Mealybug and Scale Insects in Pistachios

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Scale Insects

Black scale

European Fruit Lecanium

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

- Primarily managed by biocontrol
- Examine scale for exit holes
- Monitor in January
- 10 scale per inch of new wood considered a heavy infestation
- 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
- 2005 - ~3,000 acres infested, distribution widespread
- 2007 - >6,000 acres infested
**Identification**

- Most easily recognized by white excretions
  - Glassy white rods
  - Tail, no lateral filaments

Note: Immature females appear naked
**Life cycle**

- Live birth of crawlers
- Nymphs molt several times
- Males develop into winged forms
- Females remain wingless
- All stages aggregate

- Pupal case (male only)
- Crawler
- Adult female

- Adult male
- Immatures
- Adult females and crawlers
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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**Grape mealybug**
- Four tails
- No glassy rods
- Egg sac
- Red liquid from ostioles
Pistachios - March
Pistachios - spring
Late March - April
Pistachios - Late April
Late June to Early July
Mid-July to early August
Early August
Pistachios- August and September

Mealybugs, honeydew, and sooty mold in the cluster
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
  - Only on late harvests
- Possible increase in adhering hulls with later harvests
- Increase in sticktight (observed)
- No association with aflatoxins
Total mealybugs per cluster

1st generation
June 1 to July 15

2nd generation
Late July to Sept/Oct

Overwintering generation

Overwintering generation
The graph illustrates the treatment timings for mealybugs across different months. The x-axis represents the months from January to December, and the y-axis represents the total number of mealybugs per cluster.

### Treatment Timings

- **1st generation**: June 1 (recommended)
- **2nd generation**: Late July

#### Generation Notes:
- **Crawlers**
- **Nymphs**
- **Adults**
- **Adults still present, but have already reproduced and appear not to feed**
Economic Injury Levels

- Utilizes data from field research in 2005-2007
- Establishes economic injury levels
Pistachios - Late April
Relationship between grower paid weight and mealybug density

![Graph showing the relationship between grower paid weight and mealybug density over multiple years. The x-axis represents mealybugs per cluster in May, ranging from 1 to 9, and the y-axis represents percentage grower paid weight, ranging from 0 to 100. The graph includes data points for 2005, 2006, and 2007, with different symbols for each year. The data points show a negative correlation, indicating that as the mealybug density increases, the percentage grower paid weight decreases.]
Research

Relationship between anticipated yield and EILs

![Graph showing the relationship between anticipated yield (kg dry weight per ha) and economic injury level (mealybugs per cluster in May). The graph indicates a negative correlation, with higher anticipated yields correlating with lower economic injury levels.](image-url)
Economic Injury Level

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

EIL in May in mealybugs per cluster =

Control cost per acre x 1 mealybugs/cluster

Anticipated yield in lbs/acre x crop price in $/lb x .0475 x .0475

= $60/ac x 1

3,000 lb/ac x $2/lb x .0948

= .10 mealybugs per cluster in May
## EIL math

<table>
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<tr>
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<th>Long-term average</th>
<th>Low cost</th>
<th>Med cost</th>
<th>High cost</th>
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<td></td>
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<td>Cost per acre for control</td>
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<td>.01</td>
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<tr>
<td>= EIL in mealybugs per cluster in May</td>
<td>0.10 (1 in 10)</td>
<td>.02 (1 in 50)</td>
<td>0.10 (1 in 20)</td>
<td>0.27 (1 in 4)</td>
</tr>
</tbody>
</table>
Insecticide Timing

- **First week of June**
- **Late July**
2013 Insecticide Trial

Mealybugs per cluster (Sept 3)

- Admire
- Assail
- Bexar
- Centaur
- Movento
- Closer SC
- UTC 1
- UTC 2

Legend:
- a
- b
- ab
- c
- d
2015 Insecticide Trial

Mealybugs per cluster at harvest
(3 Sept 2015)
May 12th precounts (1 per 4 clusters)
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)

- **Admire (imidacloprid)**
  - Not as effective, but inexpensive and no application costs

- **Non-registered insecticides also effective**
  - Bexar and Closer
Biological Control
We have reared at least two species of parasites from mealybugs in Almonds.

None found yet in pistachios… likely due to permethrin for true bugs.
Biological control - predatory beetles

- Predatory beetle larvae
- Adult female mealybugs
- Empty beetle pupal cases
- Beetle larva or pupa
Pyrethroid/Permethrin use

- For NOW and bugs
- No magic application date
- Sprayed
  - With fungicides
  - With foliar nutrients
  - On their own
  - At hull split
  - Between shakes
  - 4-6 applications per season is common
Stopping the spread at harvest

- Wash equipment when leaving infested blocks
  - High pressure (or even low pressure) water
  - Shakers, catch frames, etc.

- Wash bulk containers when leaving infested blocks or after their use
  - Use bulk transport
  - 4 x 4 bins (best if kept in field)

- Avoid leaf trash from blowing out of bins during transport

- Communication
  - Growers should identify fields to harvesters
  - Hullers should be aware of infested bins
  - Hullers should have sanitation/isolation plans in place
Summary

- Monitor in May
- Treat if you have 1 mealybug per 6-12 clusters
- Centaur, top of the label, good coverage, first two weeks in June when crawlers emerge
- Movento and Assail also options
- Prevent spread by washing harvest equipment before moving off or on site
- Monitor at harvest-winter to find newly infested fields
- Long-term solution… biological control
Thank you
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