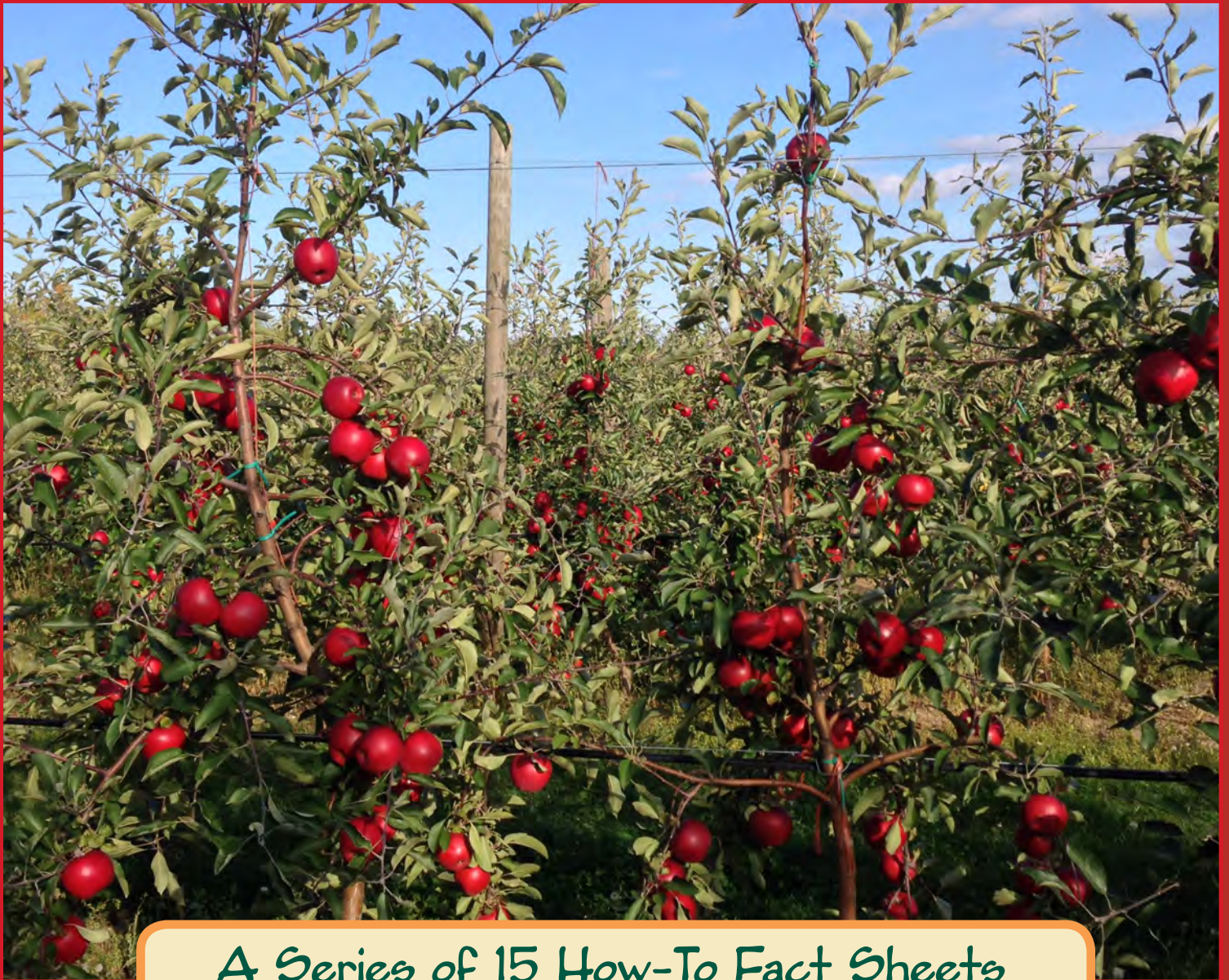
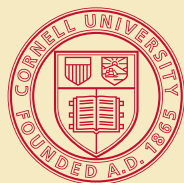




# Apple IPM for Beginners



*A Series of 15 How-To Fact Sheets*



Cornell University  
Cooperative Extension

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For more specific information, please see these websites:

[lof.cce.cornell.edu](http://lof.cce.cornell.edu)

[enych.cce.cornell.edu](http://enych.cce.cornell.edu)

[fruit.cornell.edu](http://fruit.cornell.edu)

[nysipm.cornell.edu/fruits](http://nysipm.cornell.edu/fruits)

Photos of apple growth stages and cover photos taken by J. Ogradnick, NYSAES Photo, and D. Breth. All other photos taken by D. Breth unless otherwise noted.

## **What is IPM?**

**Integrated Pest Management (IPM)** is an effective and environmentally sensitive approach that relies on a combination of cultural, mechanical, biological, and chemical controls to manage pests. IPM programs use current, comprehensive information on the life cycles of pests and their interactions with the crop plants and the environment. This information is used to prevent pests from exceeding an economic damage threshold, using the most economical means with the least possible hazard to people, property, and the environment.



# Apple IPM for Beginners

A guide for new apple growers  
to protect apple orchards from pests

**Edited by Deborah I. Breth, Cornell Cooperative Extension Lake Ontario Fruit Program**

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**This series of fact sheets** will help you address the major apple pests, but does not guarantee perfect fruit. These fact sheets and scouting guides are a compromise between the most accurate, complex information researchers have to offer and the amount of information a beginner can take in. Read the first 4 chapters carefully to start this new venture. Then follow the Scouting Calendar as apple stage of growth advances week-by-week.

View this document online at: [fruit.cornell.edu/orchard-ipm/](http://fruit.cornell.edu/orchard-ipm/)

**Note:** Blue text indicates a clickable hyperlink.

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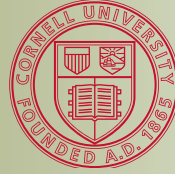
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# Apple IPM for Beginners





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## Introduction


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### So you want to grow apples?


Growing apples and other tree fruit crops can be very rewarding, but also expensive and time consuming. There are many things that must be done in a timely manner to produce edible, attractive, and marketable fruit. This series of fact sheets will focus on overcoming pests that challenge beginner apple growers in their new orchards. Throughout this series the critical practices,  “Must Do’s”, are highlighted. If these critical practices are not done in a timely manner, there will be very little useable fruit despite your best efforts. Look for the symbol  throughout this series for the essential management practices required for successful apple production.

This is not an in-depth guide on apple planting and production practices, but a brief summary of what it takes to produce apples for sale:

 **Must Do — Protect the crop from pests, including wildlife.** This series focuses on insects and diseases, but you will also have competition from wildlife and weeds. Deer severely stunt growth in trees by eating fruit buds and rubbing bark with their antlers. If you have deer in your neighborhood, take steps to protect new plantings by using repellents, or an 8 foot fence which is most effective. If deer find the trees before repellents are applied, you will have a constant battle to protect against stunted trees and reduced yields. Voles and rabbits also chew the bark, girdling trees. To deter small rodents, it may be necessary to apply wire mesh guards around young trees, but do not allow the guards to collect leaf debris as this favors trunk-boring insects. Keeping tree trunks free from weed growth also reduces habitat for these small pests. For information on how to control wildlife, go to [wildlifecontrol.info/pubs/Pages/CornellUniversity.aspx](http://wildlifecontrol.info/pubs/Pages/CornellUniversity.aspx).

 **Must Do — Identify, Acquire and Prepare an Appropriate Site.** Identify your soil type. Apple trees need a well-drained site. Seasonal high water tables in the spring and fall can kill trees outright. To check this, dig a few test holes about 2 feet deep. Gray mottling in the soil profile indicates seasonal water logging. Test the soil to determine pre-plant fertilizers for correct pH, lime, calcium, phosphorus, and magnesium.

**Kill the sod/weeds before the year of planting.**

 **Must Do — Choose a Planting System.** A planting system includes choice of rootstock, apple cultivar, planting density and spacing, and how to support trees from collapsing under the fruit load. With the help of your nurseryman, plan about two years ahead for specific rootstocks and varieties. All of these decisions are interdependent and key to a profitable planting. The choices made will impact initial costs in establishing the orchard and its later success.

**Tree growth** is dependent on the choice of rootstock, the nutrition you provide, and the variety. Tree anatomy is described in Figure 1. More dwarfing rootstocks (M9, Bud 9) have the potential to produce a limited amount of fruit the year after planting (2nd leaf) and, with appropriate tree care, grow to be about 10-12 feet. M26 can produce fruit in the 2nd-3rd leaf, and matures at about 12 feet. Semi-dwarfing rootstocks (such as M106, M111, M7) will grow a 15-20 foot tree, but will not produce many apples until the 5th leaf. Do not buy apple trees on seedling rootstocks because they can grow to 20 feet or more, are difficult to spray because of their height, and you will wait years before apple production.

**Mature tree height** also depends on tree support since most of the dwarfing rootstocks require a support

stake or trellis. It is critical to keep the main trunk growing upright, not bent over with a crop, until the trees reach the desired height.

**Cultivar or variety** (the scion grafted to the rootstock) of apples affects growth rate, and some grow more vigorously than others. Some cultivars are resistant to apple scab infections, but it is only one of the diseases you may face. If you want to spray less, look for scab resistant cultivars listed in your nursery catalogs. These cultivars have not been generally accepted by the big markets but are successfully marketed in farm markets and “low spray” niche markets. Scab resistant cultivars are essential in organic systems in the Northeast.

**Plan, plan, plan.** Lay out the field. Determine sources for fertilizer, and pesticides. Acquire trellising material and other important supplies. Determine labor and equipment needs, e.g. tractors, sprayer, boxes or bins, etc.

**⚠ Must Do — Plant with care.** Control the planting depth so the graft union is 2-4 inches above the soil line when the ground has settled around the trees. Soil type will determine if you can plant with an auger, tree planter, or a shovel. Water the trees immediately after planting but never plant into wet soil.

**⚠ Must Do — Learn as much as you can about the process.**

**Tree nutrition is a necessity.** Test your soil. Soil type, its pH and existing nutrients will determine any nutrients you will need to add through proper

fertilization. Understand that weeds and grasses growing under the trees will rob trees of nutrients and water.

**Manage crop load.** Apple trees can produce twenty times the number of apples you want; without reduction, the apples will be small, poorly colored and unsalable. “Fruit thinning” is a **⚠** “Must Do” practice to ensure quality fruit, and prevent alternate-year bearing (the tree sets heavy crops of small apples every other year).

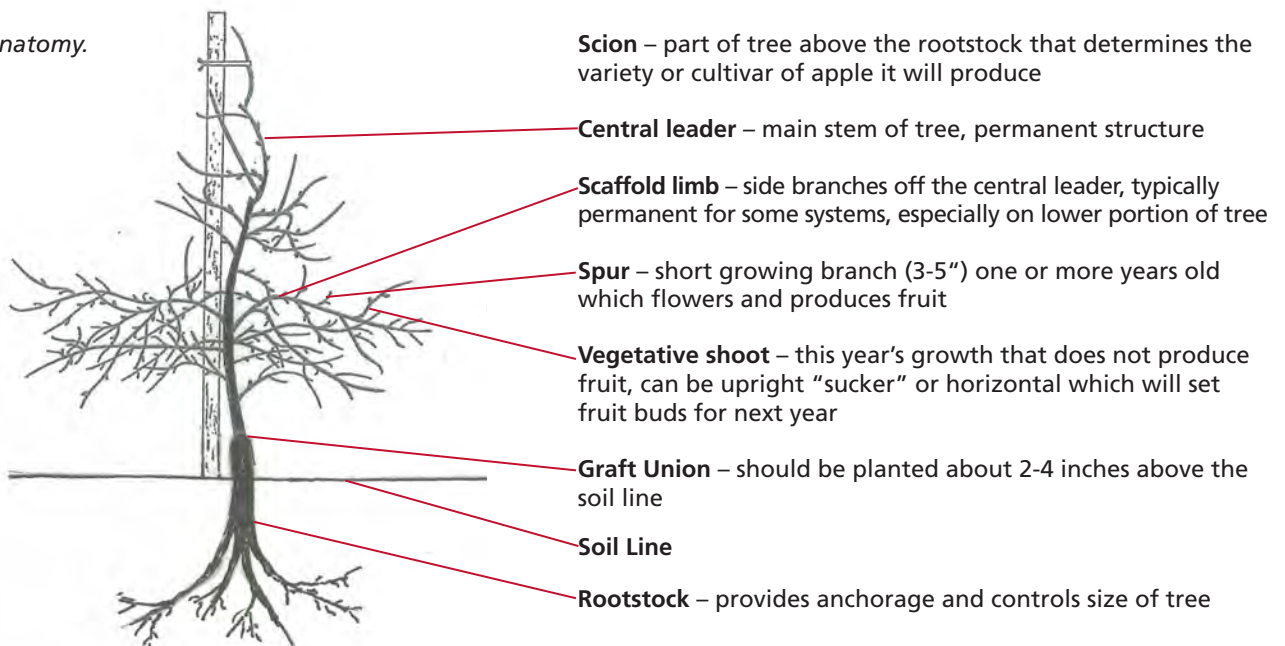
**Harvest and storage.** Know the best time to harvest fruit by variety, and what kind of storage conditions are best for each variety. Proper storage until the fruit is sold reduces soft, greasy, overripe apples.

