What works for insect, disease, and weed management in organic apple production

The first question...

- Where/How do I sell my apples?
- Local-Direct vs. Regional
- Fresh market vs. Processing market
- Wholesale vs. Value added (e.g. crunch packs, cider)

The Second Question

- Where/How do I get certified?
- Certification kicks in after 3 years of “transition”
- 1st step is to contact and select a certifier
- MDA maintains a list of organic certifiers at: http://www.michigan.gov/mdard/0,4610,7-125-1569_25516---,00.html

The KEY Concept!!

- All pests are CYCLICAL! and PREDICTABLE!
- Diseases follow moisture and temperature cycles
- Plants and Insects follow temperature cycles

The third question...

- How do I know what to do?
- SCOUTING: of ultimate importance in apple PM
- Many, Many pests
- The worst are well described
- Use phenological models to guide scouting and PM tactics

Weeds: Friend, Enemy, or Neighbor?

Pheromone Trap

OFM Flight
**Weed Management: Older Trees**

- Mowing: 2-3 times per season
- Light tillage
- Grazing
- Flaming

**Weed Management: Young Trees**

- Site preparation: multiple years of cover crops
- Mulches: Wood, Straw, Synthetic
- Cover crops: "CHOOSE YOUR WEED"

**Weed Cover**

**Weed Management: Complications**

- Rodents like cover
- Weeds or Mulches
- Girdle and kill trees

- Arthropod diversity tied to plant diversity
- NE's and pollinators
- Also some pests: Stinkbugs, Mites, Aphids
Natural Enemies

Weed Management Program

• New Plantings: apply mulch —use tree guards!
• Swiss Sandwich: Strip cultivate from drip line to row center beginning in March/April and repeating 2-5 times
• Other alternatives: Swing arm mowers, flaming —use caution!

Diseases of Apples

Apple Scab: *Venturia inaequalis*

Apple Scab

• Two major pathogens:
  • Apple Scab
  • Fire Blight
• Several minor pathogens: Flyspeck, sooty blotch, blossom blast, powdery mildew, rusts......

Apple Scab

• Primary infection
  • Sexual cycle
  • Infects leaves
• Secondary infection
  • Asexual cycle
  • Infects leaves and fruit

Apple Scab Management: Prevention

Resistant Varieties

• Liberty, Crimson Crisp, Gold Rush
• Most effective tactic
• Marketing??
### Apple Scab Management: Prevention

- **Sanitation:** Clean up leaves
- **Competitive/antagonistic BC...**
  - Mechanism?
- **Predation by earthworms and other shredders**
- **Fall fertilizer applications (High N)**

### Organic Scab Fungicides

#### Major Classes of Fungicides

- **Copper**
  - The most effective fungicide
  - Can help with Fireblight management
  - **Phytotoxic after 1/2” green**
  - Accumulates in soil
- **Sulfur**
  - Three sub-classes
  - Some provide secondary insect control
  - **Cannot be mixed with oils**
  - Can flare mites

#### Organic Scab Fungicides

**Copper**

- 2-3 applications between silver tip and 1/2” Green
- Use a 4-7 day interval for applications
- Will suppress fireblight canker
- Newer products are “micronized”
  - May provide better control at lower rates

**Sulfur**

- 3 Major Types
  - Lime Sulfur
  - Wettable Sulfur
  - Flowable Sulfur
- Must be reapplied after rainfall events
- Products provide 3-5 days protection
- “Micronized” products are superior —smaller particle size = better coverage
- Provides control for some other late season diseases

**Lime Sulfur**

- Liquid formulation 1.5-2 gallons/acre
- Coverage must precede rainfall
- Must be reapplied after rainfall events
- Can provide limited “back action” 12-48 hrs
- Will thin or russet if applied after tight cluster

**Wettable Sulfur**

- Powder formulation
- Can be applied in a liquid formulation or using a duster
- Duster applications made during or just after rainfall events
  - Rain will “carry” sulfur into the canopy
- Apply 6 lbs/acre
**Organic Scab Fungicides**

**Flowable Sulfur**
- Liquid formulation
- Provides better coverage than wettable — smaller particle size
- Is not rainfast — must be reapplied following rainfall events
- 5 qts (6F)/acre to petal fall, 2.5 qts per acre thereafter
- Check with certifier for all fungicides!

