Apple IPM 101

TERENCE BRADSHAW, PH.D.

2016 UVM APPLE PROGRAM &
VT TREE FRUIT GROWERS ASSOCIATION 120TH ANNUAL MEETING

FEBRUARY 18, 2016

- Keep it or get one!
- No updated guide 2016
- USDA Specialty Crops Multi-State Program:

Pyramid of IPM Tactics

Plants

PREVENTION

CULTURAL

(tillage, weeding, mulches, pruning, traps, barriers, flaming)

(herbicides, insecticides, fungicides, etc.)

BIOLOGICAL

(predators, parasites, nematodes)

(soap, oils, baking soda, repellants, microbials, IGRs)

CHEMICAL

(Conventional pesticides)

( biopesticides)

INTERVENTION

Toxicity

Increasing
Monitoring Pest Populations: A Key Concept!

- Regular and deliberative scouting
  - Once (or more*) per week
  - Set up a pattern in the orchard
  - Scout each block separately
  - Consistent scouting pattern
Insect Monitoring

- Red Trunk Traps
- White Visual Traps
- Wing Traps w/ Pheromones
- Apple Maggot Red Sticky Traps
Make a consistent scouting map

• Don’t go straight down one or two rows
• Cover edges + interior
• Scout for mites, curculio stings, scab between traps
• Alter your path but cover the block each time
Recordkeeping

- Use datasheets in the field
  - Smartphone??
- Use a spreadsheet in the office/shop
- Compute cumulative captures, reset the clock after spray applications
## Recordkeeping

- Use datasheets in the field
  - Smartphone??
- Use a spreadsheet in the office/shop
- Compute cumulative captures, reset the clock after spray applications

### Data Table

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**Note:** Enter each cell individually. Do not copy/paste or click-drag cell contents.
**Recordkeeping**

- Use datasheets in the field
- Use a spreadsheet in the office/shop
- Compute cumulative captures, reset the clock after spray applications

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### 2015 Apple Maggot Fly

Average of four baited red sphere traps in IPM sector

UVM Horticultural Research Center, South Burlington Vermont

![2015 Apple Maggot Fly Graph](image)

<table>
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<tr>
<th>DATE (md)</th>
<th>STLM New Capture Average</th>
<th>Sum of STLM Cumulative Average</th>
<th>TPB New Capture Average</th>
<th>Sum of TPB Cumulative Average</th>
<th>EAS New Capture Average</th>
<th>Sum of EAS Cumulative Average</th>
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**Note:**
- IPM: Integrated Pest Management
- STLM: South Hero Traps
- TPB: Topsham Traps
- EAS: Easton Traps
- OFM: Outdoor Fly Monitor
TracApple

Record-Keeping and Reporting Software

TracApple version 2011
© 2011 Cornell University. All rights reserved.

Authored by J.E. Carroll

Open the next worksheet and begin entering data. Refer to the Trac Software Manual for detailed instructions.

Changes in pesticide registrations, regulations, and use guidelines frequently occur. This software and any information contained herein is not a substitute for pesticide labeling.

The sample pesticide list included on the ChemHelp sheet was created in 2010 and is provided here for guidance only; it is not intended to be used as a substitute for pesticide label information.

Always read the pesticide label prior to use. Verify all information on the label for the product(s) you use. The software user must verify that the pesticide information used in their Trac Software ChemTable matches the label for the pesticide(s) they have used and what’s been applied.

This software is not a substitute for pesticide labeling. Accuracy of reports is the responsibility of the end user. Always read the label before applying any pesticide.

