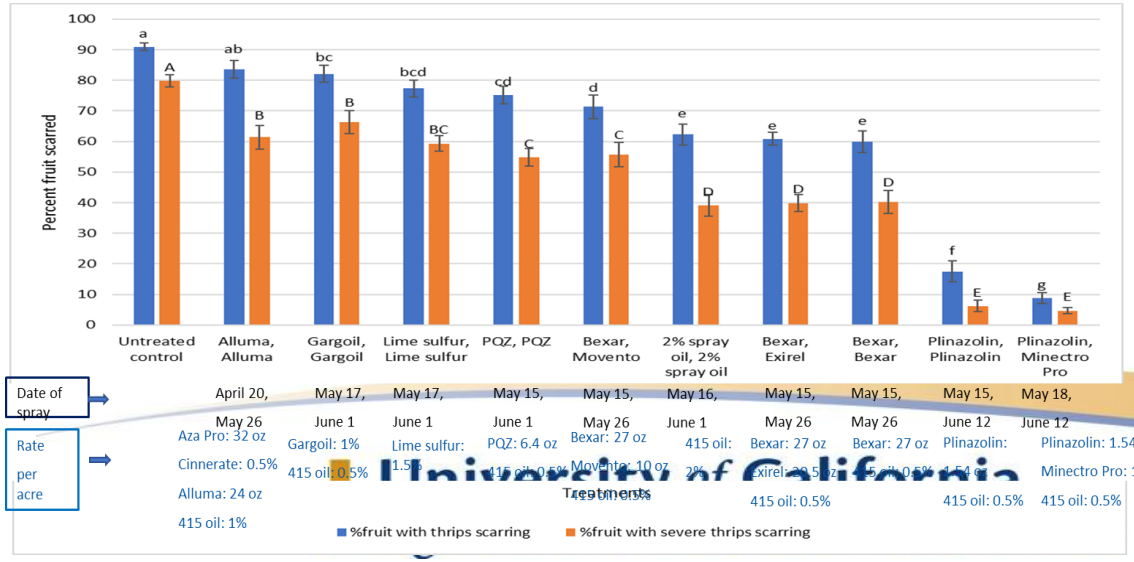
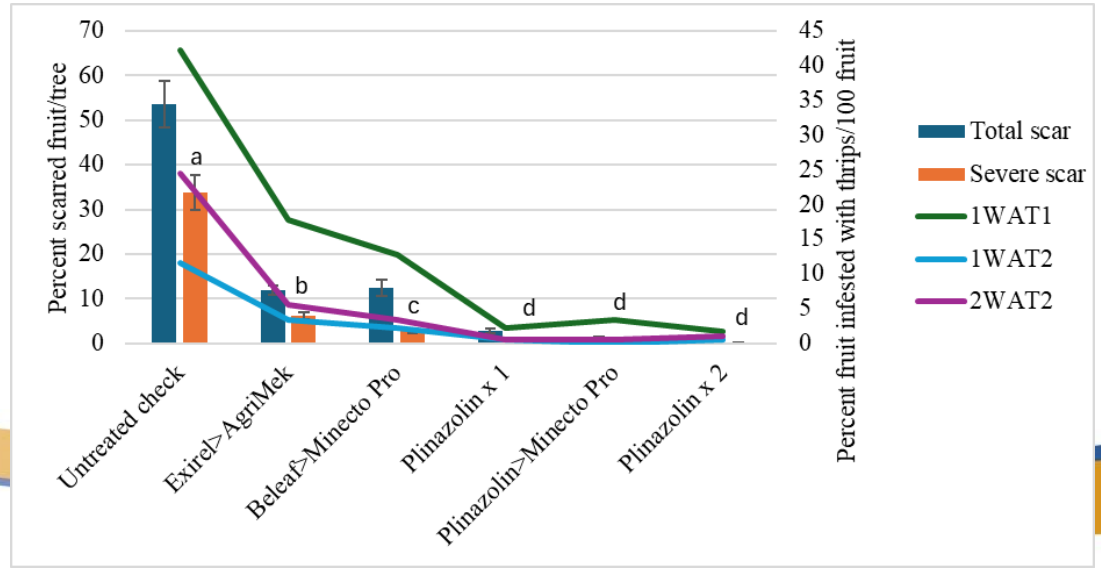


First application: Apr. 29, second application: May 13.





Trade Name	Common Name	Pesticide Class
Insecticides that work best when thrips pressure is heavy		
Exirel	cyantraniliprole	28
Minecto Pro	cyan. + abamectin	28+6
Beleaf	flonicamid	29
Plinazolin*	Isocycloseram	30
Insecticides that work best when thrips pressure is light to moderate		
Entrust/Success	spinosad	5
Delegate	spinetoram	5
Agri-Mek	abamectin	6
Movento	spirotetramat	23
Bexar	Tolfenpyrad	21A
Veratran D + sugar	sabadilla	botanical
PQZ*	Pyrifluquinazon	9B
Resistance in the SJV thrips		
Carzol SP	formetanate	1A
Cygon/Dimethoate	dimethoate	1B
Baythroid XL	beta cyfluthrin	3
Danitol 2.4 EC	fenpropathrin	3
Delegate	Spinetoram	5

No longer available to purchase.

Effective products. SJV citrus thrips have developed resistance. Use in rotation.

*Not registered in CA.

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