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**Scab Management Program**

<table>
<thead>
<tr>
<th>Timing</th>
<th>Fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grn tip to 1/2” Grn</td>
<td>Copper or Lime Sulfur or Flowable/Wettable S.</td>
</tr>
<tr>
<td>Tight Cluster</td>
<td>Lime Sulfur or Flowable/Wettable S.</td>
</tr>
<tr>
<td>Open Cluster</td>
<td>Flowable or Wettable Sulfur</td>
</tr>
<tr>
<td>Bloom</td>
<td>Flowable or Wettable Sulfur</td>
</tr>
<tr>
<td>Petal Fall</td>
<td>Flowable or Wettable Sulfur</td>
</tr>
<tr>
<td>5-7 days post PF</td>
<td>Flowable or Wettable Sulfur</td>
</tr>
<tr>
<td>7-14 day intervals</td>
<td>Flowable or Wettable Sulfur</td>
</tr>
</tbody>
</table>

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**Scab Management Program**

**Cultural Alternatives — Targeting Overwintering Inoculum**
- Gather leaves in the Fall and Spring
- Flail Mow? Burn?
- OPM lab researching this beginning Summer 2013.

Kuhn Haybob® rake-tedder purchased by the MSU OPM lab for use in the test orchard

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**Fire Blight: Erwinia amylovora**

- Bacterial pathogen
- Infects shoots, blossoms, wood
- Can rapidly kill trees
- May be carried by pollinators
- Like scab is tied to humidity and temperature conditions

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**Fire Blight Life Cycle**

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**Fire Blight Management**

- OMRI approved Streptomycin or Oxytetracycline applied during blossoming period
- Use Maryblight or Cougarblight to predict infection potential
- Copper sulfate applications before 1/2” green
- Pruning and Sanitation: best done during dormancy
  - Cut 8-12” below canker
  - Destroy infected wood
  - Sanitize tools between cuts
- Avoid susceptible rootstocks: M9, M26
A Survey of Direct Apple Insect Pests and Their Management

- Codling Moth (CM)
- Plum Curculio (PC)
- Apple Maggot (AM)

Monitoring insects in orchards

- Pheromone traps for moth pests
- Tower traps for plum curculio
- Sphere traps for apple maggot
- Traps tell us if we have a problem!

Codling Moth

- Small brown moths native to Eurasia
- Larvae (worms) develop inside fruit
- CM: apples, pears, walnuts, quince
- OFM: stone fruits, apples, and pears

CM Life Cycle

- Spring Generation
- Summer Generation
- Sting
- Entry with Frass

CM Phenology

- Two flights per season

CM Chemical Pest Management

- Cover sprays are applied during egg or early larval stage of each generation
- Granulosis Virus (CM only)
- Entrust (Spinosad)
- Horticultural Oils (during egg laying) cannot be used when sulfur is present!
Codling Moth Management

- On farm CM virus trials w/ Mating Disruption
- Virus applied 3 rates with 3 different timings
  - 4.4 oz every 7 days
  - 8.8 oz every 14 days
  - 13.2 oz every 21 days
- Increased frequency of application more important than rate!!
- Short residual

Trevor Nichols Small Plot Surround Trials

<table>
<thead>
<tr>
<th>Shallow Entries</th>
<th>Deep Entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Virus 4.4 oz</td>
</tr>
<tr>
<td>Virus 8.8 oz</td>
<td>Virus 13.2 oz</td>
</tr>
</tbody>
</table>

Mean followed by the same letter are not significantly different at p = 0.05.

CM Behavioral Pest Management

- Mating disruption with synthetic sex pheromones
- Very specific and provides season long management
- Cornerstone of organic CM management

CM/OFM Mating disruption

- Females produce a unique odor that attracts males
- Mating disruption adds lots of synthetic odor sources
- This confuses males, prevents mating, and infested fruit
- Cornerstone of organic CM management

CM Biological Pest Management

- Release natural enemies
  - Trichogramma
  - Parasitic nematodes
- $$$$$Expensive!!!
- Conserve natural enemies
- Encourage diversity

CM Physical Pest Management

- Sanitation: Debris provides pupation sites
- Banding: Cardboard or burlap bands as pupation sites
- Bands are destroyed prior to next generation emergence
- Can also be used as a means of sampling the population

CM Management Program

- Apply Mating Disruption by April 1
- Begin applying virus at 200-250 (1200-1250) degree days, low labeled rate, 7-10 day interval through at least 800 (1800) degree days.
- Horticultural oils at 1150 degree days (150 second generation)
- IF NEEDED, apply Entrust® at 250 (1250) and 650 (1650)
Plum Curculio

