New methods for managing slugs in cabbage

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Cornell Cooperative Extension
Vegetable Program
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Grower Cooperators:
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• Ray Stein, Spencerport

CVP Program Assistants
• Katie Klotzbach
• Rebekah Edgell
• Elizabeth Buck

Slugs in Cabbage

Slugs are an increasing threat to cabbage production in New York
• CRDP made slug control one of their highest research priorities for 2010
• Sporadic pest favored by cool and wet conditions (spring & fall), residue on soil surface, weedy patches, along hedge rows
• More cabbage being grown in rotation with corn = more slug problems

Slugs in Cabbage

Slug feeding results in large holes in the leaves with the veins in tact

Slugs in Cabbage

Loads are rejected when slugs squeeze between the leaves in the cabbage head

Slugs in Cabbage

Slug frass can be a contaminant in cabbage heads
About Slugs

Field Slug
*Deroceras reticulatum*
- Color: gray/fawn with darker flecks
- Length: up to 4 cm

Garden Slug
*Arion hortensis*
- Color: blackish
- Length: up to 3 cm

In New York:
- 1.5 to 2 generations per year
- Over-winter in any life stage (eggs, juveniles & adults)

**Slugs Like it Cool & Moist**

Slugs prefer high humidity & low temperatures
- 50 -60 °F for egg laying, egg hatch & feeding
- Temperatures in the 90s are lethal
- Prone to desiccation

**Slugs are Hard to Kill**

- Most contact poisons are sloughed off by slugs’ ability to “slime”
- Slugs are not insects
  - Slugs are gastropods
  - Phylum Mollusca: snails, clams, squid, etc.
  - Slugs have a different biology than insects
  - Killed by molluscicide, NOT insecticide
    - a.i. metaldehyde (Deadline Bullets)

**Deadline Bullets (bait)**

- Only true molluscicide in the United States
- Causes the mucus-producing cells to burst = no slime = dead slug
- Effective in reducing slug damage & increasing yield of minimum tillage field corn and soybeans when applied preventatively (3-4 leaf stage)
- Good coverage is essential
  - 4-5 pieces per square foot
- Recommended rate for vegetables
  - 20 to 40 lbs per acre
Challenges with using Deadline Bullets in cabbage

- Slugs are a sporadic pest in cabbage
  - Use as a rescue treatment, not preventatively (too expensive)
- If Deadline Bullets is applied after slugs have entered into cabbage heads, would they be attracted to the DB bait and come out of the heads?
- Pellets are not to contaminate edible portions of plant
  - How to get Deadline Bullets to soil surface through cabbage plants’ large prostrate leaves without it getting into the heads?

Iron Phosphate (i.e. Sluggo)

- Trade names: Sluggo, many others
- Several labels OMRI approved for organic use
- Several labels for use in home garden
- Low mammalian toxicity
- Data suggest that iron phosphate is comparable to Deadline Bullets
  - Breaks down quicker during moist conditions

Deadline Bullets (bait)

Lannate LV (EPA No. 352-384)

- a.i. methomyl 29%
- May 22, 2012: 2(ee) recommendation for control of slugs in field corn, soybeans & cabbage in NY
  - 1.5 pt per acre
  - 5-7 day intervals
  - Up to 24 pts or 15 apps per growing season
  - Recommend spraying at night or early morning
  - PHI = 24 hours
- Also labeled for control of worm pests in cabbage

Iron Phosphate (bait)

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Hot Pepper Extractent as a Slug Repellent?

Browseban (repellant)

- a.i. 2% capsaicin and related capsaicinoids (hot pepper extractant)
- Sensory irritant causing burning of mouth, throat, eyes and skin
- Labeled on cabbage as a deer and raccoon repellent
- Never been tested on slugs
  - Would it deter slugs from entering or evacuate a treated plant?

Bioassay: Set-Up

Collect slugs from cabbage field, place 5 on a cabbage leaf, mist with water, apply sprays with CO₂ backpack sprayer (40 gpa, 30 psi). Baits placed underneath cabbage leaf.

