Crop Rotations to Minimize Insect Damage: Avoidance in Space and Time

Wisconsin Fresh Fruit and Vegetable Association Market Field Day
Wisconsin Dells, WI

November 6, 2009

Russell L. Groves
Department of Entomology
University of Wisconsin
1630 Linden Drive
Madison, WI 53706

groves@entomology.wisc.edu
Vegetable Production in Wisconsin

- Important production state nationally: ranked 2nd in total processing production

- Good crop climate also limits pests

- Production linked historically to canning industry

- Recent increase in fresh market
National Vegetable Production Acres (NASS 2002)
Wisconsin Vegetable Pest Management

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

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

- Soil-dwelling larvae (grubs) of click beetles
- Pest in early established market gardens
- Many different species, all with unique lifecycles
- Can be a pest on a wide range of vegetable and fruit crops:
  - cereals, vegetables, soft fruit, and potatoes
Generalized Wireworm Lifecycles

- Varied, taking 3 – 4 years to develop from egg to adult.
- Nearly all spent in larval stages: egg & pupa = 1 month
- Overwinter at 10 – 24”, movement > 55°F
- Females emerge to mate, then burrow and re-emerge to oviposit
Wireworm Damage

Sweet corn

Sweetpotato

Transplant Cucumbers

Beans

Peanuts
Wireworm Damage: Potato

- Larvae move up and down in soil in response to changes in temperature and moisture.

- Older, larger larvae most often associated with damage.

- Recent damage with smaller holes on mature tubers with well-formed periderm.
Possible explanations for increasing damage to crops

- Increased rotations with grasses for soil conservation or small grain, corn production
- Relatively mild winters in the last several years
- The loss of registration of insecticides with long residual soil activity
  - “Older chemistries (slated for removal by EPA-FQPA) are finally dissipating”. Some materials had a half-life of 20 years.
- Avoid losses by leaving new ground fallow for at least one year!!
Insect Management in Potatoes
- Key Pests -

- Colorado potato beetle
- Green peach aphid
- Potato leafhopper
- Over-wintering site
- Close to last crop
- Adults 6” to 12” deep
- Protected by mulch
- Walk to crop (May-June)
- Adults lay eggs on underside of leaves
- Larvae hatch 5-7 days
- 1st instar move to terminals
- Little damage

- Yellow / orange
- 20-40 eggs/mass
- Small larvae feed in terminals
- 4 instars, 5-7 days/stage
- Large larvae (3+4) feed extensively
- Pupae in soil
- 2-3 weeks
- Summer adults emerge (July)
- Very active – very hungry
Crop Rotation; avoid planting adjacent to previous potato

- Rotate > 400 m (¼ mile)
- Delays infestation
- Reduces infestation size
  - effect increased if small grain separates field from source of overwintered beetles
- Causes infestation to proceed from field edge
  - facilitates scouting
  - allows spot or perimeter applications of insecticide
Perimeter Insecticide / Edge Treatments
Chemical Control

- Must control overwintered generation in June
- Ignore overwintered adults unless severe feeding
- Target young larvae, 1<sup>st</sup> and 2<sup>nd</sup> instar
- Look for egg hatch
- 5 to 10 days, depending on temperature
Cucurbit Insect Control

Insect management:

• Generally similar insect pests on all

• Insects may be more severe on some crops and in different geographic regions
# Calendar of Insect Pests

<table>
<thead>
<tr>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aphids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafminers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flea beetles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash Bug</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cucumber Beetles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pickleworm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash Vine Borer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteflies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed maggots</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table and diagram illustrate the monthly appearance of various insect pests, helping gardeners and farmers manage their crops effectively by identifying when to expect these pests and take appropriate actions.
Calendar of Insect Pests

<table>
<thead>
<tr>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash Bug</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cucumber Beetles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash Vine Borer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed maggots</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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, Host range

- Wide host range
- Can develop on organic matter

## Crop Susceptibility

<table>
<thead>
<tr>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucurbits (squash, cucumber, melon)</td>
<td>Peas</td>
<td>Corn</td>
</tr>
<tr>
<td>Beans (lima, snap)</td>
<td>Beans (soy, kidney)</td>
<td></td>
</tr>
<tr>
<td>Brassica roots (radish)</td>
<td>Brassica (broccoli, cauliflower)</td>
<td></td>
</tr>
</tbody>
</table>
Seed corn maggot: Seedling damage

Occurrence
- Overwinter in soil as pupa
- Adults emerge in spring – locally abundant
- 4-5 generations / year. 2\textsuperscript{nd} 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 1\textsuperscript{st} leaves only giving crop a ragged appearance
- Cool weather, which delays plant emergence increases severity of damage
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 (neonicotinoids*, bifenthrin)
- Commercial seed treatments (Entrust)

*Not registered for target
Squash Vine Borer

**Occurrence**

- Adults are diurnal, wasp-like moths
- Lay eggs singly on vines
- Larvae bore into plants and destroy vascular tissues = wilting and death.
- Not a pest of watermelon, muskmelon, or cucumbers
- Emerging issue on winter squash (Hubbard) and pumpkin
- Occasional second generation
Squash Vine Borer Control

**Sampling**
- Field history: past problems = future problems
- Often more serious in smaller plantings
- Pheromone traps; emergence of adults at 1,000 DD$_{50}$
- Direct observation = entrance holes & frass

**Cultural**
- Practice good field sanitation
- Destroy residue

**Note:** directed application to the first 12-16” of vine; ‘post-chicory bloom’.

**A3688** (http://www.uwex.edu/ces/pubs)
Striped and Spotted Cucumber Beetles

Lifecycle

- Adult beetles 8-10 mm length and 3-4 mm wide
- Striped cucumber beetle *Acalymma vittatum*
- Spotted cucumber beetle *Diabrotica undecimpunctata*
- Striped cucumber beetles overwinter in protected areas as adults and become active in mid-spring.
- Appear early, lay eggs at the base of cucurbits, and have 2 generations / year
- Striped is most severe
Cucumber Beetles: Damage

- Defoliation
- Pollination Interference
- Feeding Scars
- Rindworms
Cucumber beetles: Management

**Cultural**
- Later planting
- Eliminate weeds, weedy edges
- Sanitation - pollinators
- Row cover early
- Crop rotation
- Transplants
- Trap crops on plastic mulches

**Biological**
- None effective

**Chemical**
- Avoid flowering to protect bees (late afternoon sprays)
- At-plant systemic (nicotinyls), foliar insecticides (pyrethroids, carbaryl), and new technologies (seed trt’s)

Row cover and seed treatment experiments, AAES 2008
QUESTIONS?