- Small dark weevil
- Native insect adapted to apples
- Attacks stone and small fruit
- Larvae feed within the fruit
- Especially difficult for Organic apples

PC Life Cycle

- Spring Damage
- Summer Damage

PC Chemical Tactics

- Cover sprays applied in Spring or at Harvest
- “Surround” Kaolin clay
- “Pyganic” Pyrethrins

Plum Curculio Management

- Small plot trials comparing Surround with conventional chemistries
- Surround applied 4x
- Guthion® applied 2x
- Intermediate performance in 2001
- Comparable performance in 2002

Hogs Providing: PC Management

- Summer feeding significantly reduced both years
- Numerical reduction of oviposition in 2008

2003 Trevor Nichols Large Plot Surround Trials

<table>
<thead>
<tr>
<th>Date</th>
<th>Control</th>
<th>Surround</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 July</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td>23 July</td>
<td>b</td>
<td>B</td>
</tr>
</tbody>
</table>

Mean followed by the same letter are not significantly different at p = 0.05.

2007 and 2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Ungrazed</th>
<th>Grazed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oviposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean followed by the same letter are not significantly different at p = 0.05.
PC Management Program

<table>
<thead>
<tr>
<th>Compound trade name</th>
<th>Chemical class</th>
<th>Activity on adult</th>
<th>Crop stage and initial control timing (GDD&lt;sub&gt;50&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyganic</td>
<td>Pyrethrum</td>
<td>Lethal via contact, repellent</td>
<td>Petal fall (approx. 250 GDD); Petal fall (approx. 175 GDD) Multiple applications (less than 24 hour residual)</td>
</tr>
<tr>
<td>Surround WP (not recommended for cherries)</td>
<td>Particle film</td>
<td>Repellent</td>
<td>Usually 16 lb by first cover</td>
</tr>
</tbody>
</table>

**ADDITIONAL TACTICS:**
- Begin monitoring/mass trapping using pyramid traps by April 1.
- Remove/destroy dropped fruit during “June Drop”

### PC Physical/Cultural Tactics
- Mass Trapping along edges
- Sanitation During June Drop
  - Livestock
  - Mechanical removal?

### Apple Maggot

- Small fruit fly
- Native insect adapted to apples
- Attacks apples, hawthorne, some native berries

### Apple Maggot Life History
- Females emerge late June-September
- Lay eggs in fruit
- Larvae feed and develop
- Larvae pupate in soil and emerge following year

### AM Chemical Tactics
- Cover sprays/gel baits applied for active period
- Pyganic, Entrust
- Kaolin clays

### AM Physical Tactics
- Mass trapping using sphere traps
- Can be combined with insecticides
- Requires multiple traps per tree
- Very effective but labor intensive
AM Management Program

- Begin monitoring/mass trapping using sticky traps on orchard borders in by the second week of July
- Apply Surround® by the 3rd week of July and maintain coverage through August
- After flies are detected apply GF 120® naturalyte or Entrust® —GF120 is prone to washing off under heavy rains
- Quantify “suppressive” potential of soils
- Quantify impact of Fungicides on soil ecology and insect pest management
- Development of scab specific OMRI approved fungicides?
- Refinement of Swiss Sandwich systems
- Reintegration of animals into orchards....

Apple Pest Management: The Future

Acknowledgements

- The MSU Tree Fruit Team
  - Larry Gut       John Wise
  - Mark Whalon    Julianna Wilson
  - George Sundin  Ron Perry
  - Amy Irish-Brown Phil Schwalier
  - Bob Tritten    Bill Shane
  - Mark Longstroth

- MSU OPM Lab
  - Brad Baughman  Krista Buehrer
  - Nate Walton

- Organic Apple Grower Collaborators
  - Jim Koan       Steve Tennes
  - Gene Garthe

Additional Resources

- Organic Pest Management Website
  www.opm.msu.edu

- MidWest Organic and Sustainable Education
  Apple Fact Sheet http://www.mosesorganic.org/attachments/productioninfo/fsOrchardManagingPests.pdf

- MSU Fruit Extension website http://msue.anr.msu.edu/topic/info/fruit

- West Virginia/Ohio Organic Disease Management
  http://www.caf.wvu.edu/kearneysville/organic-apple.html#Option 2