Aster Leafhoppers in Carrots, Lettuce and Celery
Jennifer Allen - Vegetable Crop Specialist

The aster leafhopper, a pest of carrots, celery and lettuce in Ontario, transmits aster yellows disease. In Ontario, aster leafhoppers overwinter as eggs, hatch in early May and become adults mid-to-late May. Depending on the season there are three to five generations per year. In addition to an overwintering population, Ontario fields may be inhabited by migrant aster leafhoppers from the southern U.S.

Aster yellows symptoms in lettuce and celery plants first appear in the center leaves resulting in chlorosis and abnormal growth. In carrots, symptoms begin as a yellowing and twisting of foliage followed by ‘hairy’ carrots whereby root hairs develop resulting in bitter tasting, unmarketable carrots. Symptoms are usually most severe in July and August.

Aster leafhoppers can be monitored using either sweep nets or sticky traps.

**Sweep Nets**
Recommendations for sweep netting include making 20 sweeps in 5 locations per field. Record the number of aster leafhoppers per 100 sweeps. Using these numbers an aster yellow index (AYI) can be determined. The AYI is calculated by multiplying the number of leafhoppers collected per 100 sweeps by the infectivity level. The infectivity level can be determined by testing local leafhoppers or by tracking infectivity of populations in the U.S. Based on data from Michigan an initial infectivity rating of 3.5% is advised.

When the following AYIs are reached treatment is required:

<table>
<thead>
<tr>
<th>Crop</th>
<th>AYI</th>
<th># leafhoppers/100 sweeps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots*</td>
<td>70 - 75</td>
<td>20 – 21</td>
</tr>
<tr>
<td>Romaine lettuce and Celery</td>
<td>30 – 35</td>
<td>9 -10</td>
</tr>
<tr>
<td>Head and Leaf Lettuce</td>
<td>20 – 25</td>
<td>6 -7</td>
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* Some carrot varieties have a higher tolerance to aster yellows than others. An AYI of 70 - 75 is a general guideline. Contact me to find out if your varieties are resistant, intermediate or more susceptible to aster yellows.

**Sticky Traps**
Orange-yellow traps, similar to those used to monitor carrot rust fly can also be used to monitor aster leafhoppers.
Install five traps in fields less than or equal to 4 ha (10 acres) or install 10 traps in fields greater than 4 ha (10 acres). Traps should be monitored every one to two days to detect population changes. If more than 20 aster leafhoppers are detected on one or more traps, control tactics are required.

See OMAF publication #363, Vegetable Production Recommendations for aster leafhopper control recommendations.

For more information, refer to OMAF Factsheet 98-057 available online at: http://www.gov.on.ca/OMAF/english/crops/facts/98-057.htm
Looking back into past issues of *Hort Matters* and other OMAF newsletters, it would seem that we’ve published a number of articles that fall into the “When Good Bugs Go Bad” category. It would be nice if there were just good guys and bad guys and the good guys were always good. Nature has not provided us with such a luxury. Under certain environmental conditions, even beneficial insects (and their relatives) can seemingly turn against you. In the last couple of weeks, we’ve seen damage to several crops in Ontario caused by … millipedes!

Before we go any further, it is important to distinguish between millipedes and other inhabitants of the soil frequently encountered during scouting activities. Millipedes are sometimes confused with wireworms (larvae of click beetles - truly “bad guys” from an agricultural standpoint), as well as centipedes and symphylans. Millipedes are typically dark in colour (brown or grey-black) and have hard, cylindrical many-segmented bodies. The number of body segments increases with age and varies by species. Each body segment has 2 pairs of legs (Figures 1 and 2), except for the first three segments behind the head, which have a single pair each. “Millipedes” translates roughly to “thousands of feet” or “thousand leggers”; while this isn’t entirely accurate, they do indeed have many legs. When disturbed, millipedes will curl up tightly (note that dead ones are particularly foul-smelling). In contrast, wireworms have three well-defined body sections (head thorax abdomen) and three pairs of true legs on the thorax. Both wireworms and millipedes may require several years to complete their development. If you need some assistance in identifying these, a useful link can be found at [http://www.gov.on.ca/OMAF/english/crops/facts/livingsoil2.htm](http://www.gov.on.ca/OMAF/english/crops/facts/livingsoil2.htm).

Millipedes are important scavengers, feeding on decaying organic matter and mixing it through the soil. In other words, millipedes are normally considered beneficial. Unfortunately, under some circumstances they can cause crop damage. Millipedes have high moisture requirements and thrive in damp, dark places, particularly those with protected areas and crop residues or heavy mulch. Last fall’s wet soils and this spring’s prolonged cool wet soil have led in some cases to a population explosion of millipedes. Under high population pressure, millipedes will eat emerging and young plants. In this article we use ginseng as an example, but other crops may also be at risk. When wet conditions persist and millipede populations are high enough, they can eat new shoots and roots as the seed germinates (Figure 3). In the case of ginseng, where the hard-coated seed cracks just before germination, the seed pulp may also be eaten away (Figure 4). Plants that make it to the soil surface and begin to extend above the straw may be chewed off where they break through the soil (Figure 5). Clearly, this is another case of *when good bugs go bad*!

