Hop Pest Management
What’s bugging your bines?

Melanie Filotas
Specialty Crops IPM Specialist
OMAFRA
Challenges for hops growers

• Lots of things like to live on hops
• Not all of them are a problem
• Not all problems show up every year
• Symptoms can be similar. Just because a leaf is yellow doesn’t mean it’s downy mildew!
• Some are beneficial
Beware the show off

The grower noticed this…

But when we looked closely, we also saw…

this… and this… and this… and this… and this…

and all of these…
What is scouting?

- Critical to successful IPM
- More than just “keeping an eye out” while doing other activities
- Routine, systematic inspection of a crop for insects, diseases and weeds
Thresholds

- A determination of how much is too much
- **Economic Injury Level (EIL)** = the pest density at which the cost of management tactics is equal to the value of the loss in yield
- **Economic/Action Threshold** = the pest density at which control efforts are triggered to prevent pest populations from reaching the EIL

Scientific thresholds for hops pests, particularly in northeastern North America, are limited to nonexistent.
Timing “Windows”

- Crops have “windows of vulnerability” to pests
- Pests also have “treatment windows” – times when they are at a life stage that is vulnerable to control measures, or when they have reached damaging levels

A pest is a “problem” when it is present in sufficient numbers at a time when the plant is vulnerable to attack
Monitoring - Useful tools

• A 16-20X hand lens
• Shovel/trowel
• Pocket knife
• Bags (plastic and paper) and vials
• Flagging tape
• Maps, scouting forms, etc
• Pie plate/tapping tray/tarp
• Pole pruner or ladder
Monitoring – Strategies

- Monitor at least 1X/week
- Same time each day, but note that some insects are only active at night
- Keep light behind you when you scout
- Use historical data to identify hot spots
- Be aware of pest biology and environmental conditions to know when certain pests will be active
- Keep track of new versus old damage.
Monitoring – Procedures

• First scan to look for patterns (patches of poor growth, off colour)
• Visit hot spots, previously flagged sites but also visit predetermined, randomly-selected plants
• Travel a “W”-shaped path covering the entire field, checking a minimum of 5-10 plants per “leg” of the “W”, examining stems, leaves, flowers and cones at all levels
• Grapes: walk two rows (both sides) of each variety and look at 100 plants for pests and damage
• Get close and examine tops and undersides of high and low leaves, cones, etc.
• Don’t forget that some pest problems involve the roots
• Scout border areas
• Flag problem areas
Monitoring – Techniques

- **Visual Assessment** – closely monitor leaves, stems, bines, burrs, cones, etc. for signs of insects, diseases or damage.
- **Tapping** – shake stems/bines onto a pie plate (young plants) or tarp (large plants) to dislodge insects.
- **Sampling** – from representative areas in the field. Collect leaves or other plant parts, looking away as you sample to avoid bias. Place in bags and keep cool.
- **Traps** – placed at edge of field, checked weekly, replaced as needed.
Record keeping

- Allows you to track pests over time and evaluate management strategies

- Allows you to identify hot spots in your field

- Field maps – include varieties, age of planting, surrounding vegetation and features

- Scouting forms, record sheets, field notebook
Record keeping

• Things to record (each time):
  – crop growth stage
  – disease severity
  – populations levels of insect pests
  – damage and where observed
  – presence of beneficial insects
  – rainfall amounts, temperature highs/lows, weather events
  – pest control measures used
<table>
<thead>
<tr>
<th>Date</th>
<th>Block</th>
<th>Tentiform leafminer</th>
<th>Mites (European red mite and Two spotted spider mite)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>eggs</td>
<td>sapfeeders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tissue feeders</td>
<td>pupae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>parasitism</td>
<td>egg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>nymph</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>adults</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Block</th>
<th>OFM</th>
<th>CM</th>
<th>DWB</th>
<th>TLM</th>
<th>OBLR</th>
<th>AM</th>
<th>EAS</th>
</tr>
</thead>
</table>
Field Maps

Date

Orchard Development

Weather

Traps

Block #1

Block #2

Hwy 2

Orchard St.
Tools

Remember that major hops growing regions in the US, which have different production practices, pest complexes and environmental conditions – information from these areas is still useful, but not always totally applicable.

