Cabbage and Onion Maggot Flies

Update 2012

Onion maggot (*Delia antiqua*) and cabbage maggot (*Delia radicum*) flies look nearly identical but are likely to be found only on or near their host crop. Cabbage root maggot attacks on all types of Brassica crops, while onion maggots are highly specific for the Allium family including onions, garlic, leeks, chives, and shallots. A good indicator of the start of cabbage root maggot flight is blooming of the common roadside weed, yellow rocket. This weed typically blossoms in late April or the first week of May in western Massachusetts. First generation eggs are reported to be laid when the common lilac is in full bloom (source: Univ of WI). Onion maggot emerges slight later, while seedcorn maggot is active earlier (see table below).

**Life cycle.** Onion and cabbage maggot flies spend the winter as small brown pupae in the soil. Adults emerge in spring and adults can travel up to a mile in search of host plants. Cabbage root maggot flies are rather delicate, hump-backed gray-brown flies, about 5-7 mm long. Onion maggot flies are very similar. Female flies seek out their host crop to lay eggs at the base of the stem. Cool, moist soil conditions favor survival of the eggs, and soil temperatures over 95 F kill them. When the soil temperatures in the upper ½ to 1 inch are high (>100 degrees F) that soil temperature itself then reduces maggot damage by killing eggs.

When eggs hatch, larvae feed on roots and can cause complete destruction of the root system. In crops such as broccoli or cauliflower the first sign of a problem is wilting of the plant on sunny days and yellowing or purpling of outer leaves. Later, plants collapse, wilt down, and die. If you pull one up you will see that the reason it is wilting is the roots are gone. You may find the legless white maggots feeding, or the small brown, oblong pupae. In Brassica root crops such as turnips, radishes and daikon, feeding tunnels made by maggots make the root unmarketable.

In onions, newly hatched larvae crawl behind the leaf sheath and enter the bulb, and feed on the roots, stem, and developing bulb. Feeding damage also encourages entry of soft rot pathogens.

**Avoiding damage by later planting.** The first flight and egg-laying period is generally most intense in the first half of May, depending on accumulated growing degree days – thus, it will vary with the season and location. After the first flight is over, and as soils heat up, fewer eggs are laid and those that are laid are less likely to survive. In the Connecticut Valley, we have observed in some years that Brassica transplants set out after May 15 did not suffer damaging infestations of cabbage maggots. In cooler areas of the state, scouting has sometimes found damaging levels into June. Each season will be different. It is impossible to name a consistent and reliable date after which it is safe to
plant onions or cole crops, but late May into June will likely be safer than the first half of May.

**Monitoring.** Flies are attracted to bright yellow colors. Yellow sticky cards (3X5 inches) are inexpensive and easy to use; you can purchase small wire stakes made for this purpose, or clip to a wooden stake. Place near the soil. Check and change traps twice weekly to record changes in fly activity. Leaving them for a whole week usually results in a card and flies covered with blown soil, and is a less accurate measure of flight activity (sources: Great Lakes IPM, Gemplers). Yellow pan traps filled with water and a drop of soap also work.

**Using Growing Degree Days.** The beginning and peak of each fly generation can be identified using degree day accumulations. Most growing degree day information for plants and insects is based on a base temperature of 50 F, but maggot flies are adapted to cooler temperatures, and are active at a lower base temperature of 40 F. Degree days are calculated on a daily basis by using the formula: 
\[
\frac{(\text{Max temp} - \text{Min temp})}{2} - \text{base temperature}. 
\]
The same formula is used for calculating degree days in Celsius. GDD are expressed in Fahrenheit (FGD) or Celsius (CGD). It is important to be consistent in the units used for temperature and degree day calculations. In Minnesota and Wisconsin, research has shown that peak emergence of the first three generations of seedcorn maggot fly occur when 200, 600 and 1000 Celsius degree days (equivalent to 360, 1,080, and 1,800 Fahrenheit degree days) have accumulated. To change Fahrenheit growing degree days to Celsius, multiply by 5/9.

Research at Cornell University by J. L. Jyoiti and A. M. Shelton has resulted in a model that describes what proportion of the overwintering fly population, on average, has emerged at certain cumulative GDD. The number that follows the (+/-) indicates how much the population tends to vary around that average. The following table indicates the cumulative GDD (in Celsius) initial, partial and complete overwintering generation.

