Introducing a Pest and Disease Forecasting Tool for Mitigating Risk in Vegetable Crops

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Vegetable IPM Resources

- **Vegetable Insect Mgmt Web-page**
  - [University of Wisconsin Madison Vegetable Crop Entomology](http://www.entomology.wisc.edu/vegento)

- **Vegetable Disease Mgmt Web-page**
  - [UW Vegetable Pathology](http://www.plantpath.wisc.edu/wivegdis)

- **Wisconsin Pest Bulletin**
  - [http://datcpservices.wisconsin.gov/pb/index.jsp](http://datcpservices.wisconsin.gov/pb/index.jsp)
Wisconsin Vegetable Pest Management

Options for Insect Pest Management – *More than ever before!*

- Cultural controls
- Host plant resistance
- Transgenic plants IR traits
- Natural enemies
- Reduced-Risk Chemical Insecticides
- Baits and baiting systems
- Population disruption
- Entomopathogens

*Vegetable IPM*
Implementing an IPM Program

- Monitoring and Sampling *(inspect)*
- Pest Identification *(what pest)*
- Decision-making *(what action(s))*
- Intervention *(take action(s))*
- Follow-up *(re-inspect)*
- Record-keeping *(write it down, history)*
- Education *(learn)*
Poikilotherm / Homeotherm

- A **poikilotherm** is an organism whose internal temperature varies considerably.

- A **homeotherm** is an organism whose internal temperature remains constant.
Calculating Degree Days

- Temperature controls the developmental rate of poikilotherms (plants, invertebrates).

- The amount of heat required to complete a given organism's development does not vary—the combination of temperature (between thresholds) and time remains constant and is expressed and approximated in units called degree-days (DD).

- Different insects have different developmental minimums and maxima.
Example Insects & Associated DD’s

**Colorado potato beetle, (1st generation only)**
Base temperature = 50°F
Biofix - Begin counting when first eggs appear
- 1st instar larva at 185 DD50
- 2nd instar larva at 240 DD50
- 3rd instar larva at 300 DD50
- 4th instar larva at 400 DD50
- Pupa at 675 DD50

**Fleabees**
Base temperature = 50°F
Biofix – January 1: 150-200 DD50
(Norway maple, Amelanchier, redbud early bloom)

**Onion Maggots**
Base temperature = 40°F
Biofix – January 1: 680, 1950, 3230 DD40 for 1st, 2nd, & 3rd generation flies
1st generation eggs laid 230-280 DD40
Life cycle & Management: Scouting and Timing

- Overwinter in non-crop habitats
- Colonize crop by walking
- 2-3 generations per year
- Larvae are the insecticide target
New insecticides fit with CPB life cycle

- New compounds often target larvae
- Certain compounds perform better on specific larval instars (i.e. small larvae)
- Treatment windows pair active ingredients with seasonal distribution of CPB larvae
- Foliar application timing critical
Seed corn maggot, *Delia platura*

**Adult**
- Small grey/black fly
- Similar to housefly

**Eggs**
- Small, white
- Laid in soil at base of plants

**Larvae**
- White, legless maggots
- 4 instars; up to 1/4”
- 3-4 weeks per generation
- 3-5 generations per year

**Pupa**
- Brown, oval shaped
- In soil
Seed corn maggot: Seedling damage

**Occurrence**

- Overwinter in soil as pupa
- Adults emerge in spring
- 4-5 generations/year. 2nd adult peak in May/June is usually most serious

**Damage**

- Larvae hatch and tunnel germinating seeds
- Larvae feed in seed and developing plant and prevent emergence or severely distort plant.
- Moderate feeding may injure 1st leaves only giving crop a ragged appearance
- Cool weather, which delays plant emergence increases severity of damage
Seed corn maggot: DD$_{39}$ Calculations

Degree Day Calculator

Degree days totalize the amount of heat available above a threshold temperature since a given day. The number of degree days accumulated over some period of time is often related to the phenological development of plants and insects, and so can be used to estimate when pests will be at a life stage vulnerable to control. The base, or lower threshold temperature is that below which the organism does not grow or develop. The cap, or upper threshold is the maximum temperature at which organismal development occurs. Some specific examples can be found at our European Corn Borer and Alfalfa weevil web pages.

For more information, see:
- Degree Day Concepts (UC-Davis)
- Weather and Modeling (UC-Davis) (has videos on how to use DD).

Note: These parameters are usually specific for a particular crop and pest. Make sure you are using the right ones for your particular situation. Some values for common pests in our area are listed below.