Numerous websites, forums, vendors, etc.
Natural Enemies - Know who your friends are!

Very active in Ontario hops yards.
Friend versus Foe

**Predator**

*Amblysieus fallacis*

- Feeds on spider mites
- Faster moving

**Pest**

Two-spotted spider mite

- Feeds on plants
- Slower moving, webbing
2010-present

Survey the major pests of Ontario hop yards through:

• Grower inquiries/submissions
• Site visits
• OMAFRA/University of Guelph summer student project
## Results to Date – Ontario versus US West coast INSECTS

<table>
<thead>
<tr>
<th>Pest</th>
<th>Ontario</th>
<th>Oregon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-spotted spider mite</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hop aphid</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hop looper</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Slugs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Garden Symphylan</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Prionus beetle</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Bertha armyworm</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Japanese beetle/Rose chafer</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Question mark caterpillar</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Earwigs</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Cutworms</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Leafhoppers</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
## Survey results – Ontario versus US West coast DISEASES

<table>
<thead>
<tr>
<th>Pest</th>
<th>Ontario</th>
<th>Oregon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downy Mildew</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Virus/Viroid Complex</td>
<td>(Yes)</td>
<td>Yes</td>
</tr>
<tr>
<td>Alternaria Cone Disorder</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fusarium canker/blight</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Verticillium wilt</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Red Crown Rot</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Black Root Rot</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Phoma blight</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Downy mildew
*Pseudoperonospora humuli*

- Fungus-like organism, specific to hops

**When to look:**
- Year-round (overwinters in rhizomes) but symptoms will be most evident under wet conditions, mild to warm temperatures and prolonged leaf wetness

**What to look for:**
- Roots and crowns with reddish brown streaks when cut, crowns may rot
- Stunted, brittle “basal spikes” and “aerial spikes”
- Infected bines falling from string
- Angular yellow or brown lesions between leaf veins with sporulation on leaf undersurface
- Brown, shrivelled burrs and cones. Sproluation may or may not be present under bracts
Downy mildew

- Basal spikes (systematically infected shoots)
- Discoloration of bracts
- Stunting, yellowing, downcurled leaves
**Management:**

- Disease-free rootstock
- Use tolerant varieties (e.g. Perle, Magnum, Fuggle, Willamette)
- Thorough, early pruning
- Manage canopy to reduce leaf wetness (removal of basal growth, appropriate irrigation management, control weeds, etc.)
- Timely application of fungicides when environmental conditions are favourable

**Thresholds:**

- Predictive/degree day models in western US, none for northeast. Most control measures are preventative.
Powdery mildew
Podosphaera macularis

• Fungus – specific to hops

When to look:

• Year round, but infection favoured by rapid plant growth, mild temperatures, high humidity and cloudy weather. Especially periods with small differences between night and day temperatures (night >10°C and daily high around 20°C)

What to look for:

• Initially, pale spots on leaf, then powdery fungal colonies on leaves, buds, stems and cones
• Abortion or distortion of developing cones
• Burrs and young cones become white and powdery, then develop brown necrotic spots
• Cone tissues may turn reddish brown or have an altered aroma. Hops may seem to dry down too early.
Powdery mildew

Thresholds:
• None

Management:
• Use tolerant varieties (e.g. Nugget, Fuggle, Cascade)
• Thorough, early pruning
• Manage canopy to reduce leaf humidity and increase light (removal of basal growth later in season, plant spacing etc.)
• Avoid excessive nitrogen fertility
• Timely application of fungicides
• Harvest early if severe
Two-spotted Spider Mite
*Tetranychus urticae*

