Cole Crop Insect Control

Many crops with same insect pest complex

Head crops
- Cabbage
- Cauliflower
- Broccoli
- Also: Brussels sprouts, Kale, Kohlrabi, Collards, Mustard greens, Chinese cabbage, etc.

Root crops – Turnips, Radish, Rutabaga, etc.
# Calendar of Cabbage 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>
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<tbody>
<tr>
<td><strong>Key Pests:</strong></td>
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<tr>
<td>Imported cabbage worm</td>
<td>Diamondback moth</td>
<td>Cabbage Looper</td>
<td>Cabbage Maggot</td>
<td>Flea beetle</td>
<td>Thrips</td>
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<tr>
<td><strong>Intermittent Pests:</strong></td>
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# Insect Pest Complex

## Key Pests - Lepidoptera
- **Diamond back moth**
- **Imported cabbage worm**
- **Cabbage looper**

## Sporadic Pests
- **Cabbage maggot**
- **Flea beetle**
- **Cabbage aphid**
Managing Insects on Cole Crops

★ ★ Excellent example of potential for biological control ★ ★
(Mahr et. al. NCR 471)

History of problem

- Direct damage to marketable product by key pests
  - Worms on heads
  - Maggots on roots
- Multiple insecticide applications used
- Resistance developed as threat to production

Solution

- IPM implementation based on biological control of key pests
- Pesticides switched to specific, ‘soft’ materials to preserve natural control
Naturally Occurring Parasitization of Lepidoptera

Diamondback moth 70-90%

Imported cabbage worm 30-60%

Cabbage looper 10-30%

Diadegma insulare

Cotesia glomerata

Pteromalus puparium

Trichogramma

Copidosoma floridanum
Key Pests of Cole Crops

- Complex of 3 lepidopteran species
- All feed on marketed crop
- Need to identify species but can treat as a complex
Diamondback moth life cycle

**Adult**
- Small night flyer, short fast flights
- \( \frac{1}{2}'' \), wings have diamond pattern
- Can monitor with pheromone trap

**Eggs**
- Small, hard to see
- Laid close to veins

**Larvae**
- 4-5 instars up to \( \frac{3}{4}'' \) long
- 2-3 weeks
- Cigar shaped, pointed at ends
- ‘wiggle’ when touched
- Spin thread and hang

**Pupa**
- Usually on underside of leaves
- Neatly spun pupal case
Diamondback moth

Occurrence
- Does not overwinter in Wisconsin
- Blown in on wind or imported on plants
- 4-8 generations per year

Damage
- ‘Window pane’ feeding, may also deform heads
- 1<sup>st</sup> instar mine in leaf
- Damage usually early-mid season (June/July)
- Resistance to many insecticides
- Major problem worldwide
Imported Cabbage Worm life cycle

**Adult**
- White, day flying butterfly

**Eggs**
- Laid single on undersurface
- White, turning yellow at hatch
- Cigar shaped

**Larvae**
- 5 instars; 3-4 weeks
- Velvety green with yellow dorsal line
- Slow moving
- Up to 1 ½ inches in length

**Pupa**
- Distinctive angular shape
- Usually on plant debris/old leaves
Imported Cabbage Worm

**Occurrence**
- Overwinters as pupae in Wisconsin
- 3 generations per year, 1\(^{st}\) on weeds

**Damage**
- Usually most damaging species in Wisconsin
- Large holes in leaves and heads
- Often extensive frass
- Peak damage mid-season (June/July)
Cabbage Looper life cycle