So what can you do at this point? Not much. Soil insecticides do not provide good control of millipedes. The good news is that millipedes are extremely sensitive to soil moisture levels. As soils warm up and dry out, millipede populations may return to normal. Don’t let this transgression sour you on millipedes as beneficials. They play an important role in breaking down organic material and improving soil structure.
Spray drift is always a risk when spraying in the dynamic environment that we know as agricultural production outdoors. Wind, air temperature, soil temperature, relative humidity, water volume, nozzle type, nozzle size and operating pressure all influence the drift potential of your spray task. Even minute amounts of spray drift can seriously impact vineyards, orchards, nurseries and other multi-year crops. In some cases the drift damage may not kill the crop but adversely affect productivity for many years. If you don’t do everything within your power to avoid spray drift in these situations – it will cost you.

Two Types of Drift
There are two basic types of spray drift, namely particle drift and vapour drift. Particle drift is the movement of small droplets by wind or air currents to off-target locations. What we generally refer to as spray drift is actually particle drift. The potential for particle drift can be reduced by:

- Proper nozzle selection
- Producing larger spray droplets
- Using higher water volumes
- Minimizing nozzle-to-target distances
- Avoiding windy conditions
- Avoiding dead calm conditions
- Understanding spray droplet movement
- Reading the label
- Communicating with all parties involved

Every time you turn on your sprayer there is the potential for particle drift to occur. Particle drift can occur with all pesticides.

Vapour drift occurs when a product volatilizes or evaporates into the air. These vapours are carried downwind and could affect adjacent crops. Vapour drift is product specific. Certain products are known to volatilize in higher temperatures and cause damage. The volatilization of product could occur hours or days after the spray event. Before spraying, study the long term forecast to see what conditions are anticipated. See if these predicted weather conditions are suitable as post spray conditions on the product label. Your only methods of minimizing the potential for vapour drift are:

- Careful product selection, possibly switching to less risky herbicides
- Follow label directions completely to avoid problems
- Do not use volatile products
- Avoid spraying in hot, humid weather

Products known to have vapour movement include turf and lawn care herbicides, including 2,4-D and Banvel (dicamba)

Avoiding the Risk
Remember that grapes, orchards, and nursery stock are multi-year crops. Injuries caused by spray drift may inflict long term injury or adversely stress the plants affecting their health. This can lead to reduction in yield over longer periods of time. Experience has shown us that spray drift is not just a problem next door but may be separated by fields or farms. Drift can be deflected up and over by things such as topographic features, wind breaks and shelterbelts or other large man-made structures. In humid, cool and calm or near calm conditions, spray drift can flow downhill much like water. Spray droplets or product vapours carried in the air go where the air goes. Spray drift incidents are most often caused by particle drift and to a lesser degree vapour drift.
Spraying in the vicinity of multi-year crops requires special care. Avoiding the use of certain what we will refer to as nasty products means that the potential damage that might result from possible spray drift is significantly reduced. Some multi-year crops are ultra sensitive to glyphosate or 2,4-D based products. Product formulation may reduce the risk of volatization, eg. amine formulations of 2,4-D are less volatile than esters. The label will have cautionary application statements that should be followed. Look for restrictions on ambient air temperatures when spraying should be avoided. Contact the company representative to see what injury problems might be expected should drift occur onto a sensitive crop. It’s worth your time to do a bit of homework to prevent drift before you spray rather than trying to figure out what happened after a drift incident.

**Drift Investigations**

In an effort to arrive at what or who injured an adjacent crop, the Ontario Ministry of the Environment can and may use tissue analysis as part of their investigation. The leaves of the injured crop are analyzed as well as the dead weeds of the suspect offending party. If the same product is detected in both samples and weather records point to your spray event, you might have some explaining to do. This is where your spray records really come into play. You may be asked to justify every decision you made regarding a particular spray event.

**Next Steps**

If you spray in the vicinity of grapes, orchards and nursery stock you need to look at all aspects of your spray program to see where you are vulnerable to causing drift damage. A lot has been written about ways to reduce off-target drift. Nozzle technology has been constantly improving to deliver sprays with significantly less drift potential. Don’t assume however, that drift reducing nozzles eliminate drift completely. The statement that the potential for drift exists every time you turn on the sprayer still holds.

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**Monitoring Soil Moisture**

*Anne Verhallen, Soil Management Specialist (Horticulture); Pan Fisher, Berry Crop Specialist; Rebecca Shortt, Irrigation Engineer*

The ongoing dry spell for some and spotty rains for others has had irrigation going full blast and rightly so! It is easy to get caught by drier than expected soil especially early in the spring/summer. Irrigation scheduling or monitoring soil moisture will give you a “heads up” before lack of soil moisture affects the crop.

**Why monitor soil moisture:** Although the rule of thumb is "an inch of water/week" for horticultural crops, the exact amount of water to apply to a crop depends on how much the crop needs and how much water the soil can store.