**Growing Degree Day Cabbage Maggot Stages**
(Model by: J.L. Jyoiti and A.M. Shelton)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Accumulated Degree Days</th>
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<tbody>
<tr>
<td>1st Emergence</td>
<td>161 +/- 8.1</td>
</tr>
<tr>
<td>25 percent</td>
<td>204 +/- 2.8</td>
</tr>
<tr>
<td>50 percent</td>
<td>251 +/- 7.9</td>
</tr>
<tr>
<td>75 percent</td>
<td>304 +/- 36.6</td>
</tr>
<tr>
<td>95 percent</td>
<td>387 +/- 7.7</td>
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Comparison of first generation peak flight of key maggot fly pests using seasonal degree day accumulation.

Peak flight is when 50% of the population has emerged.
Based Temperature is 4 degrees C

<table>
<thead>
<tr>
<th>Generation</th>
<th>Seedcorn</th>
<th>Onion</th>
<th>Cabbage</th>
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<tr>
<td>1st Peak</td>
<td>200</td>
<td>250-300</td>
<td>250</td>
</tr>
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Monitoring cabbage for eggs. If you have transplants hardening off in a cold frame or outdoors, flies may find them and lay eggs in the flats. To check for eggs in the field or in flats, look for the 1/8-inch long, torpedo-shaped white eggs that are laid along the stem, or on the soil next to the stem of young transplants. Often eggs are laid in neat rows, or inserted into the soil. They may be under a small clod of dirt near the stem. A pencil point or knife helps stir the soil to look for them. A reliable field scouting method is to check 25 or more plants, in groups of 2-5 plants, scattered around the field. If you find an average of 1 egg/stem or more, it is likely to be a damaging population and a banded soil drench is recommended. Eggs may be more abundant in wetter areas of the field. Egg numbers may build up rapidly after the first eggs are seen.

Soil Drench. Target the seed furrow or the base of the plants after transplanting, and use at least 100 to 200 gallons of water per acre to help the insecticide penetrate to the root zone. Insecticide options are limited. Two organophosphate (Group B) insecticides, Chlorpyrifos (eg Lorsban 4E, 75 WG, or 15G) and diazinon (Diazinon AG500) labeled for control of cabbage maggot fly in Brassicas (check label for specific crops allowed and other restrictions). They can be used as soil drench direct seeded and transplanted crops, transplant drench for transplants. This material does not move readily in soil after the application is made, so it is important to provide adequate water so that the material penetrates several inches into the soil when it is applied. Under dry soil conditions, additional water may be needed to penetrate the soil.

One relatively new insecticide product is Ecotrol G. See the article on seedcorn maggot for details. See also the 2012-2013 New England Vegetable Management Guide (available online at www.nevegetable.org.).

If you make several plantings, scout each planting (it takes about 15 minutes) 4-7 days after transplanting to determine if there is need for a soil drench.

Floating row covers provide an effective barrier against this pest. Place the cover as soon as the transplants are set. Use in a rotated field, as flies overwinter in soil after late season crucifers and could emerge under the cover if the same field has spring brassicas.
Replace cover after weeding operations. As soil temperatures rise, the first flight ends and crops grow large, covers can be safely removed.

**Cultural practices and natural controls.** Crop rotation contributes to keeping populations low; greater distances are more effective. Fall tillage to bury crop residues and to expose over-wintering pupae is also important. For onions, bury or haul away onion cull piles. In vigorous Brassica crop, cultivation that brings soil up around the stem may help encourage formation of adventitious roots from the stem, which can help compensate for root loss even if maggots are present.

Naturally-occurring fungal diseases occasionally will reduce onion maggot numbers significantly, particularly when flies are abundant and relative humidity is high. During a fungal epidemic dead, diseased flies, can be seen clinging to the highest parts of plants along field edges. Predaceous ground beetles, which eat onion maggot eggs, larvae and pupae, can also be important in reducing maggot numbers. Because these soil-inhabiting beetles are susceptible to insecticides, broadcast soil insecticide treatments should be avoided whenever possible.

**Nematodes for biological control.** One alternative method that has shown promise but has not been widely field-tested is soil application of entomopathogenic nematodes, especially *Steinernema* spp. *Steinernema feltiae* has been found to be more effective compared to other *Steinernema* or *Heterorhabditis* species in attaching to and penetrating cabbage root maggot larvae at low temperatures (10°C) which is an important trait for use in spring when soils are cold. Common application methods include suspension of nematodes (infective juveniles) in water and application of water to transplants prior to setting in the field (as a spray or soaking drench), in transplant water used in the water wheel transplanter, as a drench after transplanting, or a combination of pre-plant and post-plant applications. Rates of 100,000 to 125,000 infective juveniles per transplant have been shown to be needed to achieve reduction in damage.


Onion maggot: