New management tactics for the control of seed maggots

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Central WI Processing Crops
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Hancock, WI

Outline

• Specialty Crops Research Initiative
• Earlier trial results:
  - 2012-2014 insecticide delivery trial
  - 2011-2012 seed treatment evals
• 2016 SCM trials
• Future directions and new risk for pest management in snap bean

SCRI-Snap bean insect pest management

Project Objectives

Objective 1. Identify consumer preferences and willingness to pay for sustainably produced and processed vegetables and quantify market segments

Objective 2. Create and test sustainability assessment tools and sustainability metrics for commercial vegetable growers

Objective 3. Validate and improve the relationship between practice-based sustainability assessments and environmental and economic outcomes at the farm scale in each region

Implement sustainable practices to identify opportunities for improved water, nitrogen, and pesticide use efficiency at the field and farm level (Bland, Colquhoun, Mitchell, Ruark)

Refine sustainable production practices to reduce environmental and economic risk (Bland, Colquhoun, Hutchison, Nault, Groves, Ruark)

Objective 4. Build critical mass of support for sustainably grown and processed vegetables.

Specialty Crop Research Initiative

Diamides for pest management

• Mode of action: attacks the ryanodine receptors
• Insect stops feeding, becomes paralyzed and dies (<72h)
• Most effective through ingestion
• Exceptionally long residual control (14-21 days)
• Active against Lepidoptera, Coleoptera and Hemiptera
• Much less toxic to bees than neonicots or pyrethroids

Exirel® (cyazypyr):
- Anthranillic diamide (MoA group 28)
- Use rate 13.5 – 20.5 fl. oz / ac (foliar)
- Control of Leps, Aphids, and PLH
- Application timing critical
- Label anticipated for bean 2015, 2016 or 2017 (?)

Coragen® (rynaxypyr):
- Anthranillic diamide (MoA group 28)
- Use rate 3.5 - 5 fl. oz / ac (foliar)
- Control of Leps
- Active against Lepidoptera, Coleoptera and Hemiptera
- Much less toxic to bees than neonicots or pyrethroids
Insecticide tank mix (chlorantraniliprole & cyantraniliprole)

Results – Proportion pods damaged – NY, All trts

• Average (mean percentage±SE) O. nubilalis snap bean pod damage within each phenological application timing.
• Timing was significant in each year.
• Insecticide treatment main effect was significant in all years of the investigation, with bud stage applications possessing the least effective levels of control.
• Treatment by timing interactions were not significant in either year.

Means separation by treatment and timing – NY 2014

• Average (mean percentage±SE) O. nubilalis plant and pod damage within each phenological application timing and insecticide treatment.
• Timing was again observed to significant in each year.
• Insecticide treatment main effect was significant in all years and interactions were significant with stage and timing.

Means separation by treatment and timing – WI 2014

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• Timing was again observed to significant in each year.
• Insecticide treatment main effect was significant in all years and interactions were significant with stage and timing.
Summary of Co-application studies – WI and NY

- Diamide insecticides (e.g. Coragen & Exirel) appear to have very good activity against ECB when applied as a foliar.

- Co-application of diamides with fungicides (bloom) had no antagonistic effects and were similar in performance to current foliar recommendations (pod-formation).

- Cyantraniliprole (aka. cyazypyr) was effective against ECB when applied as an in-furrow and as a liquid fertilizer pre-mix applications (future directions).

Co-application studies – Principal focus was ECB – SCM?

- Diamides appear to be a novel option for ECB.

- What new options exist for seedcorn maggot?

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 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
Future Directions – Revisit SCM and PLH

In the Pipeline, Review, Researchable:
- Exirel, Vermark (cyrantraniliprole) – 2017
- Coragen (chlorantraniliprole) – researchable
- Trigard (cyromazine) – researchable
- Spinosad (FarMore) - researchable

At-plant insecticides Registered for Seed Corn Maggot in Wisconsin: 2017

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Company</th>
<th>Active Ingredient for OM</th>
<th>Chemical Class (IRAC group)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazinon AG500 &amp; 600</td>
<td>Makhteshim</td>
<td>Diazinon</td>
<td>OP (3)</td>
<td>Pre-plant broadcast &amp; incorporate</td>
</tr>
<tr>
<td>Lorsban 4E, 75WG, Advanced</td>
<td>Dow AgroSciences (Lorsban), other companies</td>
<td>Chlorpyrifos</td>
<td>OP (3)</td>
<td>At planting in furrow, Post planting banded along row over row</td>
</tr>
<tr>
<td>Capture LFR</td>
<td>FMC</td>
<td>Bifenthrin</td>
<td>Pyrethroid (3)</td>
<td>Post-planting banded</td>
</tr>
<tr>
<td>Coragen**</td>
<td>DuPont</td>
<td>Rynaxypyr</td>
<td>Anthranilic diamide (28)</td>
<td>At planting in furrow, Post planting banded, Drip/indrome</td>
</tr>
<tr>
<td>Vermark**</td>
<td>DuPont</td>
<td>Cyanpyr</td>
<td>Anthranilic diamide (28)</td>
<td>At planting in furrow, Post planting banded, Drip/indrome</td>
</tr>
</tbody>
</table>

