Scale Insects

Three species
1-5 generations per year
Suck plant juices
Can reduce yields, produce honeydew that decreases photosynthesis

Management

- Primarily managed by biocontrol
  - Parasitoids
  - *Phytocoris*
- Monitor in January
- 10 scale per inch of new wood considered a heavy infestation
- Examine scale for exit holes
- Oil, pyriproxifen, buprofezin, carbaryl are all effective in mid-February

Gill's Mealybug- history

- Introduced into Tulare County in the mid to late 1990s, thought to be *Ferrisia virgata*
- Spread slowly initially
- 2002- Identified as a new species of mealybug, *Ferrisia gilli,* native to the southeast US
- 2004- pistachios now infested in >2,000 acres in at least 5 counties, also found in almonds and winegrapes
- 2007- >6,000 acres infested
- 2020- Statewide distribution

Identification

Most easily recognized by white excretions

- Glassy white rods
- Tail, no lateral filaments

Life cycle

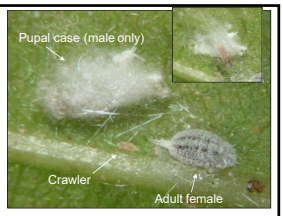
Live birth of crawlers

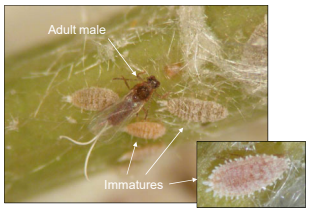
Nymphs molt several times

Male adults with wings

Females remain wingless

All stages aggregate



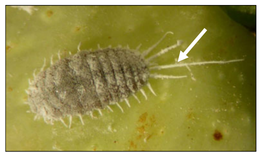


Gill's Mealybug

- Two tails
- Glassy rods
- No egg sac
- No red liquid

Grape mealybug

- Four tails
- No glassy rods
- Egg sac
- Red liquid



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- Two tails
- Glassy rods
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Grape mealybug

- Four tails
- No glassy rods
- Egg sac
- Red liquid from ostioles

Winter

March

Late March-April

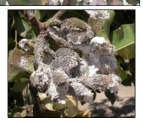

Late June to EarlyJuly


Mid-July to early August

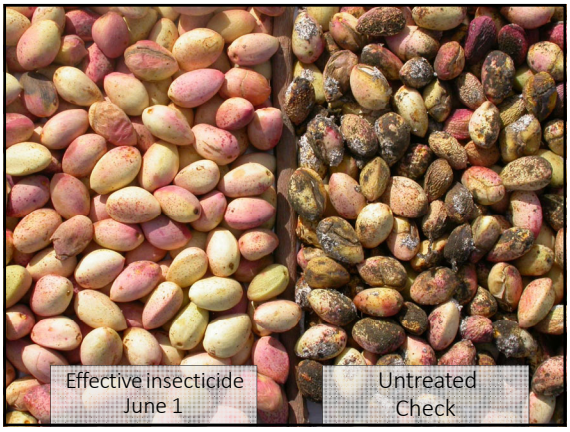

Early August

August and September

Mealybugs, honeydew, and sooty mold in the cluster



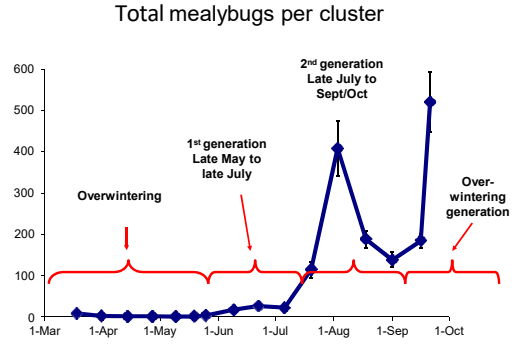
Honeydew on bark



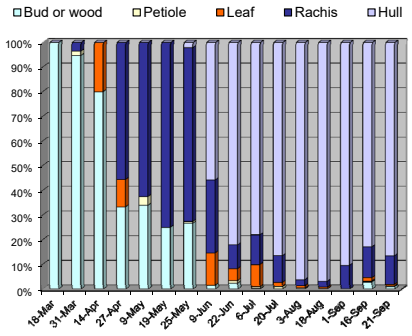
Damage

Mealybugs intercept carbohydrates that were intended for kernel development. Smaller kernels = less weight and less splitting

