Integrated Pest Management for Apple Insect Pests in Home Gardens

Celeste Welty
Extension Entomologist
February 2015
Growing apples…

• Accept insect pest damage (typically on ~40% of fruit)

or

• Work to prevent insect damage
  – Calendar approach
  – IPM approach
IPM for apple

• Monitoring
• Predictions
• Preventive tactics
• Curative tactics
Key insect pests of apples

codling moth

plum curculio

apple maggot
Occasional pests of apples

San Jose scale
stink bugs
rosy apple aphid
woolly apple aphid
tarnished plant bug
Occasional pests of apples: some induced if natural enemies killed by insecticides used on key pests

San Jose scale
stink bugs
rosy apple aphid
woolly apple aphid
tarnished plant bug
Codling moth

• The key pest in apple fruit (& pears too)

• Young larva enters fruit, tunnels to seeds at core
Codling moth life cycle
Codling moth life cycle

1\textsuperscript{st} generation in May/June

2\textsuperscript{nd} generation in July/August
Mechanical controls of codling moth

- Trunk bands
- Fruit bagging
Trunk bands: the idea

- Larva exits fruit
- Crawls under bark scale to pupate
- Bands offer shelter
- Destroy the shelter!
Trunk bands:
4 - 6” corrugated cardboard on trunk & main branches
**Trunk bands:**
4 - 6” corrugated cardboard on trunk & main branches

<table>
<thead>
<tr>
<th>Target</th>
<th>Install</th>
<th>Remove &amp; destroy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(^{st}) generation</td>
<td>mid-May</td>
<td>Late June</td>
</tr>
<tr>
<td>2(^{nd}) generation</td>
<td>mid-July</td>
<td>November</td>
</tr>
</tbody>
</table>
Fruit bagging

• Supplies:
  – 2-layer Japanese bags
  – Or brown paper bags + twist ties
Fruit bagging

• Install on fruit $\frac{1}{2} - \frac{3}{4}$” diameter (~2 – 3 weeks after petal-fall)

• Remove 2 weeks before harvest

• Labor intensive!
Apple bud stages

1. Dormant
2. Silver tip
3. Green tip
4. Half-inch green
5. Tight cluster
6. Pink
7. Bloom
8. Petal fall
9. Fruit set
Cultural controls of codling moth

• Sanitation:
  — Scrape cocoons from picking crates, fences

• Host reservoir elimination:
  — Cut down abandoned trees
Insecticide for codling moth?

- **Calendar approach:**
  - Spray every 2 weeks from petal-fall until harvest (= 9 sprays)

- **IPM approach:**
  - Use 2 sprays @ 2 generations
  - 1st spray at 1st egg hatch
  - 2nd spray 14 days later
When do codling moth eggs hatch?

- Hatch begins:
  - 2 to 3 weeks after moths begin to fly
  - 250 degree-days (base 50°F) after moths begin sustained flight
- Use pheromone trap for moth flight
- ‘Biofix’ is date sustained flight begins
Traps for monitoring codling moth

• Trap choices:
  – Sticky trap
  – Bucket trap

• Use pheromone lure
Apple pests & ‘integrated’ control

• Chemical control
  – Needed for codling moth
  – Use selective insecticide

• Biological control
  – Of aphids, mites, other leaf pests
  – Conserve natural predators
Insecticides for codling moth

• **Organic**
  - spinosad
  - B.t.
  - kaolin
  - azadirachtin + pyrethrins

• **Conventional**
  - carbaryl
  - malathion
  - acetamiprid
  - esfenvalerate
  - gamma-cyhalothrin

• **Natural but not OMRI**
  - pyrethrins + PBO

shorter lived &
more selective
(narrow spectrum)

longer lived &
less selective
(broad spectrum)
‘Multi-purpose fruit spray’? (for insect + disease control)

• **malathion + carbaryl + captan**
  – Bonide Fruit Tree Spray Concentrate
  – Gordon’s Liquid Fruit Tree Spray

• **pyrethrins + sulfur**
  – Bonide Citrus, Fruit & Nut Orchard Spray

• **pyrethrins + PBO + extract of neem oil**
  – GreenLight Fruit Tree Spray Concentrate
  – Ferti-lome Fruit Tree Spray

• **lambda-cyhalothrin + pyraclostrobin + boscalid**
  • Bonide Fruit Tree & Plant Guard Concentrate
‘Multi-purpose fruit spray’? (for insect + disease control)

• **malathion + carbaryl + captan**
  – Bonide Fruit Tree Spray Concentrate
  – Gordon’s Liquid Fruit Tree Spray

• **pyrethrins + sulfur**
  – Bonide Citrus, Fruit & Nut Orchard Spray

• **pyrethrins + PBO + extract of neem oil**
  – GreenLight Fruit Tree Spray Concentrate
  – Ferti-lome Fruit Tree Spray

• **lambda-cyhalothrin + pyraclostrobin + boscalid**
  • Bonide Fruit Tree & Plant Guard Concentrate

**beware fruit thinning for 30 days after bloom**

**only organic option**
Plum curculio: external damage

- Egg-laying scar: crescent
- Late-season feeding damage: ragged hole
Plum curculio: adult

- Hides during day
- Active at night
- Active when >65°F, humid, calm
- Falls when disturbed
Plum curculio: control

• Not many effective tactics

• Mechanical:
  – Limb jarring (‘beating’) on first warm humid nights near petal-fall