**How many apples are produced?** If branched trees are planted at a density of 800-1200 trees per acre and managed properly, growers can expect 100-200 bushels/acre in the 2nd year, 400 bushels/acre in the 3rd year. A mature yield of 100 apples per tree can be expected **using dwarfing rootstocks.** Planting costs can be recovered in 5 years depending on management skills and how the owner accounts for his/her labor.

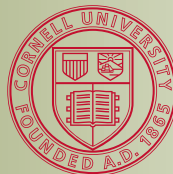
**Where will this fruit be sold?** With an estimate of how much fruit might be produced, it is necessary to identify sales options through farmers markets, direct sales at the farm, or u-pick. Larger quantities might be brokered by a packer/shipper in the region. Unless there is a solid marketing plan, consider that there are many growers in the region that would be happy to sell apples by bulk bin for a farm market.

**Good luck on your endeavor!**

Figure 1. Tree Anatomy.



# Apple IPM for Beginners



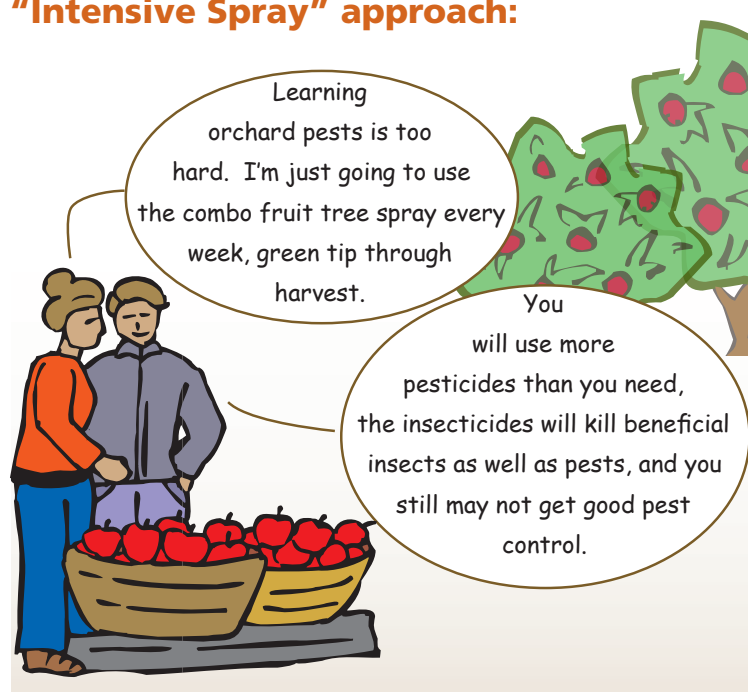
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## Set Up for Success

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Molly Shaw, Tioga County Cornell Cooperative Extension

Good orchard pest control is complicated, and it's challenging to learn.

### "Intensive Spray" approach:



### "Laissez-faire" approach:



## Take the Sustainable Integrated Pest Management Approach

Use the "Scouting Calendar" to determine what pest issues are present at each developmental stage, and what action to take to prevent damage. Insect and disease pest severity depends on the weather and site. Not all pests listed in this packet will be problems in all sites, neither is this an all-inclusive list of pests that can threaten apples in your location.

### Read and follow all required pesticide labels

to decide how much to apply, when to apply, and what safety equipment is needed while mixing and spraying. The label lists what pests will be controlled, the necessary rate and the timing. The label will also list in the "Agricultural Use" box, the amount of time needed to wait to re-enter the sprayed area (REI). The label will show, under the "Crop use" section, how long to wait before harvesting the crop after the spray (pre-harvest interval = PHI).



## Supplies you will need:

- 10x hand lens and/or “optivisor” (3x magnifier).
- Accurate min/max thermometer protected from direct sun or shade.
- Rain gauge or home weather station.
- Locate a NEWA weather station near you and learn how to use it to monitor weather, disease prediction models, insect pest development, thinning, and irrigation recommendations. ([newa.cornell.edu](http://newa.cornell.edu)).
- Small bags for leaf sampling.
- Pocket knife.
- Insect monitoring traps and pheromone lures as per specific pest fact sheet (Great Lakes IPM, Gemplers, or pesticide distributors).
- Sprayer that can provide good spray coverage throughout the tree.
- Orchard spray materials (for specific choices, see *Choosing Sprays*).
- To use many commercial orchard sprays, you must be a certified pesticide applicator. For information on how to become a certified applicator, see NYS Department of Environmental Conservation: Pesticide Certification and Business Registration at [dec.ny.gov/permits/209.html](http://dec.ny.gov/permits/209.html).
- Personal protective equipment to spray pesticides (Gemplers, or your pesticide supplier, or a hardware store).
- Subscribe to *Cornell Scaffolds Fruit Journal* newsletter for commercial producers at [scaffolds.entomology.cornell.edu](http://scaffolds.entomology.cornell.edu). For free subscriptions contact Dr. Art Agnello at [ama4@cornell.edu](mailto:ama4@cornell.edu).
- Subscribe to a regional Cornell Cooperative Extension fruit program to get daily or weekly

time-sensitive updates: Lake Ontario Fruit Program at [lof.cce.cornell.edu](http://lof.cce.cornell.edu) or Eastern NY Horticulture Program at [enych.cce.cornell.edu](http://enych.cce.cornell.edu).

- For more production and pest management detail, read the content on the Cornell Fruit website: [fruit.cornell.edu](http://fruit.cornell.edu).

## Calculating Degree Days:

Measuring ‘Degree Days’ is a method of measuring heat accumulated over the season. Plants and insects are not warm-blooded, so their growth and development is linked to the daily temperatures. We track degree days to predict the timing of certain pest events in orchards.

Degree Days are the difference between the average daily temperature and a base temperature (50°F unless otherwise noted) and added together (accumulated degree-days) starting at a certain date or event. Below the base temperature, an insect or disease in question doesn’t grow or develop. To calculate degree days:

1. Record the minimum and maximum temperature for the day (use a min/max thermometer).
2. Average those temperatures.
3. Subtract the base temperature. If this number is negative, record a “zero.”

Example 1: Yesterday’s high was 85°F, and the low was 65°F. Average temp = 75°F. Subtract the base temperature (50), and you have 25 degree days accumulated that day. Add 25 to previous total starting at a specific event or date.

Example 2: Yesterday’s high was 55°F, the low was 40°F. Average temp = 47.5°F. This is less than the base temperature, 50 degrees, so you have 0 degree days accumulated.

Or use a NEWA station nearby to find the accumulated degree days for pest development ([newa.cornell.edu](http://newa.cornell.edu)).

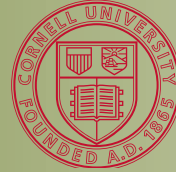
### Create your own table to record degree days.

Date	Max °F	Min °F	Precip	*Degree Days, daily and accumulated					
				Base 32 °F		Base 43 °F		Base 50 °F	

\*Degree days = (Max temp + minimum temp)/2 - base temperature





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## Scouting Calendar



Apple Stage and Approximate Dates	Pest Action	How to Follow Up
 <p><i>dormant</i>, December-March</p>	<ul style="list-style-type: none"> <li>• Prune out all <b>cankers (fire blight and others)</b>. Burn cuttings.</li> </ul>	<p>Refer to <i>Fire Blight</i> to identify cankers.</p>
 <p><i>silver tip</i>, March</p>	<ul style="list-style-type: none"> <li>• <b>Mites</b>: plan dormant oil application to smother mite eggs.</li> <li>• Prune out all <b>cankers (fire blight and others)</b>. Burn cuttings.</li> <li>• <b>Apple scab and fire blight</b>: spray copper. ⚠</li> <li>• Order fungicide for <b>apple scab</b> sprays.</li> </ul>	<p>Refer to <i>Mites</i>.</p> <p>Refer to <i>Choosing Sprays</i>.</p> <p>Refer to <i>Fire Blight</i>.</p> <p>Refer to <i>Apple Scab</i>.</p>

Apple Stage and Approximate Dates	Pest Action	How to Follow Up
 <p data-bbox="54 654 239 686">green tip, April</p>	<ul data-bbox="420 261 1186 586" style="list-style-type: none"> <li>Record green tip date</li> <li><b>Apple scab:</b> spray fungicide. ⚠️</li> <li>Record rainfall, reapply fungicide to new leaf growth every 5-7 days or after a rainfall of 1.5" or more.</li> <li><b>Worms in fruit?</b> Order traps for <b>oriental fruit moth, codling moth, obliquebanded leafroller, apple maggot.</b></li> <li>Herbicide – apply glyphosate under trees, do not spray bark or tree.</li> </ul>	<p data-bbox="1213 261 1982 326">See: NEWA, <a href="http://newa.cornell.edu">newa.cornell.edu</a> for weather data and identify a nearby station.</p> <p data-bbox="1213 342 1465 375">Refer to <i>Apple Scab</i>.</p> <p data-bbox="1213 391 1528 423">Refer to <i>Choosing Sprays</i>.</p> <p data-bbox="1213 440 1507 472">Review: <i>Worms in Fruit</i>.</p> <p data-bbox="1213 488 1451 521">Trap supplies from:</p> <p data-bbox="1213 537 1661 570">Great Lakes IPM, <a href="http://greatlakesipm.com">greatlakesipm.com</a></p> <p data-bbox="1213 586 1877 643">Gemplers Pheromone Lures and Traps, <a href="http://gemplers.com/pheromone-lures">gemplers.com/pheromone-lures</a></p>
 <p data-bbox="54 1024 344 1057">quarter-inch green, April</p>	<ul data-bbox="420 706 1186 911" style="list-style-type: none"> <li><b>Apple scab:</b> spray fungicide. ⚠️</li> <li>Record rainfall, reapply fungicide to new leaf growth every 5-7 days or after a rainfall of 1.5" or more.</li> <li>Herbicide – if no weed spray under trees, apply your selection of herbicide.</li> </ul>	<p data-bbox="1213 706 1982 771">See: NEWA, <a href="http://newa.cornell.edu">newa.cornell.edu</a> for weather data and identify a nearby station.</p> <p data-bbox="1213 787 1465 820">Refer to <i>Apple Scab</i>.</p> <p data-bbox="1213 836 1528 868">Refer to <i>Choosing Sprays</i>.</p> <p data-bbox="1213 885 1507 917">Review: <i>Worms in Fruit</i>.</p> <p data-bbox="1213 933 1982 966">Refer to <i>Cornell Tree Fruit Guidelines</i> for weed control options.</p>
 <p data-bbox="54 1451 302 1484">half-inch green, April</p>	<ul data-bbox="420 1070 1129 1138" style="list-style-type: none"> <li><b>Apple scab:</b> continue fungicide protection and monitor rainfall (Do not use copper after 1/4" green). ⚠️</li> </ul>	<p data-bbox="1213 1070 1465 1102">Review <i>Apple Scab</i>.</p> <p data-bbox="1213 1118 1518 1151">Review <i>Choosing Sprays</i>.</p> <p data-bbox="1213 1167 1625 1200">Record sprays in <i>Orchard Journal</i>.</p>

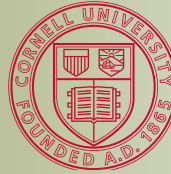
Apple Stage and Approximate Dates	Pest Action	How to Follow Up
 <p data-bbox="107 613 317 643">tight cluster, April</p>	<ul data-bbox="464 228 1243 496" style="list-style-type: none"> <li>• <b>Apple scab and powdery mildew:</b> continue fungicide protection. Add sulfur in fungicide sprays (for mildew) as long as it's not within 10 days of oil spray. ⚠</li> <li>• Continue monitoring rainfall.</li> <li>• Hang <b>oriental fruit moth (OFM)</b> trap. Check trap every 2-3 days, if you get &gt; 30 moths per week, scout fruit for damage at petal fall.</li> </ul>	<p data-bbox="1264 228 1577 258">Review <i>Powdery Mildew</i>.</p> <p data-bbox="1264 274 1562 303">Review <i>Choosing sprays</i>.</p> <p data-bbox="1264 319 1854 349">Review <i>Worms in Fruit</i> for insect identification.</p> <p data-bbox="1264 365 1829 394">Record sprays and rainfall in <i>Orchard Journal</i>.</p> <p data-bbox="1264 410 1934 440">Record first target insect trap date in <i>Orchard Journal</i>.</p>
 <p data-bbox="107 1040 348 1070">pink bud, April-May</p>	<ul data-bbox="464 659 1243 837" style="list-style-type: none"> <li>• <b>Apple scab and powdery mildew:</b> continue fungicide sprays. This is the peak of apple scab pressure through bloom. ⚠</li> <li>• <b>Plum curculio and European apple sawfly:</b> consider insecticide application before first bloom or wait until petal fall.</li> </ul>	<p data-bbox="1264 659 2011 721">Study <i>Fire Blight</i> to prepare for potential blossom infections starting at first bloom.</p> <p data-bbox="1264 737 1871 766">Study <i>Plum Curculio</i> and <i>European Apple Sawfly</i>.</p> <p data-bbox="1264 782 1677 812">Record sprays in <i>Orchard Journal</i>.</p> <p data-bbox="1264 828 1566 857">Review <i>Choosing Sprays</i>.</p>
 <p data-bbox="107 1463 369 1492">first bloom, April-May</p>	<ul data-bbox="464 1081 1243 1442" style="list-style-type: none"> <li>• Record date of 1st blossom open</li> <li>• <b>Apple scab and powdery mildew:</b> continue fungicide sprays on susceptible varieties. ⚠</li> <li>• <b>Fire blight:</b> use NEWA model to monitor infection risk and time antibiotic sprays. Have antibiotic on hand for fire blight bloom sprays. ⚠</li> <li>• Set out <b>codling moth (CM)</b> traps. Check traps every 2-3 days. Record date of first catch.</li> <li>• Start recording degree days (base 50) after 1st CM in trap.</li> </ul>	<p data-bbox="1264 1081 1493 1110">Review <i>Fire Blight</i>.</p> <p data-bbox="1264 1127 1572 1156">NEWA <a href="http://newa.cornell.edu">newa.cornell.edu</a></p> <p data-bbox="1264 1172 1986 1234">Review <i>Worms in Fruit</i> for target insect identification and timing for insecticide sprays.</p> <p data-bbox="1264 1250 1864 1279">Use chart to calculate degree days or use NEWA.</p>

Apple Stage and Approximate Dates	Pest Action	How to Follow Up
 <p>full bloom, April-May</p>	<ul style="list-style-type: none"> <li>• <b>Apple scab and powdery mildew:</b> continue fungicide protection on susceptible varieties. Add sulfur in sprays (for mildew) as long as it's not within 10 days of oil. ⚠️</li> <li>• <b>Fire blight:</b> continue monitoring weather for blossom infections. ⚠️</li> <li>• <b>Cedar apple rust and other rust disease:</b> if rust is an issue (Hudson Valley and Lake Champlain of NY) include fungicide that controls rust diseases.</li> <li>• <b>Codling moth, oriental fruit moth monitor:</b> clean and count moths in traps weekly.</li> <li>• Record all sprays.</li> </ul>	<p>Review <i>Choosing Sprays</i>.</p> <p>Review <i>Fire Blight</i>.</p> <p>Check NEWA for <b>fire blight</b> risk through bloom.</p> <p>Review <i>Apple Rust Diseases</i>.</p> <p>Record all sprays in <i>Orchard Journal</i>.</p>
 <p>petal fall, May</p>	<ul style="list-style-type: none"> <li>• Record date when 75% of flowers on north side of trees have no petals.</li> <li>• <b>Plum curculio:</b> first insecticide needed. ⚠️</li> <li>• <b>European apple sawfly:</b> first insecticide needed.</li> <li>• <b>Apple scab and powdery mildew:</b> continue fungicide protection on susceptible varieties for 2 more weeks. ⚠️</li> <li>• <b>Fire blight:</b> scout fruit clusters for wilting symptoms and lingering bloom.</li> <li>• <b>Codling moth and oriental fruit moth:</b> continue monitoring traps, change traps and lures as directed by products.</li> <li>• Record Sprays.</li> </ul>	<p>See records in <i>Orchard Journal</i>: count total applications of captan and mancozeb, number of sprays and total lb/acre.</p> <p>Review <i>Plum Curculio</i>.</p> <p>Review <i>Choosing Sprays</i>.</p> <p>Review <i>Fire Blight</i>.</p> <p>Calculate degree-day accumulation for <b>codling moth</b>. Spray insecticide at 200-250 DD (50F) after first trap catch.</p>
 <p>fruit set, May</p>	<ul style="list-style-type: none"> <li>• Sample leaves for <b>mites</b>.</li> <li>• Second spray for <b>plum curculio</b>, 10-14 days after the petal fall spray. ⚠️</li> <li>• Scout for <b>scab</b> – if none, then you're done spraying for it.</li> <li>• <b>Powdery mildew:</b> continue fungicide protection on susceptible varieties until terminal bud set.</li> <li>• <b>Fire blight:</b> scout for infections and cut them out.</li> <li>• <b>Codling moth, oriental fruit moth:</b> continue monitoring traps.</li> <li>• Thin fruit crop. ⚠️</li> </ul>	<p>Review <i>Mites</i>.</p> <p>Review <i>Apple Scab</i> for refreshing your memory of what scab infections look like.</p> <p>Review <i>Powdery Mildew</i>.</p> <p>Review <i>Worms in Fruit</i>.</p> <p>Calculate degree-day accumulation for <b>codling moth</b>. If more than 5 codling moths per week during bloom or petal fall, spray insecticide at 200-250 DD (50F) after first trap catch.</p> <p>Refer to <i>Cornell Tree Fruit Guidelines</i> for thinning information.</p>



Apple Stage and Approximate Dates	Pest Action	How to Follow Up
 <p>fruit sizing, June</p>	<ul style="list-style-type: none"> <li>• Powdery mildew: continue fungicide protection.</li> <li>• Apple maggot: put out red ball traps in mid-June, monitor and clean traps weekly through August.</li> <li>• Leafhoppers, aphids, &amp; mites: scout growing shoots and leaves weekly.</li> <li>• Codling moth, oriental fruit moth: continue monitoring.</li> <li>• Fire blight: cut out any strikes and spray only if you get hail.</li> <li>• Weeds: apply glyphosate to herbicide strips under trees.</li> </ul>	<p>See records in <i>Orchard Journal</i>: count total applications of captan and mancozeb, number of sprays and total lb/acre.</p> <p>Review <i>Worms in Fruit</i>.</p> <p>Review <i>Leafhoppers and Aphids</i>.</p> <p>Review <i>Mites</i>.</p> <p>Review <i>Choosing Sprays</i>.</p> <p>Record all sprays in <i>Orchard Journal</i>.</p> <p>Refer to <i>Cornell Tree Fruit Guidelines</i> for choosing weed control options.</p>
 <p>terminal bud set, July</p>	<ul style="list-style-type: none"> <li>• Mildew: fungicides can be terminated when terminal buds are set and no new leaves are growing.</li> <li>• Apple Maggot: monitor and clean traps through mid-August ⚠️</li> <li>• Leafhopper, Aphids, and Mites: continue weekly scouting</li> <li>• Codling Moth, Oriental Fruit Moth: continue monitoring</li> <li>• Fire blight: cut out any strikes, spray only if you get hail</li> <li>• Summer Diseases – if you don't like blotchy, dirty-looking apples, use fungicide for sooty blotch/ flyspeck diseases.</li> </ul>	<p>Review preharvest intervals on labels for all fungicide, insecticides and herbicides.</p> <p>Record all sprays in <i>Orchard Journal</i>.</p> <p>Review <i>Worms in Fruit</i>.</p> <p>Calculate degree-day accumulation from first codling moth trap catch = ~1250 DD (50F) requires insecticide application. Additional sprays will depend on trap catch.</p> <p>Review <i>Choosing Sprays</i>.</p> <p>Review <i>Summer Diseases</i>.</p>
<p>harvest, September</p>	<ul style="list-style-type: none"> <li>• Pick Fruit when it is Ripe!</li> <li>• Reap rewards for your tireless efforts!</li> <li>• Or go to local farm market &amp; buy your apples. 😊</li> </ul>	<p>Look for signs of fruit damage. Identify the cause so it can be corrected next season.</p>
<p>after harvest</p>	<ul style="list-style-type: none"> <li>• Borers: paint trunks white with indoor latex paint to avoid bark splitting and cracking in winter temperature extremes.</li> <li>• Rodents: check guards on tree trunks</li> <li>• Mow grass between rows to remove shelter for voles and mice.</li> </ul>	<p>Review <i>Borers</i>.</p> <p>Review <i>Wildlife Damage Management Fact Sheet Series: Voles</i> <a href="http://wildlifecontrol.info/pubs/Documents/Voles/Voles.pdf">wildlifecontrol.info/pubs/Documents/Voles/Voles.pdf</a></p>

# Apple IPM for Beginners



Cornell University  
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## Choosing Sprays

The New York State Department of Environmental Conservation (NYS DEC) controls pesticide usage in NYS in part by registering pesticides as “general use” or “restricted use”. DEC requires training and licensing for those who spray “restricted use” pesticides. Many insecticides and a few fungicides that are legal for use in NYS orchards require this license.

*Cornell's Pest Management Guidelines for Commercial Tree Fruit Production* lists pest control products for legal use for specific pests on NY tree fruits. This list changes as new products acquire (or lose) DEC approval, so the Guidelines are published every year and can be ordered online at the Cornell Store ([store.cornell.edu/c-875-guidelines.aspx](http://store.cornell.edu/c-875-guidelines.aspx)). Choose products based on your farm size, the quantity of product available, use rates and number of sprays anticipated, cost, and product shelf-life.

It is important to refer to the *Cornell Tree Fruit Guidelines* for charts rating effectiveness of fungicides on diseases (Table 6.1.1) and insecticides (Table 7.1.1). Each product's toxicity to beneficial insects is also listed. A short list of products, most of which do not currently (at time of printing) require a license, is provided. Find the brand name first, followed by the chemical name of the active ingredient. Refer to the current *Cornell Tree Fruit Guidelines* for up-to-date listings of registered NY pesticides. Note: Professional orchardists are

### 2014 Cornell Pest Management Guidelines for Commercial Tree Fruit Production



Trapping brown marmorated stink bug (BMSB) near harvest, Campbell Hill, NY (Chris Izzo, Orchard)  
Photo by Peter Zandich, Cornell University Hudson Valley Research Laboratory, Highland, NY



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Online version of this Guideline is available at [pmguidelines.org](http://pmguidelines.org).

Additional information at the Cornell fruit homepage: [www.fruit.cornell.edu](http://www.fruit.cornell.edu)

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Molly Shaw, Tioga County Cornell Cooperative Extension

quite precise regarding which pesticides they choose for which insects or diseases. They take into account pesticide resistance management, weather, and other factors. Study the *Cornell Tree Fruit Guidelines*, Chapter 5-7, for more detail.

Remember, **the pesticide label is the law** on how that product may be used. Both the pest and the crop must be listed on the label, and you must follow the listed rates and time of application. Also pay careful attention to the Pre-Harvest Interval. ‘PHI’ is the number of days you must wait between application and harvest. Make sure you wear proper safety equipment and garments as required on the label (PPE = Personal protective equipment).

Safety Glasses or Goggles

Chemical Resistant Coveralls



Respirator

Chemical  
Resistant  
Rubber  
Gloves

Chemical  
Resistant  
Rubber  
Boots

## Spraying Weather

Optimal spraying weather is a light 3-8 mph wind, no rain in the forecast for at least 6 hours, and temperatures less than 85°F. No oil should be included in a spray 48 hours before or after freezing temperatures. To ensure sprays stay on target—drying on the leaves rather than drifting to non-target areas—it is best to apply at dawn or dusk when winds tend to be calm.

## Protecting pollinators

Insecticides can be toxic to bees if they are exposed to direct treatment or to sprays that have not dried. Read the label section on “Environmental Hazards” before spraying insecticides for proper use if bees are visiting the orchard.

## Tank Mixes

Growers may mix fungicides and insecticides in a sprayer “tank mix” if their scouting and weather monitoring show that both are needed. But never delay a spray to make a tank mix work. Also, a few tank mixes are toxic to tree leaves or fruit—always read that label to find any restrictions on products that can be mixed!

## Buying Sprays

Some orchard pest control products are available at the local farm store. However, sooner than later you’re going to have to find a supplier for more specialized products. Here are some options:

## Orchard pest monitoring supplies:

Great Lakes IPM, 800-235-0285, [greatlakesipm.com](http://greatlakesipm.com).

Gemplers, 800-382-8473, [gemplers.com/pest-mgmt](http://gemplers.com/pest-mgmt).

## Agricultural chemicals:

Helena (Geneva, NY) [www.helenachemical.com](http://www.helenachemical.com).

They may also supply your local farm store, which can broker special orchard products upon request.

CPS (Sodus, NY) [cpsagu.com](http://cpsagu.com).

Winfield Solutions (Lyons, NY), or Call Customer Service Department at 1 (855) 494-6343 to find the WinField™ retailer nearest you.

Note: Cornell does not endorse any company. These suppliers are listed here for your convenience. This is not a comprehensive list.

Fungicides for Diseases				
	Apple Scab	Powdery mildew	Rust	Sooty blotch/ flyspeck
Copper (various brands)	4 (Green tip before infection)	0	na	na
Captan	4	0	0	3
mancozeb (various brands)	3	0	4	4
Polyram (metiram)	3	0	4	4
Sulfur (various)	2	2	0	1

0=none, 1=slight, 2=fair, 3=good, 4=excellent disease control, \* may be resistant

Anti-Bacterials for Blossom Sprays to Prevent Fire Blight
Streptomycin (Agristrep, Firewall, or Harbour) Oxytetracycline (Mycoshield, Fireline)
Copper Products: can be used during bloom to protect blossoms but can cause a rough finish on apple skin.
Biological controls can be used during bloom if low risk of blossom blight. List includes Serenade Optimum, ASO; Double Nickel 55; and Blossom Protect.

<b>** Miticides for Apples</b>			
Miticides	European Red mite	Two-spotted spider mite	Timing
Portal (fenpyroximate)	3	3	threshold
Horticultural oils*	3	1	Dormant
Zeal (etoxazole)	3	3	Pink, or Petal fall
Stylet-oil*	3	1	Petal fall, plus 2 week intervals

0=none, 1=slight, 2=fair, 3=good

\*Do not apply Captan 7-10 days before or after oil.

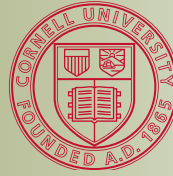
\*\*Do not use the same miticide two seasons in succession.

<b>Basic Insecticides for Apples</b>						
Insecticide	Plum Curculio	European Apple sawfly	Green Aphids/Leaf hoppers	Oblique banded Leafroller	Codling moth/oriental fruit moth	Apple maggot
@Surround (kaolin clay)	2	-	1	-	2	2
@BT (Biobit, Dipel, etc.)	0	-	0	3	2	0
Sevin (carbaryl)	2	-	1/3	2	2	2
*Imidan (phosmet)	3	3	1	1	3	3
Malathion	2	2	2/1	1	2	2
Avaunt (indoxacarb)	3	2	1/3	0	2	2
*Admire Pro (imadocloprid)	-	-	3/3	-	-	-
Assail (acetamiprid)	2	2	3/3	0	3	3
Delegate (spinetoram)	2	-	-/-	3	3	2
@Entrust (spinosad)	0	-	0/0	3	2	2

0=none, 1=slight, 2=fair, 3=good, \*Restricted use, @ organic option



# Apple IPM for Beginners



Cornell University  
Cooperative Extension

## Apple Scab



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### Time of Concern

Green tip through four weeks after petal fall



green tip



petal fall

### Damage



NYSAES Photo.

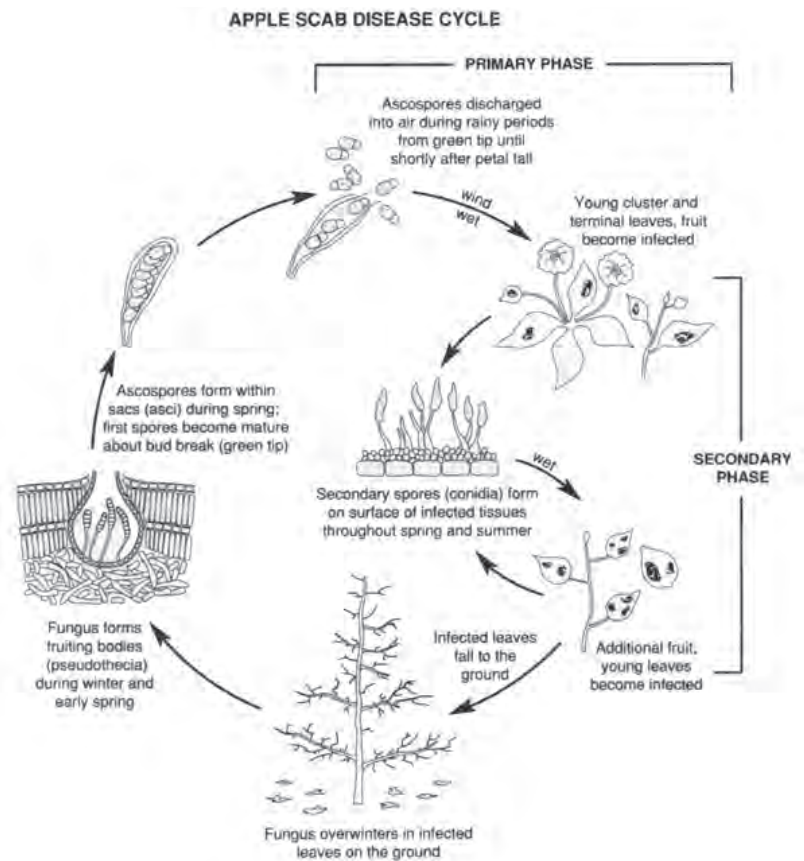


Photo: K. Cox, Cornell Univ.



Photo: K. Cox, Cornell Univ.

### Pest Cycle



Reprinted with permission from *Apple Scab*, 1993, W. Wilcox, © NYS IPM Program and Cornell University.

This is a disease of leaves and fruit caused by a fungus that overwinters on infected leaves that dropped to the ground from the previous season. The fungal spores are “shot” from the leaf litter in the spring after 0.01” of rainfall, and will infect the tiniest bit of green leaf that has emerged from leaf buds (“green tip”). If not protected with fungicide, newly expanding leaves are susceptible to infection every time it rains. As brownish spots develop on leaves, spores from those spots move by rain to infect other leaves and fruit.

## IPM Steps for Beginners

The key to this disease is prevention. Stop the first spores (found on last year's leaf litter) from infecting new leaves by applying a fungicide to trees before spores are released. If infection takes hold on new leaves, it's very hard to keep the fruit free of infection later in the season.

1. For smaller plantings, rake up or vacuum and destroy overwintering leaves before new growth begins. To help old leaves decay faster and reduce the source for overwintering scab spores, spray a mix of urea (40 lb. dissolved in 100 gallons of water per acre) to the orchard floor, under trees, and between rows during the fall or early spring.
2. Either use scab resistant apple varieties (most of which are only resistant to scab but not other diseases), OR prevent infection by keeping foliage covered with fungicide from green-tip to 4 weeks after petal-fall.
3. Spray fungicide before the rain as soon as any sign of green is visible in the tip of the buds.
  - Use a sprayer that gets thorough coverage of the foliage and fruit. Spores will germinate and infect leaves if they do not contact fungicide.
  - Monitor rainfall. Fungicide will be washed off after 1.5" of rain. Reapply.
  - New leaf growth after a fungicide application is not well protected. Reapply every 7 days to protect new leaves.
4. Use *Cornell Tree Fruit Guidelines* ([store.cornell.edu/c-875-guidelines.aspx](http://store.cornell.edu/c-875-guidelines.aspx)) to choose a labeled fungicide for NYS. Important notes:
  - Copper can be used for the very early scab spray(s), but not after ¼" green, or the fruit will russet.
  - Do not spray Captan within 10-14 days before or after an oil spray—it will burn the trees.
  - During an extended rainy period, reapply protectant fungicides such as mancozeb during a light rain, but reapply a mix of captan and mancozeb after the rain.
  - Keep track of the number of fungicide applications. Mancozeb used at 3 lb./acre, has a maximum of 21 lbs. per acre per season. Use no more than 64 lbs. of Captan 50% per acre per season; or 40 lbs. of 80% per acre per season.

## Ready for More Precision?

Consult NEWA ([newa.cornell.edu](http://newa.cornell.edu)) for the apple scab model by clicking "Pest Forecasts," then "Apple Diseases". NEWA will not determine if there is an infection until it has already happened, typically too late for any preventative action. But if the forecasted weather is correct, it can predict when you will need to apply protectant fungicide. Learn to use the Mills table below if you have your own weather monitoring equipment.

Beginning at green tip, count the number of hours the leaves are wet starting after the beginning of rainfall until they are dry. Monitor the average temperature in the orchard during the time the leaves are wet. If, for example, the rain started at 7 PM and did not dry out until 10 AM the next morning, there were 15 hours of leaf wetting, and if the average temperature during that time was 45°F, the Mills table shows there was a scab infection. If fungicide was not applied before the rain, it is critical that protectants are applied within 18-24 hours of the start of the rainfall or you will need to include another fungicide that will stop the infection after the fungus has penetrated the leaf cuticle. (See *Cornell Tree Fruit Guidelines* for fungicide alternatives.)

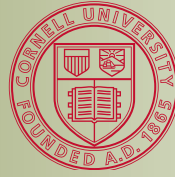
Scout for scab infections 10 days after petal-fall. If none are present, this can be the last scab fungicide applied. If infections are present (the earlier fungicide applications provided poor protection), fungicides will need to be applied on susceptible varieties for the rest of the season to prevent scab fruit spots.

*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.*

Temperature (°F)	Hours	Lesions Appearance (days)
34	41	-
36	35	-
37	30	-
39	28	-
41	21	-
43	18	17
45	15	17
46	13	17
48	12	17
50	11	16
52	9	15
54-56	8	14
57-59	7	12-13
61-75	6	9-10
77	8	-
79	11	-



# Apple IPM for Beginners



Cornell University  
Cooperative Extension

## Fire Blight



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Molly Shaw, Tioga County Cornell Cooperative Extension

### Time of Concern

Dormant (Silver tip) & Bloom, but all through growing season



silver tip



bloom

### Damage



Figure 1. Oozing overwintering canker in spring.



Figure 2. Blossom blight infection showing blackened veins at base of leaf and drop of ooze.

### Pest Cycle

Fire Blight is a bacterial disease that attacks and infects all parts of apple and pear trees. The bacteria overwinter in the cambium of the trunk and branches. Figure 1 shows the bacteria oozing from the edge of an infected canker. In the spring, this bacterial ooze allows the disease to be carried by insects onto open blossoms, and bacteria multiply on the stigma, reaching dangerous numbers. Rain or dew moves bacteria to the base of the flower where it begins the infection process, causing the blossom and surrounding leaves to wilt and ooze more bacteria. A blighted blossom cluster is shown in Figure 2 with blackened flower stems and mid-vein of the adjacent leaf and a drop of yellow to amber ooze leaking from the stem. The infection moves from the blossom to adjacent shoot tips (shoot blight in Figure 3); and from the cankers, to adjacent shoots. The bacteria can travel through the cambium to the rootstock. Rootstocks such as M9 and M26 are very susceptible to fire blight and often become girdled, killing the tree (Figure 4). If fire blight is established in the orchard, a hailstorm facilitates the spread of bacteria, which in turn can infect wounds throughout the tree and fruit. Symptoms of wilting will appear approximately 7-10 days after the infection or hail event; this suggests a weekly schedule of scouting for fire blight.

### Cultural Factor of Infection

Most apple cultivars are susceptible to fire blight infections if they are growing too vigorously and the weather is warm. Many hard cider varieties bloom very late and therefore are very susceptible to blight. Do not over-fertilize with nitrogen. Pruning hard in the winter also stimulates extreme shoot growth, which is very susceptible to fire blight during the growing season. Pick off blossoms on newly planted trees before warm, wet, weather, which is ideal for fire blight infection.

## Damage, continued



Figure 3. Shoot blight infection of growing terminal.



Figure 4. Rootstock blight, which occurs in susceptible rootstocks such as M9 and M26, will girdle and kill the tree.

## IPM Steps for Beginners

1. Prune out cankers in the winter; cut shoot strikes and oozing cankers as soon as you see them. Cut 12-18" behind watersoaked symptoms in the bark. If the main trunk is infected, remove the tree.
2. Using copper for the first scab spray at silver to green tip, as well as at green tip to ¼-green will also help reduce (but not remove) the potential for fire blight.
3. To reduce infection, remove blossoms on trees too young to fruit before they open. Copper (at low rates on label) can be sprayed at first bloom, full bloom, and petal fall, but can cause rough fruit finish (russet) under slow drying conditions. Do not use copper during bloom on Golden Delicious.
4. If there is a history of fire blight problems nearby, spray streptomycin during bloom if warm, wet weather, and blossom infection is likely. Remove wild apple trees from hedgerows; ornamental pears, hawthorns, and crabapples can be hosts too. You may need multiple applications (not typically more than 3 per variety).
5. Blossom infection is likely if any blossoms are open, and you have 3 days in the mid-70s°F, or 2 days in hi-70s and low 80s. If a "high" risk is predicted, it takes very little moisture (dew) to move the bacteria to the base of the flower. If it's warm enough for you to perspire, check the temperatures in the forecast. There is likely a risk of blossom blight infection.
6. Don't over-fertilize with nitrogen—quick-growing shoots are particularly susceptible to fire blight.

Phases of fire blight disease symptoms					
Fire Blight Phase	Dormant- Green Tip	Bloom	Petal Fall	Terminal Bud Set	Harvest
Cankers					
Blossom blight					
Canker blight					
Shoot blight					
Rootstock blight					



## Ready for More Precision?

Pay very close attention to new orchard plantings. They bloom later than established orchards and usually during warmer weather when the risk of blossom infection is higher. Apply copper at planting time, and again when buds begin to grow. Remove blossoms before they open, but without removing the shoot growing from the blossom cluster. Do not risk spreading fire blight when training new trees by cutting competing leader shoots or removing blossoms during warm, wet weather. If blossoms cannot be removed, apply an anti-bacterial product.

Go to the NEWA website ([newa.cornell.edu](http://newa.cornell.edu)) for a location near you. There you will find forecasts of blossom blight predictions and when symptoms are predicted to appear. At the NEWA Apple Disease Models page ([newa.cornell.edu/index.php?page=apple-diseases](http://newa.cornell.edu/index.php?page=apple-diseases)), enter your own first open blossom date, and enter dates when streptomycin was applied. Figure 5 shows the risk of blossom infection predicted in NEWA using past and forecasted weather data. If you use a biological product, these must be applied early in bloom (1-5% bloom) before high risk is predicted.

### Fire Blight Risk Predictions for Sodus (Lake)

Blossom blight predictions using the Cougarblight model begin at first blossom open.

First blossom open date:

*First blossom open 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 during bloom more accurately.*

Orchard Blight History:

*The orchard blight history above is the NEWA default. Select the actual blight history for your orchard and the model will recalculate recommendations.*

### Blossom Blight Summary - Cougarblight

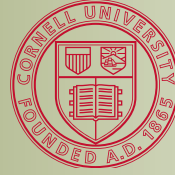
	Past	Past	Current	Blossom Blight 5-Day Forecast				
				Forecast Details				
Date	May 8	May 9	May 10	May 11	May 12	May 13	May 14	May 15
4-day DH	-	268*	398*	413*	450	324	312	614
Risk Level	-	Caution*	High*	High*	High	High	High	Extreme
<b>Wetness Events</b>								
Rain Amount	NA	0.50	0.27	0.00	0.01	0.28	0.54	0.07
Rain Prob (%) Night Day ?			- -	- -	- -	- -	- -	- -
Dew ?	NA	Yes	Yes	No	No	No	Yes	Yes
Leaf Wetness (hours)	NA	14	6					

NA - data not available

[Cougarblight Charts](#)

Download Time: 5/10/2014 23:00

Figure 5. NEWA apple disease forecast for fire blight infection of blossoms. Source: newa.com



## Powdery Mildew

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Lake Ontario Fruit Program

Molly Shaw, Tioga County Cornell Cooperative Extension

### Time of Concern

Tight cluster until shoots stop growing



Tight cluster



Terminal bud set

### Damage



Figure 1. Mildew is growing out on shoot from overwintering infection of the vegetative bud last season. Photo: K. Cox, Cornell Univ.



Figure 2. Mildew growing out from overwintering infection of the flower bud last season. Photo: K. Cox, Cornell Univ.

### Pest Cycle

Powdery mildew (PM) is a fungal disease that appears as a white, powdery growth on leaves, and may distort shoot growth. The fungus survives from one season to the next by overwintering in infected buds—buds which will not produce fruit. Many infected buds die over winter if low temperatures go below  $-15^{\circ}\text{F}$ , so PM tends to be worse after a mild winter. As these buds grow in the spring they develop the symptoms of infected shoots as in Figures 1 and 2. The optimal infection time for powdery mildew starts at tight cluster when PM infected blossom clusters and vegetative shoots begin to produce white powdery spores. The spores are windblown to new, healthy leaves while they are still growing and expanding, as in Figure 3. These new infections result in yellow spots developing on the upper surface of the leaves and begin to produce more white powdery spores on the undersurface. Eventually, these curling, drying leaves can't contribute to the tree's nutrition.

Powdery mildew fungus can infect new leaves when the temperature is between  $50\text{-}77^{\circ}\text{F}$  and the relative humidity is 70% or greater, especially in the nighttime and early morning hours. Rain is not necessary to cause infection; in fact, free water on the leaves prevents the spores from infecting the leaves, resulting in less powdery mildew during rainy seasons. When terminal buds set on shoots and there are no longer newly expanding leaves, new powdery mildew infections will stop. If PM is left unchecked in the tree, fruit will also become infected resulting in a "netted" appearance or russet on the skin of the apple shown in Figure 4.



## Damage, Continued



Figure 3. Mildew infection during the summer spreading to new leaves. Photo: K. Cox, Cornell Univ.



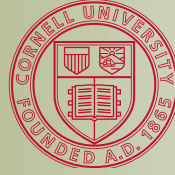
Figure 4. Mildew infection of fruit resulting in netted appearance of skin.

## IPM Steps for Beginners

1. Plant cultivars resistant to powdery mildew. Pay careful attention to susceptible varieties such as Cortland, Crispin, Gala, Ginger Gold, Honeycrisp, Jonagold, Idared, Paulared, Rome, Sansa, and NY-1.
2. Powdery mildew overwinters in apple buds. When scouting during tight cluster to pink, small orchardists can pick off infected shoots to remove inoculum, then start spraying for PM (add to scab sprays) on a 7-10 day schedule until terminal buds set at the end of the growing shoots in mid-summer.
3. Add sprayable sulfur to your pest control sprays when PM is a concern. Start at tight cluster and continue every 7 days if you see infected shoots, or if PM was a problem in years past. Caution: sulfur shouldn't be used during extremely hot weather as it can cause burning of the leaves and fruit when temperatures are above 80°F. Don't use sulfur 7-10 days before or after an oil application.
4. Stilet or other horticultural oil is another option for mildew control at 1% (1 gallon per 100 gallon solution). Use in cover sprays 2 weeks apart while leaves are still expanding. To avoid leaf and fruit burning, do not use if also applying captan or sulfur for other disease management in summer sprays.

## Ready for More Precision?

Other fungicides effective for control can be applied on a 7-14 day interval starting no later than pink bud and continuing until terminal buds set. Good spray coverage is essential for effectiveness of fungicides. Many growers are experiencing reduced effectiveness of many fungicides due to fungicide resistance in mildew. For other product options, refer to the most current version of *Cornell Pest Management Guidelines for Commercial Tree fruit Production*. See the *Choosing Sprays* fact sheet in the Orchard IPM for Beginners series.



## Apple Rust Diseases

Authors:  
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Lake Ontario Fruit Program

### Time of Concern

Tight cluster through 2 weeks after petal fall



tight cluster



petal fall

### Damage



Figure 1a. CAR gall on red cedar. Photo: D. Rosenberger



Figure 1b. Active spore production of CAR. Photo: D. Rosenberger

### Pest Cycle

Cedar apple rust (CAR) is an apple disease of leaves and fruit caused by a fungus that overwinters in galls (Figures 1a and 1b) found on eastern red cedar trees (*Juniperus virginiana* L.). The spores produced by these galls infect apple but not red cedar; the spores that are formed from infections on apple leaves and fruits infect only red cedar which means it is an alternate host disease. In regions of NY where eastern red cedar is common in the wild or landscape plantings, cedar apple rust can defoliate apple trees and result in poor quality fruit. Spring rains, when temperatures are between 46-75°F, cause the galls to ripen and produce spores which shoot into the air and land on new apple leaves and flowers. Infection occurs if the leaves, blossoms, or fruitlets stay wet for 4 hours after the spores are released and temperatures are >60°F, or 10 hours with temperatures of 43°F. One to two weeks after infection, orange pustules form on the upper surface of leaves (Figure 2) or on fruit (Figure 3). Removing the red cedar alternate host, and planting resistant apple varieties is one way to manage this disease.

Another rust disease, Quince Rust, is a fungus that infects apple fruit of most cultivars but not leaves. It attacks both leaves and fruit of hawthorn in the hedgerows. The initial source for quince rust is the overwintering cankers in cedar trees. The spores are released as with cedar apple rust and infect apple fruitlets from pink to petal fall during rainy weather. These infections then produce spores which re-infect the cedar trees. The rust symptoms appear on apple fruit 2-4 weeks after an infection. Some cultivars that are resistant to CAR are susceptible to quince rust (McIntosh and Delicious); some cultivars susceptible to CAR are resistant to quince rust.



## Damage, continued



Figure 2. CAR infections on apple leaves



Figure 3. CAR infection of apple. Photo: D. Rosenberger



Figure 4. Quince rust infection of apples. Photo: D. Rosenberger

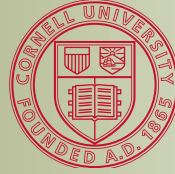


Figure 5. Quince rust infection on hawthorn fruits.

## IPM Steps for Beginners

1. The key to managing apple rust diseases is prevention.
2. If practical, remove eastern red cedar and identify hawthorn growing in hedgerows.
3. Plant resistant cultivars: refer to the KTFREC - Cedar-apple Rust Susceptibility Table ([caf.wvu.edu/kearneysville/tables/carsus.html](http://caf.wvu.edu/kearneysville/tables/carsus.html)).
  - a. CAR Resistant cultivars: Delicious, Empire Enterprise, Fortune, Golden Supreme, Liberty, Macoun, McIntosh, Sansa, Zestar.
  - b. CAR Susceptible cultivars: Ambrosia, Braeburn, Cameo, Cortland, Crimson Crisp, Fuji, Gala, Ginger Gold, Golden Delicious, Gold Rush, Honeycrisp, Idared, Jonafree, Jonagold, Northern Spy, Rome Beauty, Williams Pride.
4. To prevent infection if your orchard is in a region where eastern red cedar is prevalent, keep trees covered with fungicide effective against rust diseases from tight cluster through 2 weeks after petal-fall.
5. Spray fungicide before the rain on a 7-10 day interval using a mancozeb product up until 77 days before harvest.
6. Use *Cornell Tree Fruit Guidelines* for alternative fungicides for rust disease.

# Apple IPM for Beginners



Cornell University  
Cooperative Extension

## Summer Diseases

Author:  
Deborah Breth, Cornell Cooperative Extension,  
Lake Ontario Fruit Program

### Time of Concern

2-3 weeks after petal fall through harvest



fruit sizing

### Damage



Figure 1. Sooty blotch. Photo by K. D. Hickey, PSU.



Figure 2. Flyspeck is very apparent on green and yellow apple varieties.