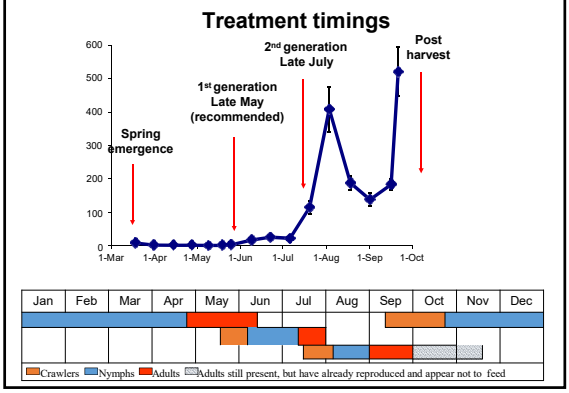
- Decrease in split inshell (% dry)
- Increase in closed shell
- Increased shell staining during second shake
- Increase in adhering hulls (observed)
- Increase in sticktights (observed)
- No association with aflatoxins



Monitoring - Mealybug Distribution

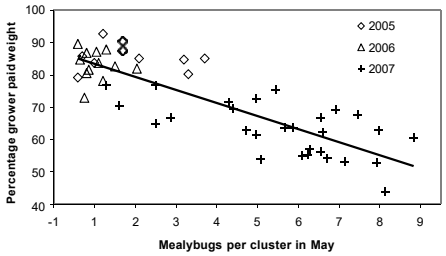


Treatment timings



Economic Injury Levels

Grower paid weight vs. mealybug density



Journal of Economic Entomology, July 2015

Economic Injury Level

$$EIL = \frac{(\text{cost of control}) \times (\text{unit of pest density})}{(\text{yield})(\text{price})(\text{crop loss to quality})(\text{crop loss to yield})}$$

EIL in May in mealybugs per cluster =

$$\frac{\text{Control cost per acre} \times 1 \text{ mealybugs/cluster}}{\text{Anticipated yield in lbs/acre} \times \text{crop price in \$/lb} \times .0475 \times .0475}$$

$$= \frac{\$60/\text{ac} \times 1}{3{,}000 \text{ lb/ac} \times \$2/\text{lb} \times .0948} = .10 \text{ mealybugs per cluster in May}$$

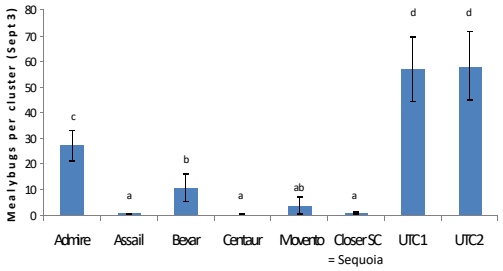
Economic injury level math

	Long-term average	Low cost High yield High price	Med cost Avg yield High price	High cost Low yield Low price
Cost per acre for control	$60	40	60	80
÷ anticipated yield in lbs/acre	3,000lb/ac	4,000	3,000	1,500
÷ anticipated price in $	$2/lb	4	4	2
÷ 0.094	0.094	0.094	0.094	0.094
= EIL in mealybugs per cluster in May	0.10 (1 in 10)	.027 (1 in 38)	0.15 (1 in 7)	0.28 (1 in 4)