**Adult**
- Large, night flying moth
- Hour glass marks

**Eggs**
- Laid singly on undersurface
- White, turning tan at hatch
- Round shaped

**Larvae**
- 5 instars; 4-5 weeks
- Green with white stripe
- Loop when moving
- Up to 2 inches in length

**Pupa**
- Roughly spun silk cocoon
- Underside of old leaves or on debris
Cabbage Looper

**Occurrence**
- Does not overwinter, adults blow in (June/July)
- 2 generations per year, persisting in late season

**Damage**
- Damage usually late season
- Extensive leaf holes and head damage
Managing the Lep. Complex

**Cultural**
- Use clean transplants

**Biological**
- Good complex of parasites
  - Diamondback moth: 70-90% parasitized
  - Imported Cabbage worm: 30-60%
  - Cabbage looper: 10-30%
- Multiple species
Putting together a biologically-based management program for cole crops

3 requirements

1. Existing or obtainable natural enemies for key pests
2. Pest specific insecticides to conserve natural enemy control
3. Non-disruptive controls for sporadic pests
2. Pest Specific Insecticides for Key Pests

- Control lepidoptera at thresholds when needed
- Conserve beneficial organisms
- Bacillus thuringiensis or spinosad (Entrust, Radiant)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Growth stage</th>
<th>Threshold (% infestation)</th>
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<tbody>
<tr>
<td>Cabbage</td>
<td>Seed bed</td>
<td>10%</td>
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<tr>
<td></td>
<td>Transplant-cupping</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Cupping-early head</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Mature head</td>
<td>10%</td>
</tr>
<tr>
<td>Broccoli/cauliflower</td>
<td>Seed bed</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Transplant-first curd</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Curd present</td>
<td>10%</td>
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</tbody>
</table>
Key Pest of Root Crops

**Cabbage Maggot Life Cycle**

**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 generations per year

**Pupa**
- Brown, oval shaped
- In or close to the roots
Seed (cabbage) 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>
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<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>
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</tr>
<tr>
<td>Brassica roots (radish)</td>
<td>Brassica (cabbage, broccoli, cauliflower)</td>
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<tr>
<td>Onion (dry bulb)</td>
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</tbody>
</table>
Cabbage Maggot Life Cycle

**Occurrence**
- Overwinters in soil as pupa
- Adults emerge in spring
- 3 flight peaks
- First peak is most serious and occurs at 300 heat units or when lilacs bloom (May)

**Damage**
- Larvae tunnel on root surface
- May be secondary rot
- Major importance on root crops
- Causes wilting, death on head crops

**Prediction of Cabbage maggot oviposition**

- May
- July
- September
- 300 DD
Cabbage Maggot Management

**Cultural**
- Rotate crop away from overwintering site (1/4-1/2 mile)
- Prevent egg laying with barrier, row cover
- Predict egg laying with heat units (300 HU with 43°F base)
- Plant early or late to avoid eggs = fly free periods

**Biological**
- Some egg predation by beetles

**Chemical**
- At-plant drench and broadcast applications
- Experimental seed treatments in review (e.g. spinosad)
Sporadic Pests of Cole Crops

Flea beetle (several species)

**Appearance**
- Small, shiny black beetles
- Hind legs enlarged for jumping
- Overwinter as adults
- 2 generations per year

**Damage**
- Adults chew small circular holes
- Can kill small plants
- Larvae in soil are not damaging
Flea Beetle Management

**Cultural**
- Exclude adults with row cover
- Attract adults to alternate trap crop (Indian mustard)
- Avoid early planting

**Biological**
- No effective controls

**Chemical**
- Serial applications of spinosad (Radiant)
- **DO NOT** disrupt biological controls for lepidoptera
Sporadic Pests of Cole Crops

Cabbage aphids

Appearance
• Grey, waxy covered aphids in dense colonies
• Multiple generations

Damage
• Feeding results in leaf distortion
• Head malformation can occur
• Dense colonies disfigure heads
• Contamination of produce is common
Cabbage Aphid Management

**Cultural**
- None available except exclusion

**Biological**
- Parasites and predators are effective

**Chemical**
- Neem extracts (Aza-Direct, Azatin)
- Insecticidal soap may suppress colonies
Cabbage Aphid Natural Controls