### Pest Cycle

The summer diseases most likely to affect apples are sooty blotch and flyspeck which often occur together. Sooty blotch/flyspeck (SB/FS) are caused by **a complex of many different fungi** found on the surface of apples. The sooty blotch/flyspeck fungi survive the winter on apple twigs and alternate host plants, typically brambles, and other woody shrubs and vines in the hedgerows. Spores from infected twigs and vines are released to infect apple fruit approximately 2-3 weeks after petal fall. Infections require many hours of high relative humidity before symptoms appear. The higher the humidity and the more rainfall, the more disease will result. In areas with lower relative humidity, it can take as long as 2 months for symptoms to develop.

Although they are only superficial infections, these fungi can leave the fruit with a very dirty, sooty and speckled appearance. Sooty blotch looks like olive green to gray sooty splotches on the surface of the apples, as in Figure 1. Flyspeck infections are tiny black dots that appear in clusters, as in Figure 2.



## IPM Steps for Beginners

1. One key to managing sooty blotch/flyspeck in apple is to reduce sources of infection in hedgerows when practical. Remove or bush-hog wild brambles within the orchard and along the perimeter.
2. Improve air movement in the tree canopy by “summer pruning”. This practice speeds up drying of fruits, and reduces the number of hours of wetness in the trees.
3. Apply fungicides to prevent infection 2-3 weeks after petal fall if the weather is wet.
4. Captan and sulfur are relatively weak against sooty blotch/flyspeck and mancozeb has a 77 day preharvest interval. Therefore, captan should be mixed with thiophanate-methyl (Topsin M) for better control under high disease pressure. Other options, including Pristine, are listed in the *Cornell Tree Fruit Guidelines*.
5. The spray intervals under high disease pressure should be 14 days. In areas with drier climate and lower relative humidity, intervals can be stretched to 21 days.
6. The last spray can be applied 30-50 days before harvest; the longer interval in a drier season, and the shorter interval under more wet weather conditions.

### Sooty Blotch and Flyspeck Risk Predictions for Knowlesville

**Petal fall date for McIntosh:**

*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 accumulated leaf wetness hours since petal fall more accurately.*

**Most recent fungicide application date:**

*If petal fall has passed, enter the date of your most recent fungicide application.*

*If no fungicide applications have been made, do not enter a date.*

In the Risk Summary table, note the accumulated leaf wetness hours since petal fall (Leaf Wetness Hours) and the Risk Level. Leaf wetness hours, rain events, and the last fungicide application date are taken into consideration in assessing risk level. To estimate risk in the near future, look at the probability of rain.

Consult the Risk Level IPM Guidelines below the **Risk Summary** table.

Figure 3. NEWA risk prediction for sooty blotch/flyspeck to determine the need for additional fungicide protection. Source: [newa.com](http://newa.com)

## Ready for More Precision?

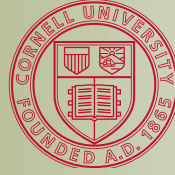
1. Research has shown that it takes approximately 200 hours of accumulated wetting measured by NEWA leaf wetness sensors for symptoms to develop after spores land on the surface of the fruit. Spores are typically dispersed near petal fall. Some fungicides, however, will stop development of symptoms of infection if applied before 200 hours of wetting has accumulated.
2. Check the NEWA station near you for apple diseases. At the website, NEWA Apple Disease Models ([newa.cornell.edu/index.php?page=apple-diseases](http://newa.cornell.edu/index.php?page=apple-diseases)), select Sooty Blotch/Flyspeck. Check the petal fall date for McIntosh for your farm, and enter the most recent fungicide application date. Figure 3 below shows the risk prediction if more than 2 inches of rainfall has occurred after your fungicide application.
3. But when fungicide residues erode, the fungus will continue development. Therefore, fungicide will need to be reapplied on a 14-21 day interval until mid-August.
4. If a heavy rain, >3 inches, occurs during late August or early September in varieties that will not be harvested within 25-30 days, a later season fungicide may be necessary.

### Sooty Blotch and Flyspeck Risk Summary - Northeastern US Model

	Past	Past	Current	5-Day Forecast				
				Forecast Details				
Date	Jul 6	Jul 7	Jul 8	Jul 9	Jul 10	Jul 11	Jul 12	Jul 13
<b>Days since petal fall</b>	47	48	49	50	51	52	53	54
<b>Accumulated Leaf Wetness Hours - ALWH</b>	191	196	201	218	218	218	218	236
<b>Risk Level</b>	High	High	High	High	High	High	High	High
<b>Rain Events</b>								
<b>Daily rain amount (inches)</b>	0.00	0.76	0.62	0.03	0.00	0.00	0.00	0.36
<b>Rain probability (%)</b>			- -	- -	- -	- -	- -	- -
<b>Night Day ?</b>								

NA - data not available.

Download Time: 7/8/2014 23:00



## Plum Curculio



Authors:

Deborah Breth, Cornell Cooperative Extension,  
Lake Ontario Fruit Program

Molly Shaw, Tioga County Cornell Cooperative Extension

### Time of Concern

Petal fall through 2-3 weeks after petal fall



petal fall



Figure 1. Plum curculio adult snout beetle. Photo: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org.

### Damage



Figure 2. Plum curculio egg laying cuts in small fruitlets. Reprinted with permission from Plum curculio, 1980, S. E. Lienk, © NYS IPM Program and Cornell University.



Figure 3. Plum curculio larva can complete its development in cherries and other stone fruit.

### Pest Cycle

Plum curculio is a pest of apples, pears, and stone fruit crops such as peaches, plums, and cherries. This weevil overwinters as an adult alongside woods, then migrates into the edges of orchards when average temperatures exceed 60°F for a couple days during bloom. After petals fall, when small fruitlets have developed, and after a couple days with temperatures of 70-75°F, the females (Figure 1) cut into small fruitlets and lay eggs in the cuts (Figure 2). The larvae do not successfully develop in apples since the eggs are usually crushed by the fruitlets as they grow, but in peaches, cherries and other stone fruit, will complete their development destroying the fruit (Figure 3). The grub is creamy white, legless, and has a brown head capsule. The egg-laying cuts in apples develop into half-moon russet spots shown in Figure 4. The presence of other curculio hosts around the orchard such as unsprayed wild plum and black cherry trees provide a ready source of plum curculio adults to cut and scar the apples.

European sawfly damage can be mistaken for plum curculio fruit cutting (Figure 5). This pest is common in Eastern NY and New England but is moving west into central and western NY. The eggs are laid on the fruit surface at petal fall, and the larvae feed around the surface before burrowing into the apple flesh. Severely damaged apples (Figure 6) will typically drop. Figure 7 shows the surface scarring of apple by European apple sawfly at harvest.



## Damage, cont.



Figure 4. Plum curculio egg laying scar in apple. Reprinted with permission from Plum curculio, 1980, S. E. Lienk, © NYS IPM Program and Cornell Univ.



Figure 5. European apple sawfly larvae will penetrate apple flesh in small fruitlets which typically drop. Reprinted with permission from European Apple Sawfly, 1991, R. Weires, © NYS IPM Program and Cornell Univ.



Figure 6. European apple sawfly scar from surface feeding. Photo: J. Carroll, NYS IPM



Figure 7. Surface scarring of apple by European apple sawfly at harvest.

## IPM Steps for Beginners

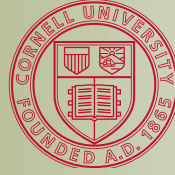
1. Spray effective pesticide at petal-fall (see *Choosing Sprays* for a list of choices in apples). This weevil is a damaging pest every year in a majority of NYS orchards. If applied promptly at petal fall, the correct pesticide spray will also control European apple sawfly where it is a problem.
2. Plum curculio adults continue to migrate into the orchard for a few weeks after petal fall, so spray another insecticide 10-14 days after the petal fall spray, or after 1.5 inches of rain (whichever comes first) to maintain protection of fruitlets for 3 weeks after petal fall.
3. For large plantings where curculio was controlled at petal fall throughout the orchard, the second spray can be applied to the perimeter rows of the orchard (50-75 feet).
4. Precautions on the use of carbaryl (Sevin) at petal fall: this product is highly toxic to honeybees and other bees exposed to direct treatment, residues on crops, or weeds in bloom. Do not apply carbaryl to crops or weeds in bloom. The use of carbaryl at petal fall can result in unintended fruit thinning. For alternatives to carbaryl, review *Choosing Sprays*. For other product options, refer to the most current version of *Cornell Tree Fruit Guidelines*.

## Ready for More Precision?

The next level of precision in plum curculio management is monitoring degree days to know more precisely when adults are finished coming into the orchard.

1. Note the date of petal fall, specifically when 75% of petals have fallen from the north side of the tree. This will vary by variety but work with the date of petal fall on early blooming varieties. If you wait until the later blooming varieties are at petal fall, you may be leaving the early blooming varieties open to damage because they will have fruitlets set before the late bloomers.
2. Monitor temperatures (degree-days base 50°F) starting at petal-fall. Use NEWA to estimate your degree day (DD) accumulation after petal-fall. When 308 DD have accumulated after petal-fall, plum curculio activity is no longer a threat.
3. If you reach 308 DD base 50°F quickly before the most recent spray has worn off, you don't need to spray again for plum curculio—adults are finished coming into your orchard for the season.
4. If 10-14 days pass and you haven't reached 308 DD, apply another spray. New adults are still coming into the orchard and the petal-fall spray isn't effective any more.
5. Consult NEWA ([newa.cornell.edu](http://newa.cornell.edu)) for the plum curculio model by clicking "Pest Forecasts", then "Apple Insects". Choose plum curculio from the list.
6. Use *Cornell Tree Fruit Guidelines* to choose a labeled insecticide for New York State.

# Apple IPM for Beginners



Cornell University  
Cooperative Extension

## Worms in Fruit



Authors:  
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Molly Shaw, Tioga County Cornell Cooperative Extension

### Time of Concern

Pink bud through harvest



pink

### Damage



Figure 1. CM or OFM in apple. Photo: E. Tee.



Figure 2. CM feeding on seeds after tunneling into apple.

### Pest Cycle

This is a complex of insect pests that attack apples, pears, and stone fruit. Not all of these pests attack all fruit types. The specific pests included are codling moth (CM), most common in apples and pears; oriental fruit moth (OFM), in all tree fruit; and apple maggot (AM), in apples. Codling moth, oriental fruit moth, and apple maggot are fruit flesh eaters. Newly hatched CM and OFM larvae bite through the skin (Figure 1) and quickly burrow into the flesh of the apple toward the core (Figure 2). CM will also feed on the seeds inside the apple core. Oriental fruit moth will also feed on young shoot tips in peaches and apples (Figure 3).

Lesser appleworm (LAW) is also part of this complex in some areas. The LAW larvae will feed on the flesh just under the surface of the skin (Figure 4). We seldom target this pest since CM and OFM controls will control LAW.

Apple maggot adults puncture the skin (Figure 5a) and place an egg just under the skin. The larvae are “maggots” that tunnel through the flesh (Figure 5b).

Larvae of the obliquebanded leafroller (OBLR) moth feed on the skin of apples (Figure 6). The larvae also web themselves in the leaves and blossom clusters, and feed there before the fruit is accessible.

All these “worms” (except for AM) overwinter in the orchard as larvae in cracks in bark; apple maggot overwinter as pupae in the soil. OFM are the first to emerge as adult moths in early May, CM emerge as adults during bloom, and OBLR become actively feeding larvae during bloom. Apple maggot adult flies will emerge from the soil in mid-June through August.

CM, and OBLR have 2-3 generations per year; OFM, 3-4 generations; and AM, 1 generation. The newly hatching larvae of CM, OFM, and OBLR are the target life stage for control; the adult flies are the target for apple maggot control.



Figure 3. OFM shoot tip feeding.



Figure 4. Lesser appleworm feeding by larva just under skin.



## Damage, continued



Figure 5a. Apple maggot "sting".



Figure 5b. Apple maggot tunneling. Photo: E.H. Glass, NYSAES, Bugwood.org

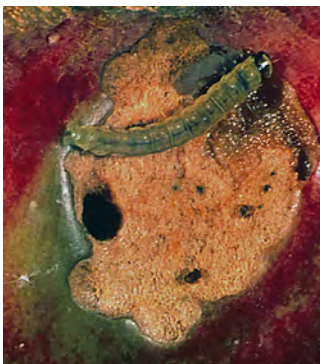


Figure 6. Obliquebanded leafroller larva feeding on apple skin. NYSAES Photo.