The crop water needs depend on the Evapotranspiration (ET) which is affected by:

- Temperature & Humidity
- Solar radiation
- Crop growth stage
- Presence of Mulch

The amount of water that the soil can store (available to the plant) depends on:

- Soil texture
- % Organic Matter
- Rooting depth

Use of water and nutrients is most efficient when water is applied in amounts needed by the crop and that the soil can store - not more, not less.

**Understanding soil moisture levels and crop response: Definitions**

- **Field capacity:** As much water as the soil can hold. (More accurately, it is the amount of water held in the soil two or three days after it has been saturated by rainfall. There is very little downward movement of soil water due to gravity and very little suction due to capillary action.)

- **Permanent Wilting Point:** The amount of water remaining in the soil when the plant wilts in a humid atmosphere. The water remaining in the soil is held tightly by soil particles and plant roots cannot absorb it.

- **Available water:** This is the amount of water in the soil between field capacity and permanent wilting point. Start irrigation before soil reaches 50% of available soil water.
Availability of soil water:

### Equipment to help you get a handle on soil moisture levels:

**Tensiometer (e.g. Irrometer)**

The tensiometer reads the soil water tension or suction, in centibars. The higher the tension, the dryer the soil. The tensiometer is made of a closed plastic tube with a ceramic tip attached to one end, and a vacuum gauge with an air tight seal at the other end. The tube is filled with water and sealed. When the ceramic tip comes to equilibrium with the surrounding soil the gauge registers the soil water tension.

Tensiometers must be installed carefully to ensure that the ceramic tip is in contact with the soil. Use a soil sampling tube to drill a hole to the proper depth. Fill the soil with a slurry of soil and water. Push the tensiometer into the hole until it reaches the bottom.

**Reading the tensiometer gauge:**

<table>
<thead>
<tr>
<th>Gauge reading in centibars</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Soil is saturated</td>
</tr>
<tr>
<td>5-10</td>
<td>Field capacity for coarse textured soils</td>
</tr>
<tr>
<td>10-15</td>
<td>Field capacity for fine textured soils</td>
</tr>
<tr>
<td>75</td>
<td>Upper limit on gauge: 80% of water depleted in coarse textured soils, or 25% depletion in fine textured soils</td>
</tr>
</tbody>
</table>

Routine maintenance is important. The liquid in the tube must be refilled and air bubbles removed with a hand pump. It can take a year or two of experience to gain confidence in the readings.

**Electrical Resistance Blocks (trade names include Watermark):**

These units measure soil water tension in centibars, similar to tensiometer readings. Watermark is one trade name for electrical resistance blocks. The Watermarks measure the electrical resistance to current flow between electrodes embedded in a material resembling fine sand surrounded by a synthetic porous material.
Watermarks and other electrical resistance blocks must be installed carefully to ensure that the blocks are in contact with the soil. Use a soil sampling tube to drill a hole to the proper depth. Fill the soil with a slurry of soil and water. Push the block into the hole until it reaches the bottom, leaving the attached wires above the soil surface. Replace the soil above the block, and firmly pat it into place. Flag each Watermark for easy access. A hand-held digital reader is attached to the wires to read the data.

The sensors can be installed in the soil, to any depth. They should be installed in groups of two. Because they require good contact with soil, they are not suited to gravelly, sandy or peat soils.

**Time Domain Reflectometry (TDR's):**

Time domain reflectometry is a relatively new way to measure soil moisture. Probes inserted into the soil measure the velocity of electromagnetic waves in the soil. These waves are slowed by soil moisture. The measurements are very accurate, and the equipment comes factory-calibrated.

The disadvantage to TDR technology is that complex electronics and expensive equipment are required. This is still a research tool, but is becoming more affordable.

*Figure 1*

**The Gro.Point™ Probe Figure 1:** The Gro.Point™ probe is a TDR based probe manufactured by Environmental Sensors Inc in Canada. Gro.Point™ probes are buried in the ground at the desired depths, and are easy to use and install. A display unit converts the sensor's output signal directly into a percentage volumetric moisture reading.

**FieldScout TDR 300 Figure 2:** This is a portable shaft mounted probe with a built in data logger that allows you to take multiple measurements anywhere in the field. The FieldScout will give almost instant readings.

**Capacitance based instruments:**

Until recently capacitance based technology was used primarily in research trials due to the expense. This technology provides repeatable and continuous readings. Per unit costs have come down in recent years and capacitance based probes are in use in a variety of large, intensive irrigation operations. Current capacitance probes are designed to be installed in a fixed location in the field for the entire season and are compatible with high levels of automation and/or telemetry. Siting of the probe is critical to ensure representative information for the field monitored.

**C-Probe, EnviroSmart, EasyAg, Profile Probe, etc.:** This probe is used by installing a waterproof access tube and inserting the probe into the tube. Numerous moisture sensing points may be fixed along the length of the probe to give readings at numerous depths specific to your crop roots.

For more information on monitoring soil moisture and using these types of instruments to make irrigation decisions see the Best Management Practices booklet Irrigation Management – available free in your local OMAF office or order a copy on-line through the OMAF website. http://www.gov.on.ca/OMAF/english/environment/irrigation/irrigation.htm