Bioassay Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate (applied once)</th>
<th>Application details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated Control</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Deadline Bullets MP</td>
<td>20 lbs per acre</td>
<td>Spread by hand</td>
</tr>
<tr>
<td>Iron Phosphate 4%</td>
<td>20 lbs per acre</td>
<td>Spread by hand</td>
</tr>
<tr>
<td>Browseban</td>
<td>1.28 fl oz per acre</td>
<td>40 gpa, 30 psi</td>
</tr>
<tr>
<td>Lannate LV</td>
<td>1.5 pts per acre</td>
<td>40 gpa, 30 psi</td>
</tr>
</tbody>
</table>
2010 Bioassay % dead slugs

- The only treatment that killed BIG slugs (<2 cm) was Deadline MP

2011 Bioassay % dead slugs

2010 Bioassay: Results

- Healthy slugs in the untreated control

2010 Bioassay: Observations

- Slugs were eating the Deadline Bullets MP

Bioassay Observations

- In the Lannate LV treatment, slugs were dead or dying within 10 minutes of application

2010 Bioassay: Observations

- In the Browseban treatment, slugs clearly appeared irritated and promptly relocated themselves to the undersides of the leaves
**Treatments: Field Trial 2010**

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<tr>
<td>Untreated Control</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Deadline MP</td>
<td>20 lbs per acre</td>
<td>Spread by hand between rows</td>
</tr>
<tr>
<td>Lannate LV + Induce</td>
<td>3 pts per acre + 0.25 % v/v</td>
<td>40 gpa, 30 psi</td>
</tr>
<tr>
<td>Browseban</td>
<td>15 fl oz per acre$^1$</td>
<td>40 gpa, 30 psi</td>
</tr>
</tbody>
</table>

$^1$15x higher than label rate

**Applications: Field Trial 2010**

- Single application – September 10, 2010
- Perfect conditions for slug activity:
  - At night 11:30 pm to 12:30 am
  - RH 85%
  - Air temperature: 53 °F
  - Wind speed: 0.2 mph
  - Heavy layer of dew on cabbage leaves
- CO2 backpack sprayer (40 gpa, 30 psi)
- Trial harvested 3 days after applications

**Evaluations**

Inside head

Outer leaves

**% plants infested (head + outer leaves)**

Elba, NY: Hoepting, 2010
Dead Slugs with Deadline Bullets

Dead Slugs with Lannate LV

Excellent Coverage with 40 gpa

Field Trial 2011: Treatments

- **Improve control of Deadline MP**
  - High rate 40 lbs single app
  - 2 x 20 lb 1 week apart
- **Browseban**
  - Labeled rate (1.28 fl oz)
  - Single vs. double app

- **Lannate LV**
  - Low (1.5 pts) vs. high (3 pts) rate
  - Single vs. double apps
  - Day vs. night apps
  - With and without adjuvant

*funded by DuPont
Field Trial 2011
- Martin Farms, Brockport, NY
- Hot spot in weedy patch along hedgerow
- Spray dates:
  - Oct 6 (day) & 7 (night)
  - Oct 13
- Evaluation: Oct 17

Field Trial 2011
- Heavy slug pressure, but fewer contaminated heads: untreated had:
  - 71% infested plants
  - 3.6 slugs per plant
  - 14% infested heads
  - 0.23 slugs per head

Field Trial 2011: Results

Field Trial 2012
- Ray Stein, Spencerport, NY
- Storage cabbage
- Hot spot within a field
- 1st spray: Oct 14 day & night
- 2nd spray: Oct 19 day & Oct 20 night
- Harvest: Oct 23
- Untreated check: 46% infested plants, 0.75 slugs per plant, 0% infested heads

Field Trial 2012: Results

Baits:
Deadline & Sluggo comparable
Early vs. Harvest Apps:
Harvest apps improved control (re-infestation?)
Field Trial 2012: Results

<table>
<thead>
<tr>
<th>Treatment &amp; Rate/A</th>
<th>% control</th>
<th>Approximate cost (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deadline MP @ 20 lb 2 app x 20 lb</td>
<td>44-64% 50-75%</td>
<td>$50 $100</td>
</tr>
<tr>
<td>Sluggo @ 20 lbs*</td>
<td>25-48%</td>
<td>$50+</td>
</tr>
<tr>
<td>Lannate LV @ 1.5 pts @ 3 pts Induce 0.25%</td>
<td>49-100%</td>
<td>$13 $26 $2.70 Worm control</td>
</tr>
<tr>
<td>Browseban @ 1.28 fl oz 2 app</td>
<td>50-91% 23-83%</td>
<td>$1 $2 Repellent for deer</td>
</tr>
</tbody>
</table>

Cost Information

*likely need multiple applications

Questions? Other Crops?
Reports available at the Cornell Vegetable Program website: http://cvp.cce.cornell.edu/