## IPM Steps for Beginners

### CM, OFM, LAW, and OBLR (caterpillars):

The key to managing these pests is proper identification and accurate timing of insecticide sprays. Use traps with insect specific pheromone lures to determine which pests are present at your location. Traps do not catch enough adults to decrease damage to apples. Traps are used to indicate when adults are flying and mating. They lay eggs after mating and egg hatch is predictable. The traps are for adult insects, though insecticide sprays will generally target newly hatching larvae, "worms", that infest the fruit.

Figure 7 shows distinguishing characteristics of CM with the bronze patch on the end of the wing, and is about 1/2 inch long; OFM have a wavy gray pattern and are 3/8 inch long; LAW will get trapped in OFM traps since they are closely related. LAW have a more "patchwork" pattern with gold patches, and are about 1/4 inch long. Many moth types will stick in the traps, even moths that look convincingly like the pest moths as in Figure 8. These "imposters" do not matter. Be careful to identify and count just the pest moths in your traps, especially for first trap catch.

1. Hang 1 trap for each of OFM, CM, and OBLR in the center of the orchard, more for >10 acre orchards (Figure 9). Check traps every 2-3 days until the first target insect is caught. Record the number of pest moths in traps, and clean insects out of the traps every week.
2. Use fresh lures for moth traps every 3 weeks for standard lures, or 8 weeks for the "extended-life" (L2) lures. Do not cross contaminate lures for different moths by handling different pheromone lures the same day.
3. Monitor traps until late September. If after 2 years you don't catch a certain species, you can conclude that you probably don't have it at your site. Figure 10 shows the typical flight activity for the season for CM, OFM, and AM. Lesser appleworm usually follows the CM flight.
4. Remove wormy apples that drop, so they don't add to the next generation of adults.
5. Spray insecticide 7-10 days after first adult catch. If trap counts exceed 5/week for CM or 10/week for OFM, continue insecticide applications on 14-day intervals.
6. Knowing what pests to target during the late spring and summer will help to determine the best insecticide choice—some insecticides are effective for all these pests, some better than others for specific pests. Review *Choosing Sprays* or the



Figure 7. Comparison of sizes for codling moth (left), oriental fruit moth (center), and lesser appleworm (right).



Figure 8. OFM in right side, imposters in OFM traps on left side

## IPM Steps for Beginners, continued

*Cornell Tree Fruit Guidelines* to determine the best insecticide choice for each and find the best one that is effective for all “worm” pests you have noted in your orchard. These pests are not problems in all orchards.

### Apple maggot:

1. Monitor adult flies with red sticky ball traps baited with ammonium scent on the edge of an orchard facing wild hawthorn or wild (unsprayed) apples.
2. Figure 11 shows the apple maggot fly is about  $\frac{1}{4}$  inch long, with a dark F shape on the wings. There are other flies with different patterns on the wings, so look closely for that F shape. The females have 4 white bands on their black abdomen, males have 3 bands on their abdomen.
3. Hanging 3-4 red sticky maggot traps per tree, baited with ripe fruit scent can “trap out” enough flies to eliminate spraying AM in small plantings. In large plantings, they’re used to monitor adults to time sprays.
4. Catching Apple Maggot flies (5/baited trap) on sticky traps (red ball coated with Tanglefoot) indicates that a spray is needed in a week. If traps have Tanglefoot, without bait, 1 fly per trap indicates a spray is needed.



Figure 9. Pherocon IIB trap with lure for CM, OFM, or LAW. Only 1 lure per trap!



Figure 11. Apple maggot adult female. Photo by Joseph Berger, Bugwood.org

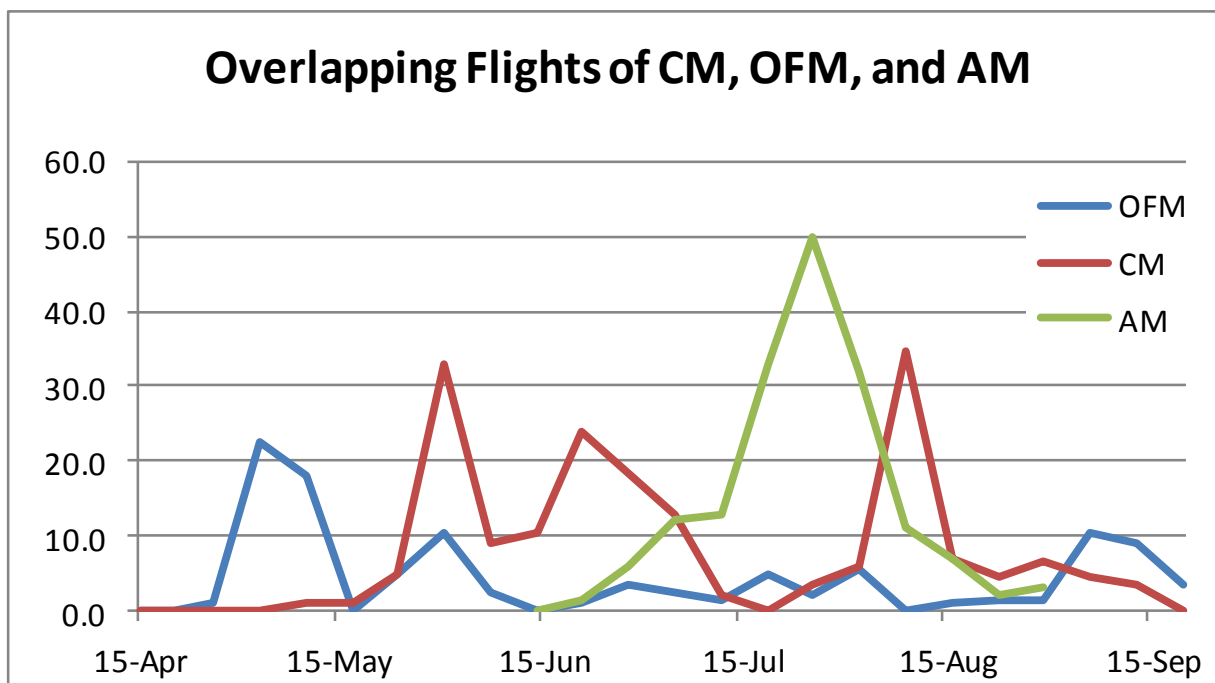

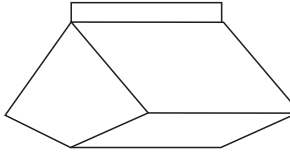

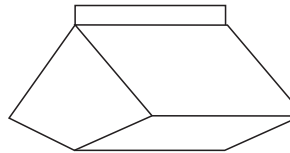




Figure 10. This graph shows weekly adult trap counts throughout the season for CM, OFM, and AM. Under high insect pressure, it may be necessary to spray every 2 weeks through August to prevent wormy apples.



**Table 1: Schedule for actions to prevent wormy fruit**

Trap and pest	Set up trap	Spray if ...	More Precision
<p>OFM</p>  <p>Photo: Mark Dreiling, Bugwood.org</p> 	<p>Tight cluster through September</p>	<p>Petal Fall or Find 1 worm in 300 fruit or &gt; 10 moths/week summer through September</p>	<p>If &gt; 30 OFM/week in spring, apply insecticide at petal fall, that will also control plum curculio and European apple sawfly. Then if &gt;10 moths per trap/week, treat within 7 days on a 2 week interval.</p>
<p>CM</p>  <p>Photo: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org</p> 	<p>First bloom through September</p>	<p>Find 1 worm in 300 fruit Or 7-10 days after &gt; 5 CM moths/week</p>	<p>Spray 200-250 DD50F after first moth and spray again in 2 weeks. If traps continue to exceed 5 per week, continue spraying on 2 week interval. Watch for late 2nd peak in June, if counts remain high, treat a third time. Then wait until the next flight starts in late July, treat 200-250 DD50F after the start of second flight and repeat after 10-14 days.</p>
<p>AM</p>  <p>Photo by Joseph Berger, Bugwood.org</p> 	<p>Mid-June through August Maintain fresh thin coat of Tanglefoot on surface of trap. Remove trapped insects weekly.</p>	<p>Catch 5 adults on baited trap, then treat. If no bait on trap, treat within 7-10 days after 1 fly caught, then on 10-14 day schedule to protect through August.</p>	<p>After the insecticide residue is depleted 7-14 days after the application (depending on insecticide) or after 1 inch of rainfall, start to monitor traps again and treat after reaching threshold, 5 flies per trap with lure or 1 fly per trap without lure.</p>

## Ready for More Precision?

If your orchard has more than 5-10 acres of apples, with high trap numbers for CM or OFM (more than 20 per week), install mating disruption pheromones and use degree day model in Table 1 to schedule insecticides.

### Fact Sheets for More Information:

Managing CM and OFM in Apples: [rvpadmin.cce.cornell.edu/uploads/doc\\_72.pdf](http://rvpadmin.cce.cornell.edu/uploads/doc_72.pdf)

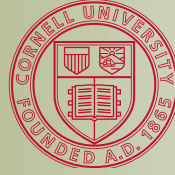
Oriental Fruit Moth: [nysipm.cornell.edu/factsheets/treefruit/pests/ofm/ofm.pdf](http://nysipm.cornell.edu/factsheets/treefruit/pests/ofm/ofm.pdf)

Codling Moth: [nysipm.cornell.edu/factsheets/treefruit/pests/cm/cm.pdf](http://nysipm.cornell.edu/factsheets/treefruit/pests/cm/cm.pdf)

Apple Maggot: [nysipm.cornell.edu/factsheets/treefruit/pests/am/am.pdf](http://nysipm.cornell.edu/factsheets/treefruit/pests/am/am.pdf)

Obliquebanded Leafroller: [nysipm.cornell.edu/factsheets/treefruit/pests/obl/obl.pdf](http://nysipm.cornell.edu/factsheets/treefruit/pests/obl/obl.pdf)

# Apple IPM for Beginners



Cornell University  
Cooperative Extension

## Aphids and Leafhoppers

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Lake Ontario Fruit Program  
Peter Jentsch, Cornell University, Hudson Valley Lab

### Time of Concern

Petal fall through Summer



*petal fall*

### Damage



*Figure 1. Rosy apple aphids on apple shoot. Reprinted with permission from Rosy Apple Aphid, 1980, R. Weires and J. Leeper, © NYS IPM Program and Cornell University.*



*Figure 2. Pygmy fruit (right) from feeding on fruit buds. Reprinted with permission from Rosy Apple Aphid, 1980, R. Weires and J. Leeper, © NYS IPM Program and Cornell University.*

### Pest Cycle

Several types of aphids feed on apple trees including rosy apple aphids, green apple aphids, and woolly apple aphids. Rosy apple aphid and green aphid eggs overwinter in the cracks of tree bark, then hatch in the spring when there are actively growing buds and leaves to feed on with their sucking mouthparts.

Rosy apple aphids are purple (Figure 1) and feed mainly on flower clusters, resulting in pygmy fruit in a cluster (Figure 2).

Green aphids feed mainly on new leaves in spring and growing shoots during summer (Figure 3). Adult aphids produce live young (skipping the egg stage) ready to feed on plant juices. This feeding results in curling of leaves. Aphid excrement is sticky and referred to as honeydew. A fungus known as black sooty mold grows on the honeydew and results in a dirty appearance of the fruit as well as reduced photosynthesis in the leaves.

Woolly apple aphids (WAA) are dark purple under a protective covering of a white fuzzy mass. These aphids also promote sooty mold growth that will deform the shoots. Woolly apple aphids are more of an induced pest because insecticides kill their predators.

There are some predators commonly found among the aphid colonies and if left unsprayed with insecticides, can sometimes clean up the aphid colony. The common aphid predators include green lacewing larvae, and hover fly larvae shown in Figures 4 and 5.

Three types of leafhoppers are also common pests on apples leaves: white apple leafhopper, rose leafhopper, and potato leafhopper. White apple and rose leafhoppers overwinter as eggs, then hatch in the spring as immature nymphs to feed on the undersides of leaves. The result is a stippled appearance on the upper leaf surface. Potato leafhoppers do not overwinter in apples,



## Damage, continued



Figure 3. Green apple aphids clustered on growing apple shoot. Photo: E. Tee.



Figure 4. Green lacewings (resemble miniature alligators) feed on aphids and mites.



Figure 5. Hover fly larvae feed on aphids. Photo: E. Tee.



