Managing Mites in Apples

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European Red Mite

- A tiny pest
- Mites suck sap from leaves
- Trees tolerate some but not lot of mites

Mites

Healthy leaves

Mite-damaged leaves
Managing Mites

- Integrated biological & chemical control
- Components:
  - Miticide choices
  - Deciding when miticide needed
  - Biological control
Managing Mites

**Key principles:**

- Each miticide has a **time** when most effective
- To avoid resistance, miticides must be **rotated**
- Predatory mites should be encouraged to survive to allow **biocontrol**
How do miticide products compare in how well they kill the target pest?
<table>
<thead>
<tr>
<th>Product</th>
<th>European red mite</th>
<th>Two-spotted spider mite</th>
<th>Apple rust mite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savey, Apollo</td>
<td>E</td>
<td>E</td>
<td>P</td>
</tr>
<tr>
<td>AgriMek</td>
<td>G</td>
<td>F</td>
<td>G</td>
</tr>
<tr>
<td>Nexter (Pyramite)</td>
<td>G</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>Acramite</td>
<td>F</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Zeal</td>
<td>E</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>FujiMite</td>
<td>E</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Kanemite</td>
<td>G</td>
<td>G</td>
<td>P</td>
</tr>
<tr>
<td>Envidor</td>
<td>E</td>
<td>E</td>
<td>G</td>
</tr>
</tbody>
</table>

E = excellent; G = good; F = fair; P = poor
How do miticide products compare in how well they avoid killing the good predatory mites?
## Effect on Predatory Mites

<table>
<thead>
<tr>
<th>Product</th>
<th>White (Phytoseiids)</th>
<th>Yellow (Stigmaeids)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savey, Apollo</td>
<td>slight</td>
<td>slight</td>
</tr>
<tr>
<td>AgriMek</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Nexter (Pyramite)</td>
<td>moderate</td>
<td>harsh</td>
</tr>
<tr>
<td>Acramite</td>
<td>slight</td>
<td>slight</td>
</tr>
<tr>
<td>Zeal</td>
<td>moderate</td>
<td>harsh</td>
</tr>
<tr>
<td>FujiMite</td>
<td>moderate</td>
<td>harsh</td>
</tr>
<tr>
<td>Kanemite</td>
<td>slight</td>
<td>??</td>
</tr>
<tr>
<td>Envidor</td>
<td>moderate</td>
<td>mod./harsh</td>
</tr>
</tbody>
</table>
What timing is most effective for each miticide product?
<table>
<thead>
<tr>
<th>APPLES</th>
<th>MITES</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” green</td>
<td>winter eggs</td>
<td>good for oil</td>
</tr>
<tr>
<td>tight cluster</td>
<td>winter eggs</td>
<td>best for oil</td>
</tr>
<tr>
<td>pink</td>
<td>larvae</td>
<td>none</td>
</tr>
<tr>
<td>bloom</td>
<td>protonymphs</td>
<td>none</td>
</tr>
<tr>
<td>petal-fall</td>
<td>deutonymphs, few new adults</td>
<td>best for Carzol</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; cover</td>
<td>adults, summer eggs</td>
<td>best for Savey, Apollo, Zeal, Envidor, Agri-Mek</td>
</tr>
<tr>
<td>summer</td>
<td>mixed stages</td>
<td>Nexter, FujiMite, Kanemite, Acramite</td>
</tr>
</tbody>
</table>
Changes in recommended **timing** of miticides on Apples

- **Savey & Apollo:**
  - From 1995-1999, only for pre-bloom
  - Now allowed post-bloom
    - Savey: PHI 28 days, since 2001
    - Apollo: PHI 45 days, since 1999
  - Work best **post-bloom**
- **Nexter (=Pyramite):**
  - Commonly used mid-summer
  - Does best at **petal-fall**
How to decide on a mite management program?
Orchard Variability

• Mite problems can vary among blocks due to:
  – Different cultivars
  – History of predator presence

• In orchards with more than 1 block, consider 2 categories of management
2 Management Categories

• Blocks where miticide usually is needed every year:
  – Apply miticide at petal-fall to 1st cover
  – Use a 3-year rotation of miticides

• Blocks where miticide usually not needed every year:
  – Use oil at delayed-dormant
  – Apply miticide in summer only if threshold exceeded
If miticide needed every year: 3-year rotation of early season miticides

<table>
<thead>
<tr>
<th>Year</th>
<th>Product</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agri-Mek</td>
<td>1st cover</td>
</tr>
<tr>
<td>2</td>
<td>Savey or Apollo or Zeal</td>
<td>1st cover</td>
</tr>
<tr>
<td>3</td>
<td>Envidor</td>
<td>1st cover</td>
</tr>
</tbody>
</table>
If miticide needed every year: What to apply later in the unlikely event that mites exceed threshold

<table>
<thead>
<tr>
<th>Year</th>
<th>Early season</th>
<th>Summer treatment (at threshold)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Timing</td>
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<td>1</td>
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</tr>
<tr>
<td>3</td>
<td>Envidor</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; cover</td>
</tr>
</tbody>
</table>
If miticide NOT every year

• Use superior oil, delayed dormant
  – Best: 1% at tight cluster
  – OK: 2% at half-inch green

• Use Savey or Apollo when summer threshold exceeded
  – Savey PHI = 28 days
  – Apollo PHI = 45 days

• If threshold exceeded 2 years in a row, alternate with Nexter or FujiMite
How to know if the mite population exceeds the threshold?
Scout for European Red Mite

• **Goal:** make a decision
  – ‘Treat’
  – ‘Do not treat’

• Use presence / absence sampling

• **Sample size:**
  – minimum = 20 leaves
  – maximum = 100 leaves

• **Based on seasonal thresholds**
  – Early summer: fewer mites tolerated
  – Late summer: more mites tolerated
### Scout for European Red Mite

<table>
<thead>
<tr>
<th>Time</th>
<th>Threshold (average number of mites per leaf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-May to mid-June</td>
<td>2.5</td>
</tr>
<tr>
<td>Mid-June to mid-July</td>
<td>5.0</td>
</tr>
<tr>
<td>Mid-July to mid-Aug.</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Scout for European Red Mite

Early summer (mid-May to mid-June)

Threshold = 2.5 mites/leaf

Mid-summer (mid-June to mid-July)

Threshold = 5.0 mites/leaf

Late summer (mid-July to mid-Aug.)