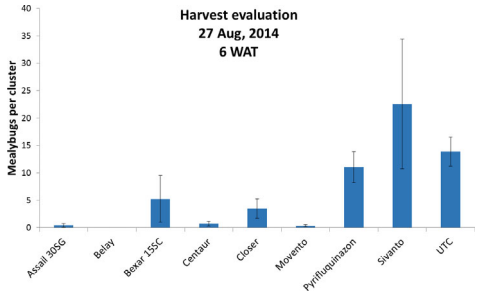
Management with insecticides

- Centaur (buprofezin)
  - Time to first generation crawlers
- Movento (spirotetramat)
  - Time to first generation, maybe ~2-3 weeks earlier
  - Surfactant is required
  - 6 oz as good as 9 oz rate in 2015 study
- Assail (acetamiprid)
  - Time to first generation
  - Best option for second generation control (mid-July)
- Sequoia (sulfoxaflor) and Belay (clothianidin)
  - An option, but inconsistent results
- Admire (imidacloprid)
  - Least effective of these products, but the cheapest and easiest to apply

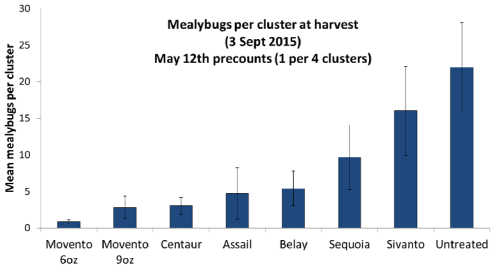
2013 Insecticide Trial



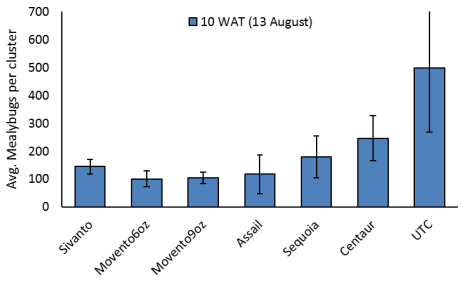
2014 Insecticide Trial



2015 Insecticide Trial



2019 Insecticide Trial



Gill's Mealybug in 2019-20

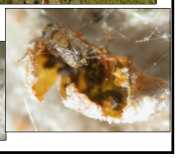
- Widespread control failures
- Multiple counties
- Multiple growers
- Multiple products
- Multiple timings
- Multiple surfactants
- Failures by growers that previously used the same products, rates, timings, surfactants, water volumes, equipment and applicators to the same orchards in previous years with excellent success

How should we respond?

- Maximize effectiveness of treatments
  - Monitor crawler emergence closely
  - Spray at a time that historically has been successful
  - Use products that historically have been successful
  - Ensure a quality application
  - Conserve biological control
- Develop a backup plan
  - Monitor to determine if a second treatment is needed
  - Second treatment in the last two weeks in July to protect harvest
  - Get a jump on next year
    - Post-harvest treatments
    - Early spring treatments

Biological Control

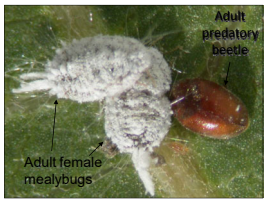
Biological control- parasitoids

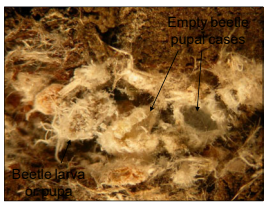


We have reared at least two species of parasites from mealybugs in Almonds.

None found yet in pistachios, even organic ones. We assume this is due to excessive pyrethroid/permethrin use.

Biological control- predatory beetles





Summary

- Monitor for adults in May
- Treatment timing is when crawlers emerge
- Treat in May if you have 1 mealybug per 6-12 clusters
- Options include Centaur, Movento, Assail, Sequoia, Belay
- An additional treatment may be needed in late July
- Post-harvest and budbreak treatments under investigation
- Prevent spread by washing harvest equipment before moving off or on site
- Ask pruning crews to report mealybugs in new orchards
- Preserve natural enemies