- Very small animals related to spiders/ticks

**What to look for:**
- Stippling and bronzing of leaves and cones
- Webbing, mites and eggs on leaf underside
- Sample leaves at 3-6 ft level until mid June, then near trellis wires

**Thresholds:**
- Pacific NW – treatment at 1-2 mites/leaf in June/July and 5-10 mites/leaf after mid-July
Two-spotted Spider Mite

Management:

• Nitrogen adequate but not excessive
• Conserve natural enemies
• Minimize dust in hop yards
• Release of predatory mites? May not be economical
• Miticides
• Pear-shaped, soft bodied “tailpipes”

**What to look for:**

• Leaf curling, wilting, cones may become limp and brown
• Black sooty mold
• Aphid colonies on leaf undersides and young tissue

**Thresholds:**

• Pacific NW – treatment at 5-10 aphids/leaf before flowering, 0 aphids after flowering
Management

- Nitrogen adequate but not excessive
- Conserve natural enemies
- Insecticide applications before pest populations become too large
Potato leafhopper
Empoasca fabae

• Small, winged sucking insect

What to look for:
• Initial leaf yellowing followed by curling and necrosis
• “Hopper burn” – outer edges of leaf turn brown, leaving a V-shaped necrotic section
• Small, pale green, rapidly-moving insect on leaf underside

Thresholds:
• Vermont – average of 2 or more/leaf after sampling at least 30 leaves
Management:

- No registered insecticides in Canada. Unknown effect of insecticides registered on other pests
- Release/conserve natural enemies
- Avoid locating yards near alfalfa fields
Expect the unexpected

Phoma blight
The Dish on Defoliators
Earwigs and Cutworms

Eastern Comma (aka “Hop Merchant”)/ Question Mark
Caterpillar Defoliators

Hop looper
Tussock moth
Hop merchant
Cutworm
Zebra Caterpillar
More Caterpillar Defoliators

Many unknown species
Beetle Defoliators

Japanese Beetle

Rose Chafer
Other Defoliators

Earwigs

Slugs

Grasshoppers
Abiotic Disorders

- Not caused by a living organism
- Water issues
- Nutrient deficiencies, pH issues
- Excess light, air pollution, hail
- Pesticide injury
- Etc.
Calcium deficiency

Magnesium deficiency

Nitrogen deficiency

Herbicide injury
**Biotic Injury**

- Look for other evidence (insects, spores, etc.)
- Will often spread within or between plants
- May be host specific

**Abiotic Injury**

- No other evidence on plant
- Does not typically spread
- May affect numerous hosts
- Look for history (recent rain, air pollution events, fertilization records, etc)
Identifying pests when you are new to a crop, or when the pest is unusual, can be very difficult, but...

Accurate identification is the key to successful pest management!
Different pests can have similar symptoms.

Similar symptoms, different management decisions.
Be cautious with “Google diagnosis”

- Information based on pests from different climates, geographic areas
- Different management regimes
- Sometimes a photo alone is not enough.

Great starting point, but not always sufficient.
When in doubt – submit samples to a diagnostic lab!
Submitting insect samples:

- Soft-bodied insects in alcohol
- As many as possible
- Whole, intact insects – antennae, legs, wings are often necessary for ID
- Adults are preferable
- Place in a cushioned, crush-proof container, kill by freezing
Submitting disease samples:

• Freshly infected – not dead material

• As much material as possible and practical (ie a few leaves, a shoot, rather than one leaf, etc.)

• Keep cool until shipping

• If dry, place in a plastic bag with a dry paper towel. If wet, place in a paper bag then a plastic bag

• Courier overnight. Preferably at beginning of week.
Sending photos:

• As clear and high resolution as possible
• Different views: field (pattern), plant, leaf, close up of symptoms
• Insects – ideally clear close ups of diagnostic features like wings, antennae, patterns, etc.
Further information...