Enable Macro Content
## Apple - Crop Protection Chemicals - Apple

### Trade Names will appear in the SprayData drop-down list.

**Enter information from the label**
- **Trade Name**
- **Applied Unit**
- **Cost Per Applied Unit**

**Enter information from the labels of the products you are using**
- **Formulation**
- **EPA Reg #**
- **Active Ingredient**

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<tr>
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<th>EPA Reg #</th>
<th>Active Ingredient</th>
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<td>2,4-D</td>
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<tr>
<td>Abba 0.15EC</td>
<td></td>
<td>66222-139</td>
<td>abamectin</td>
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<tr>
<td>Accramite 50WS</td>
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<td>Adamant</td>
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<td>264-1052</td>
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<td>Agree 3.0WG</td>
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<td>Agri-tos</td>
<td>5.17 lb Al/gal</td>
<td>71962-1</td>
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<td>abamectin</td>
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<td>Agri-mycin 17 (Nufarm) lb</td>
<td>17% streptomycin</td>
<td>55146-96</td>
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<td>4 lb Al/gal</td>
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# Worker Protection Standard - Central Posting Form

**US EPA Worker Safety and Training**

**Farm Name & Address:** Horticulture Research Center, 65 Green Mountain Drive, South Burlington, VT 05403

**Final safe re-entry for applications listed below is:** 7/17/2015 8:00:00 AM

## Location & Description of Treated Area

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<thead>
<tr>
<th>Farm</th>
<th>Orchard</th>
<th>Block(s)</th>
<th>Pesticide Trade Name</th>
<th>Active Ingredient</th>
<th>EPA Registr. Number</th>
<th>Spray Date</th>
<th>Time Start</th>
<th>Time Finish</th>
<th>REI (hrs)</th>
<th>Re-entry Date</th>
<th>Re-entry Time</th>
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<td>captan</td>
<td>66222-58-66330</td>
<td>7/16/15</td>
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<td>24</td>
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<td>8.00 AM</td>
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<td>0.00</td>
<td>0.00</td>
<td>12</td>
<td>8/7/15</td>
<td>12.00 PM</td>
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</table>
Scouting throughout the season
Spotted Tentiform Leafminer (STLM)

• Silver Tip - Place red visual traps on south side of tree trunks. Minimum of 4 traps per 8 acre block.

• Tight Cluster:
  • MacIntosh: 4/trap
  • Non-Macs: 8/trap

• Late Pink:
  • MacIntosh: 9/trap
  • Non-Mac: 21/trap

• Petal Fall: Check for 1st gen. sap mines in leaves
  • Macs: 7 mines/100 leaves
  • Non-Macs: 14 mines/100 leaves

• July
  • Macs: 50 Mines/100 leaves
  • Non-Macs: 100 Mines/100 leaves
STLM: Non-chemical management
Tarnish Plant Bug

• White Visual Traps: 6X8” traps are set out at silver tip and checked weekly. Traps should be placed near the edge of the block, at one per 3-5 acres. Hang traps at about 2’ above ground, on an outer branch. TPB(3/trap TC, 4/Trap late pink)

• Tight Cluster Thresholds
  • Wholesale: 3/trap
  • Retail: 5/ trap

• Late Pink Thresholds
  • Wholesale: 5/ trap
  • Retail: 8 trap
Pollinator protection

• Bloom is a critical time in the orchard
• No Insecticides During Bloom!
• Pesticide selection near bloom:
  • Bee hazard ratings in NETFMG
  • Organophosphates/ carbamates HIGH
  • Pyrethroids HIGH
  • Neonicotinoids LOW (?)
  • IGRs LOW
  • Fungicides LOW
• Research on pesticide effects on bee populations is increasingly being conducted
Current research on pollinator protection in orchards

• On-going research
  • Federal mandate
  • Popular concern

• Recent research (NY)
  • Pesticide use index decreases species richness & abundance of native pollinators
  • Fungicides pre-bloom
  • Insecticides post-bloom

Current research on pollinator protection in orchards

• On-going research
  • Federal mandate
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• Recent research (NY)
  • Pesticide use index decreases species richness & abundance of native pollinators
  • Fungicides pre-bloom
  • Insecticides post-bloom
  • ‘Natural’ landscape surrounding orchards buffers negative impacts