Figure 6. Potato leafhopper nymph walks sideways.

but are brought in by the jetstream from warmer states. Potato leafhoppers can be distinguished from other leafhoppers by their sideways motion, not back-and-forth (Figure 6). Adults and nymphs feed on leaves and inject a toxin causing the leaf edge to curl downward and turn yellow (Figure 7). Potato leafhoppers can cause enough damage to stunt growth in young trees.

It is worth noting that both aphids and leafhoppers build up populations quickly during hot, dry weather.

## IPM Steps for Beginners

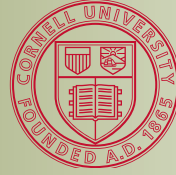
1. Young and dwarf trees are particularly susceptible to aphid and leafhopper damage. Starting in early June, scout trees every week, carefully looking at new shoots, and the underside of leaves. Larger trees may not need any treatment.
2. For leafhoppers, spray if you start seeing potato leafhopper nymphs in young trees —don't wait for it to be severe.
3. For aphids, randomly look at 50 rapidly growing shoots throughout the orchard. If 15-20 are infested with aphids, treat. OR, if 25 are infested, but at least 10 have predator insects working, don't treat.

Carbaryl is effective for control of some aphids and leafhoppers but only as long as the insecticide is present. Carbaryl (Sevin) will also kill beneficial insects. The use of systemic insecticides (imidacloprid) will protect the leaves from reestablishing aphid and leafhopper populations. Trees may need treatment on a 10-14 day schedule if, based on scouting results, potato leafhoppers continue to arrive. For other products, see the most recent version of the *Cornell Fruit Guidelines*.



Figure 7. Potato leafhopper feeding turns leaf edges yellow and curled, stunting the shoots.





## Mites

Authors:  
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Molly Shaw, Tioga County Cornell Cooperative Extension

### Time of Concern

Half-inch green through August



half-inch green

### Damage



Figure 5. Leaf bronzing is shown on the leaves on the left, and healthy leaves are on the right.

### Pest Cycle

European red mites (ERM) overwinter as red eggs around growth rings on bud spurs (Fig. 1). Eggs hatch in spring, starting at tight cluster. Figures 2 and 3 show the different appearance of female and male European red mites.

Two-spotted spider mite adults (Fig. 4) or nymphs overwinter under bark scales and on weeds under trees. When foliage under trees is no longer a good food source, they move into the trees and feed on apple leaves. Mites reproduce in multiple generations throughout the summer, building up to amazing levels during hot, dry weather. They feed on older leaves and continue to feed on newer leaves as they develop. Mite feeding results in bronze discoloration of leaves reducing leaf function (Fig. 5). This damage increases the potential fruit drop and can decrease flower bud set for the next year.



Figure 1. Red overwintering ERM eggs. Photo: J. Ogradnick, NYSAES Photo.



Figure 2. ERM female adult. Photo: J. Ogradnick, NYSAES Photo.



Figure 3. ERM male adult. Photo: J. Ogradnick, NYSAES Photo.



Figure 4. Two-spotted spider mite adults and eggs. Photo: J. Ogradnick, NYSAES Photo.



## IPM Steps for Beginners

One control option for ERM is to use a dormant oil spray early while the trees are still dormant or up to the time when buds are at tight cluster. Dormant oil spray smothers ERM eggs on the bark and helps to prevent early build-up of mites in the orchard, but generally does not harm beneficial insects. Some tree varieties are particularly susceptible to mite damage (Red and Golden Delicious, Braeburn, Northern Spys, and Romes). Examine leaves for mites starting in June, especially if weather is hot and dry.

### Precautions for using oil: ⚠️

1. Avoid freezing temperatures within 2 days before or after the oil application.
2. Do not spray captan or sulfur within 10 days before or after an oil application—it can burn the leaves and fruitlets.
3. Oil applied pre-bloom may not provide full season mite control. Other options include several miticides that can be applied to kill eggs at pink, or applied when scouting has reached treatment threshold.
4. Horticultural oil or Stylet oil (mineral oil) can be used during the summer growing season at a 1% solution mixed with water but only if the fungicides used for disease management do not include captan or sulfur.
5. If using mancozeb (up to 77 days before harvest) in combination with alternative fungicides listed for scab and mildew, this low rate of oil applied on a 2-week interval can be effective. Refer to the *Cornell Tree Fruit Guidelines* for options or *Choosing Sprays* to kill mites.

**To be effective, miticides require good spray coverage of leaves during the growing season to thoroughly contact the mites.**

## Ready for More Precision?

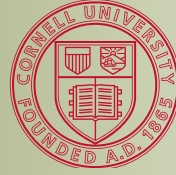
Scout for mites using a 3X optivisor or 10X hand lens. Pick middle-aged spur leaves around the fruit cluster; 4 leaves per tree for 15 trees. Examine the upper and lower surfaces of the leaves for live mites and count infested leaves, not mites. If less than 15 of 60 leaves are infested, no action is needed in June, but if more than 15 and less than 28, sample again in 1-2 weeks. If more than 41 infested leaves, treat! As vegetative shoots develop, switch to middle-aged leaves from shoots. In July, if less than 24 of 60 leaves have mites, scout again in 2 weeks; but if 51 of 60 leaves have mites, treat. If the number of infested leaves is between this range, sample again in a week. In August, if less than 31 of 60 leaves are infested, scout again in 2 weeks; if more than 56 of 60 leaves are infested, treat. Numbers between that range indicate the need to scout again in a week. Miticides are not typically needed after August 15.

See the *Cornell Tree Fruit Guidelines* sampling procedures in Insect and Mite Management, Chapter 7.

In advanced IPM programs, you can identify any predator mites present that will help control the pest mites. They can be easily seen with 3X or 10X lenses, but they move much faster than pest mites. Low numbers will do a very effective job of controlling pest mites. Predator mites are shown in Figure 6. If feeding on red mites, they will have reddish streaks running through them. Growers can establish predator mites by releasing them during bloom. They can be purchased from a supplier of biological control products. One source in New York is IPM Laboratories, Inc., [ipmlabs.com](http://ipmlabs.com).



Figure 6. Predator mites feeding on red mites. Photo: J. Ogrodnick, NYSAES Photo.



## Trunk Borers

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### Time of Concern

Pink bud through August



Pink



Figure 1. Dogwood borer, larva. Reprinted with permission from Dogwood Borer, 1985, A. Seaman, H. Riedl, and J. Cummins, © NYS IPM Program and Cornell University.



Figure 2. American plum borer. Left, larva; right, adult moth. Photos reprinted with permission from American Plum Borer, 1997, D. Kain and A. Agnello, © NYS IPM Program and Cornell Univ.



Figure 3. Flatheaded appletree borer. Left, larva; right, adult beetle. Photos reprinted with permission from Apple-boring Beetles, 1999, A. Agnello, © NYS IPM Program and Cornell Univ.

### Pest Cycle

Four types of borer insects are commonly found in apple trees, especially in “low spray” situations: dogwood borer (Figure 1), American plum borer (Figure 2), flatheaded appletree borer (Figure 3), and roundheaded appletree borer (Figure 4). American plum borers are not usually a problem unless apples are planted next to neglected stone fruit orchards. Flatheaded and roundheaded appletree borers are usually problems in “low spray” orchards.

Adults of these species lay eggs on trunks early in the summer. Borers (moth larvae or beetle larvae) that emerge from these eggs enter trunks, roots, or branches especially in low-spray or unsprayed orchards. These larvae (depending on the species) spend as little as 1 year or as long as 3 years tunneling just under the bark, in the cambium, before they emerge as adults. Tunneling in trunks, rootstocks and branches can result in girdling, which can lead to death of the tree. One sign of infestation by dogwood and American plum borer is the reddish “sawdust” (which is insect excrement, or frass) coming out of the rootstock and burr knots (Figure 6).

Leopard moth larvae are yellow with black spots while the adult moth is white with black spots (Figure 5). Leopard moth larvae can also kill the shoots and the main trunk high in the tree. This is a moth that will use many tree species to raise their larvae. The eggs hatch and float to younger apple trees on the edge of the woods where they bore into a young stem at the leaf axil. The larvae will move from stem to stem, hollowing out the pith of the shoot, killing the shoot (Figure 7). They grow to 2” in length in 2 years, then pupate, and emerge as adult moths to repeat the cycle. There is only 1 generation per year.





Figure 4. Roundheaded appletree borer. Left, larva; right, adult beetle. Photos reprinted with permission from Apple-boring Beetles, 1999, A. Agnello, © NYS IPM Program and Cornell Univ.



Figure 5. Leopard moth. Left, larva; right, adult moth. Photo: J. Pedro Mansilla Vazquez, EIFC.

## Damage



Figure 6. Borer frass on trunk – reddish sawdust around holes in trunk.



Figure 7. Leopard moth damage.



Figure 8. Burr knot. Photo: S. Hoying, Cornell University.

## IPM Steps for Beginners

1. Rootstocks with lots of burr knots (Figure 8) are attractive to borers—keep trunks in full sun and weed-free to decrease burrknot growth.
2. Paint the trunks below the scaffold branches with latex paint (diluted 50% with water) to reduce winter injury bark cracking.
3. DO NOT use trunk wraps that cling to the trees (Figure 9). They provide attractive egg-laying territory for female borers. This is contrary to many older fact sheets!

## Ready for More Precision?

Install mating disruption pheromones for dogwood borer in orchards larger than 5 acres. Pheromones can be used to confuse mating of dogwood borer in apples, as well as reducing lesser peachtree borers in peaches.

A coarse trunk spray of chlorpyrifos between  $\frac{1}{2}$  inch green and petal fall is an option. Note: only 1 spray of chlorpyrifos is allowed per year. Assail can be used between pink bud and mid-June. Refer to the most current version of *Cornell Tree Fruit Guidelines*.



Figure 9. Trunk wrap.





# Glossary

**Bactericide:** a substance used to kill bacteria, can be a disinfectant, or antibiotic. Used to kill or stop reproduction (bacteristat) of bacteria to prevent infection such as fire blight in apples.

**Diapause:** a period during which growth or development of insects is suspended and physiological activity is diminished, typically to survive the winter.

**Frass:** excrement produced by insects from digested plant parts.

**Fungicide:** substance used to control fungi, by either protecting uninfected plants with a barrier (protectant fungicide) or eradicating the infection (systemic fungicide).

**Herbicide:** a substance/chemical applied to kill nuisance or weed plants around crops. Different types of herbicides are contact (burns plants on contact), systemic (absorbed by plant and disrupts plant functions to kill plant), selective (only targets certain types of plants or weeds), and nonselective (herbicide that will injure any plant or weed it contacts).

**Inoculate:** to introduce a microorganism or virus into/onto a plant or animal.

**Inoculum:** the population of microorganisms introduced in an inoculation; fungal spores, bacteria, or virus particles which serve as a source to initiate infection and disease.

**Insecticide:** substance used to kill or repel insects.

**Miticide:** substance used to kill mites or ticks.

**Overwinter:** how an insect or a disease organism survives the winter season; insects often overwinter in silken cocoons under tree bark, beneath fallen leaves, plant matter on the ground, or other places as adults, pupae, or eggs.

**Pathogen:** a disease causing organism or agent such as fungus, bacteria, or virus.

**Pest:** any living thing that has an undesirable impact on something that is important to us.

**Pesticide:** any substance used to repel or kill pests or to prevent or reduce the damage pests cause.

**Pheromone:** chemical signals between insects; in the case of pheromone lures a female sex pheromone is injected into a time release lure to attract males of the same species.

**Phytotoxicity:** poisoning of a plant through absorption, often resulting in visible damage to leaves, fruit, or bark. Plant injury can occur when chemicals are properly applied directly to the plant during adverse environmental conditions; a material is applied improperly; a spray, dust, or vapor drifts from the target crop to a sensitive crop; incompatible chemical mix; or persistent residues accumulate in the soil or on the plant.

**Spores:** a tiny, often one-celled, reproductive unit capable of giving rise to a new individual produced by plants, fungi, and some bacterial microorganisms.

**Tanglefoot:** a sticky, tacky substance used in insect traps to immobilize insects that land on it, often used in traps in combination with pheromone lures to monitor pest populations such as codling moth in apple orchard.

**Thinning Fruit:** reduction of fruit numbers on a branch and/or in a fruit cluster, using chemicals or by hand to reduce competition between fruit to get the best size and quality.