Major Snap Bean Pests in Midwest – Future Directions

European corn borer (ECB)

Seedcorn Maggot (SCM)

Potato Leafhopper (PLH)
Products Evaluated for Managing Insect Pests of Snap Bean in WI, 2011 & 2012

Percent Snap Bean Seedlings Damaged by Seedcorn Maggot - Plover, WI 2011

- In-furrow
- Liquid fertilizer
- Seed Trt

Mean % damaged seedlings (20 ft rows)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>In-furrow</th>
<th>Liquid fertilizer</th>
<th>Seed Trt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Compo 1</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Compo 2</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Compo 3</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Compo 4</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Compo 5</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Compo 6</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Compo 7</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Compo 8</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

P = 0.0212  N=4

Percent Snap Bean Seedlings Damaged by Seedcorn Maggot - NY 2010

- In-furrow
- Liquid fertilizer
- Pre-Mix
- Granular

Mean % damaged seedlings (20 ft rows)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>In-furrow</th>
<th>Liquid fertilizer</th>
<th>Pre-Mix</th>
<th>Granular</th>
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<tr>
<td>Untreated</td>
<td>0</td>
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<td>Compo 1</td>
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<tr>
<td>Compo 3</td>
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<tr>
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<tr>
<td>Compo 8</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

P = 0.014   N=4

Cold and warm blooded animals – other options!!

- 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 Degree Day Calculations

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

**Fleabeetles**
- Base temperature: 50°F
- Biofix: January 1: 150-200 DD

**Seed corn maggots**
- Base temperature: 39°F
- Biofix: January 1: 1050, 1950, 3230 DD

US Degree Day Mapping Calculator: [http://uspest.org/cgi-bin/usmapmaker.pl](http://uspest.org/cgi-bin/usmapmaker.pl)
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
- Seed trts (Cruiser SFS, Gaucho 600F)
  - Researchable FarMore F1500 (spinosad)
  - Researchable Cyromazine
  - Related Chiorantraniliprole / Cyantraniliprole

Mean percent damage, stand loss resulting from infestation by cabbage maggot Arlington, WI. 2016

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>rate/A</th>
<th>Application Method</th>
<th>Percent Stand Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 DAT</td>
<td>16 DAT</td>
<td>24 DAT</td>
</tr>
<tr>
<td>Aza-Direct</td>
<td>4.5 pt</td>
<td>BD</td>
<td>0.0a</td>
</tr>
<tr>
<td>Pyganic</td>
<td>2.0 qt</td>
<td>BD</td>
<td>3.4b</td>
</tr>
<tr>
<td>Capture 2EC</td>
<td>5.0 flz</td>
<td>BD</td>
<td>0.0a</td>
</tr>
<tr>
<td>Capture ZEC</td>
<td>6.4 flz</td>
<td>BD</td>
<td>0.0a</td>
</tr>
<tr>
<td>Coragen 5C</td>
<td>7.5 flz</td>
<td>BD</td>
<td>0.0a</td>
</tr>
<tr>
<td>Verimark 5C</td>
<td>13.5 flz</td>
<td>BD</td>
<td>0.0a</td>
</tr>
<tr>
<td>Lornban Adv</td>
<td>4.5 pt</td>
<td>BD</td>
<td>0.0a</td>
</tr>
<tr>
<td>Control</td>
<td>—</td>
<td>—</td>
<td>0.0a</td>
</tr>
</tbody>
</table>

*Mean percent damage, stand loss estimated from 6 experimental replicates (15 plants/plot).

2016 Cucurbit at-plant SCM trial @ Cashton, WI

Squash seedling emergence ratings

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Mean Number of Emerged Plants per Plot</th>
<th>P=0.0033</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aza-Direct</td>
<td>ab</td>
<td>—</td>
</tr>
<tr>
<td>Pyganic</td>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>Capture</td>
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<td>—</td>
</tr>
<tr>
<td>Verimark</td>
<td>a</td>
<td>—</td>
</tr>
<tr>
<td>Coragen</td>
<td>a</td>
<td>—</td>
</tr>
<tr>
<td>Admire Pro</td>
<td>a</td>
<td>—</td>
</tr>
<tr>
<td>Entrust</td>
<td>a</td>
<td>—</td>
</tr>
<tr>
<td>UTC</td>
<td>b</td>
<td>—</td>
</tr>
</tbody>
</table>

Mean number of emerged plants per plot

Del Monte Experimental Site, Plover, WI

Research Grant Funding:
- Midwest Food Processors Association
- USDA SCRI – SCBG Program
- USDA AFRI Foundational

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Questions?