Key IPM practices to minimize pollinator impacts in orchards

- No insecticides when bees are foraging
- Consider bee poisoning hazard

### Table 7.1.3. Relative toxicity of pome fruit insecticides and miticides to beneficial arthropods.

<table>
<thead>
<tr>
<th>Trade Name (active ingredient)</th>
<th>Honeybee(^1)</th>
<th>Amblyseius falacic(^3)</th>
<th>Typhlodromus pyrri(^2)</th>
<th>Stethorus punctum(^1)</th>
<th>Aphidoletes aphidimyza(^1)</th>
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<td>M</td>
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<td>L</td>
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<td>M</td>
<td>L</td>
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<td>L</td>
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<tr>
<td>Admire Pro, Pasada, Sherpa (imidacloprid)</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>*Agri-Flex (abamectin/thiamethoxam)</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>L</td>
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<tr>
<td>*Altacor (chlorantraniliprole)</td>
<td>L</td>
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<tr>
<td>Apollo (clofentezine)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>*Asana (esfenvalerate)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Assault (acetamiprid)</td>
<td>L</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Avanti (indoxacarb)</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>§Aza-Direct, §Azatin, §Trilogy (azadirachtin)</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>*Battalion, *Decis (deltamethrin)</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>*Baythroid, *Tombstone (cyfluthrin)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Belay (clothianidin) w/ suppl. label</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Beleaf (flonicamid)</td>
<td>L</td>
<td>L</td>
<td>L</td>
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</tr>
<tr>
<td>Belt (fluendamide)</td>
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<td>L</td>
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</tbody>
</table>
Key IPM practices to minimize pollinator impacts in orchards

• No insecticides when bees are foraging
• Consider bee poisoning hazard
  • Select appropriate materials when possible
• Thinning:
  • Use liquid carbaryl formulations when possible
• Maintain good bee habitat
  • No flowering plants in orchard during spray season
  • Flowering ‘natural’ habitat within 2 km of orchard
European Apple Sawfly

• Traps similar to those for monitoring TPB, non UV reflecting white sticky traps. Trap density is the same 1 per 3-5 acres near edges. Hang traps at pink on south side of the tree, outside branches at 5-6 feet above ground.

• Early Pink: Place White Sticky Traps in Orchard

• Threshold (Petal Fall):
  • No Pre-Bloom Insecticide: 5/trap
  • Blocks receiving Pre-bloom Insecticide: 9/trap
Plum Curculio

- Late Bloom - begin to inspect fruit on early-blooming cultivars in perimeter rows for fresh egg-laying scars
- Visual inspection of 10 fruit per tree.
- Threshold:
  - Traditional: prophylactic petal fall spray
  - IPM: first evidence of damage
- Use DD model to determine time of last spray
  - 308 DDb50°F from McIntosh petal fall: end of ovipositional period

NEWA model for Plum Curculio
NEWA model for Plum Curculio

NEWA Apple Insect Models

Select a pest: Plum Curculio

Weather Station:
Shoreham, VT

Accumulation End Date:
06/19/2015

Calculate

Plum Curculio Results for Shoreham

Petal Fall: 5/21/2015

Petal Fall date above is estimated based on degree day accumulations or user input. Enter the actual date for blocks of interest and the model will calculate the protection period after petal fall more accurately.

Accumulated degree days (base 50°F) petal fall through 6/18/2015: 426 (0 days missing)

Pest stage: Adults inactive

The pest stage above is estimated. Select the actual stage and the model will recalculate recommendations.

<table>
<thead>
<tr>
<th>Pest Status</th>
<th>Pest Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plum curculio oviposition is over.</td>
<td>Plum curculio control sprays are no longer necessary.</td>
</tr>
</tbody>
</table>

Disclaimer: These are theoretical predictions and forecasts. The theoretical model predicting pest development or disease risk uses the weather data collected or forecasted from the weather station location. These results should not be substituted for actual observations of plant growth stage, pest presence, and disease occurrence determined through scouting or insect pheromone traps.
Codling Moth

• Place pheromone traps at pink stage, on the outside of the trees about 6-7 feet above ground level.

• One trap per 5 acres, for orchards over 5 acres min of 5 pheromone trapes is rec. one for each cover and one in center. Traps should be checked daily until first capture, then weekly.
Codling Moth

Petal Fall:
- For 1st generation CM, 250-350 DDb50°F from first capture.
- July:
  - For 2nd Gen CM, 1260-1370 DDb50°F from first capture.

Feeding Codling Moth larva

Codling Moth adult

Codling Moth pheromone trap
Codling Moth

2006 UVM HRC Codling Moth New Trap Captures
Average of one pheromone baited wing trap per block in seven monitored blocks

NEWA Apple Insect Models

Codling Moth Results for South Hero
First Trap Catch: 5/26/2015
Accumulation End Date: 08/14/2015
Second Generation Flight Start: 8/7/2015
Accumulated degree days (base 50°F) second generation flight start through 8/14/2015: 144 (0 days missing)

PEG stage: Moths flying & egg hatch begins

Post Status
Eggs from the second generation of CM have started to hatch.

Post Management
Apply insecticides to control newly hatching larvae. In order to manage insecticide resistance, it is best to apply a different class of materials to control this second generation of CM than was used earlier in the season against the overwintering generation. Insecticides applied at this time to control CM will also control the second generation of OFM. The summer generation of OFM may also be active at this time and materials should be applied that are active against both internal Lepidoptera and leafrollers. Pesticide information
Apple scab: Evaluating for end of 1° spraying

- End of primary ascospore release (??)
  - 900 DDb32°F from McIntosh green tip
  - 0.1” rain, temp >50°F will release ‘final’ spores

- IF you have covered for all infection periods AND ALL ascospore release is complete, you are done spraying against apple scab for the season.

- Scout orchards after 10-14 days of last infection period
  - 50 terminals in all parts of trees (interior, treetops)
  - <1% of leaves with any scab lesions visible
Apple scab: Evaluating for end of 1° spraying

- End of primary ascospore release (??)
  - 900 DDb32 °F from McIntosh green tip
  - 0.1” rain, temp >50°F will release ‘final’ spores

- IF you have covered for all infection periods AND ALL ascospore release is complete, you are done spraying against apple scab for the season.

- Scout orchards after 10-14 days of last infection period
  - 50 terminals in all parts of trees (interior, treetops)
  - <1% of leaves with any scab lesions visible

---

**Table 6.2.1. Revised Mills Table.** Approx. hours of wetting necessary to produce primary apple scab infections, and approx. number of days required for lesions to appear, at different average temperatures.

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Hours [1]</th>
<th>Lesions Appearance (days) [2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>41</td>
<td>–</td>
</tr>
<tr>
<td>36</td>
<td>35</td>
<td>–</td>
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<td>37</td>
<td>30</td>
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<td>39</td>
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<td>41</td>
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<td>43</td>
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<td>48</td>
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<td>50</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>52</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>54–56</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>57–59</td>
<td>7</td>
<td>12–13</td>
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<tr>
<td>61–75</td>
<td>6</td>
<td>9–10</td>
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<tr>
<td>77</td>
<td>8</td>
<td>–</td>
</tr>
<tr>
<td>79</td>
<td>11</td>
<td>–</td>
</tr>
</tbody>
</table>

[1] Refer to Notes on Apple Scab Management for computing wetting intervals for primary infection when rain begins at night in low-inoculum orchards. Data of MacHardy & Gadbury (1989); and Stensvand, Gadbury, & Steen (1997).

[2] Number of days required for lesions to appear after infection has been initiated. No further wetting is required. Additional days may be required if conditions are unfavorable for lesion development (prolonged periods above 80° F or very dry weather).
Apple Maggot Fly

- Red ball traps used to monitor emergence & flight

**NEWA Apple Insect Models**

- **Select a pest:** Apple Maggot
- **Weather Station:** South Hero, VT
- **Accumulation End Date:** 08/14/2015

**Apple Maggot Results for South Hero**

- **First Trap Catch:** 7/28/2015
- **Accumulated degree days (base 50°F) first trap catch through 8/14/2015:** 373 (0 days missing)
- **Pest stage:** Adults move into orchards, eggs laid

**Pest Status**

| Previous studies have shown that August 1-15 is the time period when the most AM flies immigrate into commercial orchards, although flies can be trapped in late June and into September and early October. |

**Pest Management**

| After 10-14 days have elapsed since the first AM treatment (estimated period of residual effectiveness of insecticides), continue to check AM traps and apply additional sprays when trap catches exceed the threshold. Perimeter sprays can be used for low pressure orchards. In high pressure orchards, after the first spray is applied, continue to apply sprays to a larger perimeter area. Repeat monitoring protocol and apply additional sprays as necessary to provide protection until at least September 1. Pesticide information |

**Map**  |  **Results**  |  **More info**
Apple Maggot Fly: Mid-June

• Red ball traps used to monitor emergence & flight

• Three traps/block,
  • 1-2 rows in from the edge
  • 5-6 feet above
  • Surrounded but not touched by fruit and foliage
  • Inspected weekly.

• Thresholds:
  • Non Baited Spheres: 1/trap
  • Baited Spheres: 5/ trap

• Continue to Monitor through August

European Red Mite

Petal Fall: Threshold Middle

- age fruit cluster leaves, May 15 - June 1, 30% leaves with motile mites.
- June 1 - 15: 45% leaves w/ motile mites
- June 16 - 30: 55% leaves w/ motile mites
- July 1 - 15: 65% leaves
- July 15 - 31: 80% leaves w/ motile mites
- August: 80%

Figure 7.1.3 – Mite Sampling Chart
Threshold = 2.5 mites/leaf
(June 1 - 30)
Leafhoppers: mid-summer

- Petal Fall-June: examine leaves for presence of 1st gen. nymphs and adults
  - Threshold: 25/100 Leaves

- August: examine leaves for presence of 2nd gen. nymphs and adults
  - Threshold: 25/100 Leaves
Oblique Banded Leaf Roller

- Petal Fall: hang pheromone traps in orchard
- Begin to accumulate DD base 43F from first capture
- June: When 600 DD base 43F are reached, examine 10 expanded terminal shoots per tree from as wide and are of the block as possible. Record number of terminals infested.
Oblique Banded Leaf Roller

- Petal Fall: hang pheromone traps in orchard
- Begin to accumulate DD base 43F from first capture
- June: When 600 DD base 43F are reached examine 10 expanded terminal shoots per tree from as wide and are of the block as possible. Record number of terminals infested.
- June-July: Scout 100 fruit per block at least weekly, spray at first sign of damage
Practice good IPM!

- Plan ahead
- Use decision support tools (NEWA)
- Have necessary information on management tools available (NETFMG)
- Dedicate an employee to regular & consistent scouting program
- Be methodical
- Be ready to act
2016 UVM Apple Program

Terence Bradshaw
- UVM Tree Fruit & Viticulture Specialist
  College of Agriculture & Life Science

Ann Hazelrigg
- Director, UVM Plant Diagnostic Clinic
  UVM Extension

Sarah Kingsley-Richards
- Jessica Foster
  Research Technicians

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  Addressing Stakeholder Priorities and Needs for 2013-2016

Northeast SARE
- Biological Management of Apple Replant Disease

Vermont Agricultural Experiment Station
Vermont Tree Fruit Growers Association
Vermont Hard Cider Company