Threshold = 7.5 mites/leaf

Source: Cornell University
Scout for European Red Mite

Steps:
1) take 4 leaves from each of 5 trees
2) rate each as infested or not
3) get total number infested leaves (of 20)
4) plot the number infested on chart
5) see which decision zone the point is in:
   – ‘Treat’
   – ‘Do not treat; resample in 7 days’
   – ‘Do not treat; resample in 14 days’
   – ‘Continue sampling’
Mite Scouting - early summer

example:
In first 20 leaves, 3 are infested

Cornell University
Scout for European Red Mite

• If you need to continue sampling:
  – take 10 more leaves
  – rate each
  – get new total
  – plot new point
  – check decision

• If you still need to continue:
  take 10 more leaves at a time, add to total, plot, until decision reached
Mite Scouting - early summer

**example:**
In next 10 leaves, 1 is infested.

3 + 1 = 4

Decision: do not treat; resample in 14 days

Cornell University
What are predatory mites and how are they used?
Predatory mites in orchards

• Fast white mites (Family Phytoseiidae)
  – *Neoseiulus fallacis* (=*Amblyseius fallacis*)
  – *Typhlodromus pyri*

• Slow yellow mites (Family Stigmaeidae)
  – *Zetzellia mali*
  – *Agistemus fleschneri*
White Predatory Mites

- **N. fallacis:**
  - most common natural predator in Ohio
  - high feeding rate (good)
  - not abundant until July/August (bad)

- **T. pyri:**
  - not found naturally in Ohio
  - lower feeding rate (bad)
  - active earlier than *N. fallacis* (good)
  - can survive on pollen etc. (good)
  - congregate in flowers (convenient)
Z. mali, yellow predatory mite

- Abundant in Columbus research orchard since 1996
  - the only predator species, April & May
  - the dominant predator, July & August
  - providing biocontrol of European red mite where Imidan used
  - also tolerates pyrethroids

- Feeds on all stages, but prefers eggs and young nymphs
Biocontrol Research

• Is *T. pyri* (white predatory mite) from western New York suitable for use in Ohio?
  – Unimproved strain, via flower transfer, 1996, to Licking County
  – Pyrethroid-resistant strain, via trunk bands, 1999, to Franklin Co.

• How can local populations of *Z. mali* (yellow predatory mite) be built up to provide biocontrol?
Objectives:
1. Can *T. pyri* become established in Ohio?

Yes.
Seems to tolerate our hot summers.
Research, White Predator Mites

Objectives:
2. Does *T. pyri* do a better job than *N. fallacis* in controlling European red mite?

Yes.
Not only because of better (earlier) timing, but it tolerates Pyramite better.
Objectives:
3. How does *T. pyri* affect native predators?

It displaces *N. fallacis*.
It suppresses *Z. mali* but does not displace it.
Research, White Predator Mites

Objectives:
4. How quickly does *T. pyri* spread?

Within 3 years of light seeding, within 2 years of heavier seeding.
Objectives:
5. Is the pyrethroid-resistant strain good enough at controlling mites that pyrethroids can be used for insect control?

Yes, at least at the low end of rate, in a variety not highly susceptible to European red mite. Concern about flare-up of San Jose scale (parasitoid seems to be killed).
Research, yellow predator mite

- What orchard chemicals can *Z. mali* tolerate?
- Can *Z. mali* be transferred to an orchard where it is not found naturally?
Research, yellow predator mite

• **Slide-dip Bioassays:**
  – Mites stuck on glass slide
  – Dip for 5 seconds
  – 24-hour mortality reading

• **Products tested in 2000 & 2001:**
  – Insecticides & miticides (29)
  – Fungicides (19)
  – Plant growth regulators (10)
Research, yellow predator mite

Highly toxic to *Z. mali*:

- **Insecticides**: Thiodan (100% mortality)
  - Pyramite (100%)
  - Vendex (100%)
  - Omite (100%)
  - cyhexatin (97%)
  - high Danitol (81%)
  - Kelthane (74%)
  - high Asana (63%)

- **Fungicides**: Sulfur (100%)
  - Lime sulfur (74%)
Research, yellow predator mite

Orchard transfer trial:

• **Trunk bands**
  – Paper tree wrap with burlap liner (Oct. - Jan.)
  – Seeded in commercial Fuji 4/26/01 & 5/17/02

• **Branch transfer**
  – 31 July 2001 in Fuji
  – 23-25 July 2002 in Fuji & 2 Red Delicious blocks
Research, yellow predator mite

Orchard transfer trials, 2001 & 2002
• Mite counts, mid-July to mid-Sept.
• Results, was *Z. mali* established?
  – No from trunk bands in April
  – Yes from branches in July
• Conclusions:
  – Trunk bands work well for *T. pyri* but not for *Z. mali*
  – Better luck with branch transfer
Future Research

• Update survey of predatory mite species
  – Last done 1992
  – Yellow mites more common since ‘95/96?
    • Omite no longer used
    • Thiodan used less since Provado
  – Might be need for conservation not seeding

• Additional seedings of *T. pyri* especially where pyrethroids needed