• Chemical:
  – permethrin at petal-fall
  – kaolin (‘Surround’) at petal-fall & weekly for 2 more weeks

David J. Shetlar, Ohio State Univ.
Apple maggot: damage

• A key pest in northern USA
• Not a pest in southern USA
• Variable in latitude of Ohio
Apple maggot: life stages

- Adult fly lays egg on fruit
- Larva tunnels through fruit
- Pupate in soil
Apple maggot: mechanical control

- Adult female fly attracted to round red object
  - **Sticky ball trap**: 1 trap per 100 real fruit
- ‘Tanglefoot’
- Clean with **mineral spirits**
- Optional: fruit volatile lure
Apple maggot: chemical control

• Spray every 2 weeks in July & August

• Products:
  – acetamiprid
  – carbaryl
  – esfenvalerate
  – spinosad
# Mechanical tactic summary

<table>
<thead>
<tr>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit $\frac{1}{2} - \frac{3}{4}$” diameter (~2 weeks after petal-fall)</td>
<td>Place bags over fruit</td>
</tr>
<tr>
<td>~4 weeks after petal-fall (early June)</td>
<td>Put strips on trunk</td>
</tr>
<tr>
<td>~6 weeks after petal-fall (mid-June)</td>
<td>Place red ball traps</td>
</tr>
<tr>
<td>~10 weeks after petal-fall (mid-July)</td>
<td>Remove &amp; destroy strips</td>
</tr>
<tr>
<td>~12 weeks after petal-fall (early Aug.)</td>
<td>Put strips on trunk</td>
</tr>
<tr>
<td>~14 weeks after petal-fall (mid-Aug.)</td>
<td>Remove red ball traps</td>
</tr>
<tr>
<td>2 - 3 weeks before harvest</td>
<td>Remove bags</td>
</tr>
<tr>
<td>Late autumn</td>
<td>Remove &amp; destroy strips</td>
</tr>
</tbody>
</table>
## IPM & chemical control

<table>
<thead>
<tr>
<th>Principle</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid killing pollinators (bees)</td>
<td>Do not spray during bloom</td>
</tr>
<tr>
<td>Avoid killing natural enemies</td>
<td>Use ‘selective’ insecticide or short-lived chemical</td>
</tr>
<tr>
<td>Avoid development of insecticide resistance</td>
<td>Rotate chemical groups</td>
</tr>
</tbody>
</table>
### Chemical tactic summary

<table>
<thead>
<tr>
<th>Timing*</th>
<th>Target</th>
<th>Organic</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>petal-fall</td>
<td>plum curculio</td>
<td>kaolin</td>
<td>permethrin</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; cover</td>
<td>codling moth, gen. 1</td>
<td>spinosad</td>
<td>acetamiprid</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; cover</td>
<td>codling moth, gen. 1</td>
<td>spinosad</td>
<td>acetamiprid</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; cover</td>
<td>apple maggot*</td>
<td>spinosad</td>
<td>acetamiprid</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; cover</td>
<td>apple maggot</td>
<td>spinosad</td>
<td>acetamiprid</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt; cover</td>
<td>codmoth-2 + maggot</td>
<td>pyret+azad or pyrethrins</td>
<td>gam-cyhalothrin</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt; cover</td>
<td>codmoth-2 + maggot</td>
<td>pyret+azad or pyrethrins</td>
<td>gam-cyhalothrin</td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; cover</td>
<td>apple maggot</td>
<td>pyret+azad or pyrethrins</td>
<td>carbaryl or pyr+PBO</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; cover</td>
<td>codling moth, gen. 3*</td>
<td>pyret+azad or pyrethrins</td>
<td>carbaryl or pyr+PBO</td>
</tr>
</tbody>
</table>

* cover sprays at 2-week intervals

* in gray: only if pest known to be present
# Common insecticides

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Representative product: Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>spinosad</td>
<td>-Captain Jack’s Deadbug Brew (Bonide), -Entrust (Dow)</td>
</tr>
<tr>
<td>kaolin</td>
<td>Surround At Home (Gardens Alive)</td>
</tr>
<tr>
<td>pyrethrins</td>
<td>PyGanic (MGK), Bug Buster-O (Monterey)</td>
</tr>
<tr>
<td>pyrethrins + azadirachtin</td>
<td>Azera (MGK)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Representative product: Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyrethrins + PBO</td>
<td>Fruit &amp; Vegetable Insect Killer (Garden Safe)</td>
</tr>
<tr>
<td>acetamiprid</td>
<td>Ortho Flower Fruit &amp; Veg. Insect Killer (Scott)</td>
</tr>
<tr>
<td>carbaryl</td>
<td>Sevin (Garden Tech)</td>
</tr>
<tr>
<td>gamma-cyhalothrin</td>
<td>Spectracide Triazicide Insect Killer (Spectrum)</td>
</tr>
<tr>
<td>permethrin</td>
<td>Eight Insect Control (Bonide)</td>
</tr>
</tbody>
</table>
Resources

• Codling moth trapping & degree-day egg hatch model (1 page)
• Degree-day methods (1 page)
• List of insecticides for apple: common name & brand names (5 pp.)
• Bulletin on traps for fruit pests
• Fact sheet on fruit bagging, from Kentucky
Questions?

e-mail: welty.1@osu.edu
office phone: 614-292-2803
website: bugs.osu.edu/welty/