<table>
<thead>
<tr>
<th>Pest</th>
<th>Method</th>
<th>Base Temp</th>
<th>Upper Temp</th>
<th>Biofix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Scab</td>
<td>Simple</td>
<td>32F</td>
<td>None</td>
<td>Bud break</td>
</tr>
<tr>
<td>Alfalfa Weevil (DD Map)</td>
<td>Sine</td>
<td>48F</td>
<td>68F</td>
<td>January 1</td>
</tr>
<tr>
<td>Black Cutworm</td>
<td>Sine</td>
<td>50.7F</td>
<td>86.0F</td>
<td></td>
</tr>
<tr>
<td>Cabbage Maggot</td>
<td>Simple</td>
<td>43F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Colorado Potato Beetle</td>
<td>Simple</td>
<td>52F</td>
<td>None</td>
<td>When eggs are first scouted</td>
</tr>
<tr>
<td>Common Asparagus Beetle</td>
<td>Simple</td>
<td>50F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Corn plant development (DD Map)</td>
<td>Modified</td>
<td>50F</td>
<td>86F</td>
<td>Emergence</td>
</tr>
<tr>
<td>Corn Rootworm Adults</td>
<td>Simple</td>
<td>50F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Cranberry plant development DD Map</td>
<td>Modified</td>
<td>45F</td>
<td>86F</td>
<td>Ice off</td>
</tr>
<tr>
<td>European Corn Borer (DD Map)</td>
<td>Modified</td>
<td>50F</td>
<td>86F</td>
<td>January 1</td>
</tr>
<tr>
<td>(Sweet corn, Field corn)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seedcorn Maggot (DD Map)</td>
<td>Sine</td>
<td>39F</td>
<td>84F</td>
<td>January 1</td>
</tr>
<tr>
<td>Flea beetles (Beet, Cole crops, Potato)</td>
<td>Simple</td>
<td>50F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Imported Cabbageworm</td>
<td>Simple</td>
<td>50F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Onion Maggot</td>
<td>Simple</td>
<td>40F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Squash Vine Borer</td>
<td>Simple</td>
<td>50F</td>
<td>None</td>
<td>January 1</td>
</tr>
<tr>
<td>Stalk Borer (DD Map)</td>
<td>Sine</td>
<td>41F</td>
<td>86F</td>
<td>January 1</td>
</tr>
<tr>
<td>(Sweet Corn, Field Corn, Potato, Snap Bean)</td>
<td>Modified</td>
<td>50F</td>
<td>86F</td>
<td>January 1</td>
</tr>
<tr>
<td>Tree and shrub pests (DD Map)</td>
<td>Modified</td>
<td>50F</td>
<td>86F</td>
<td>January 1</td>
</tr>
<tr>
<td>Western Bean Cutworm (More information)</td>
<td>Simple</td>
<td>50F</td>
<td>None</td>
<td>May 1</td>
</tr>
</tbody>
</table>

42.0 ° North latitude, -98.0 ° West longitude

http://agwx.soils.wisc.edu/uwex_agwx/thermal_models/degree_days
Last Friday’s DD$_{39}$ Estimates

Seadcorn maggot (SCM) is a soil insect pest of soybean, corn and many vegetable crops. SCM overwinters as a pupa in the soil. Adult flies emerge in spring after the ground has thawed and sufficient heat units, or degree-days, have accumulated for SCM to reach the adult stage. SCM flies lay eggs in freshly plowed fields with decaying green plant material associated with spring cover crop incorporation or weed tillage. Animal manure applied to fields in spring can also attract SCM flies. Eggs hatch within 2 to 4 days and larvae feed belowground on seeds and germinating seedlings. There are three generations per year in Wisconsin and the Upper Midwestern U.S.

Seadcorn maggot development can be estimated using a base 39F (3.9C) degree-day calculation. For this pest the degree-day summation is started January 1st. Critical values for SCM are listed in the table below (data from Sanborn et al. 1982 and Funderburk et al. 1984).

By calculating SCM degree days, growers can avoid planting field corn, soybean, and later crops such as sweet corn or vegetables during peak adult emergence when risk of SCM damage to untreated seeds is highest (Table 1).

Table 1

Seasonal accumulation of seedcorn maggot degree days from January 1st biofix date to adult emergence peaks (50% emergence) for 1st, 2nd and 3rd generation flies.

<table>
<thead>
<tr>
<th></th>
<th>First Generation</th>
<th>Second Generation</th>
<th>Third Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fahrenheit Degree Days (FDD)</td>
<td>360</td>
<td>1,080</td>
<td>1,800</td>
</tr>
<tr>
<td>Celsius Degree Days (CDD)</td>
<td>200</td>
<td>600</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Seed corn maggot: Management

**Cultural**
- Prevent egg laying with row cover
- Speed up germination: pre-sprout, mulch, warm soil
- Avoid green manure

**Biological**
- Predacious soil beetles
- Fungal epidemics

**Chemical**
- In-furrow, insecticides (Lorsban)
- Commercial seed treatments (Entrust)