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November 3rd, 2010

Midwest Pickle Growers Association

Novel Seed Treatment and In-Furrow Uses for Cucurbit Insect Pests
### Wisconsin Vegetable Production Statistics (Wis. Ag. Stats. 2008)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Nat. Rank</th>
<th>Acres</th>
<th>% of U.S.</th>
<th>$ Value (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>3</td>
<td>64,500</td>
<td>6</td>
<td>$242</td>
</tr>
<tr>
<td>Sweet corn (Proc)</td>
<td>1</td>
<td>88,900</td>
<td>21</td>
<td>$81</td>
</tr>
<tr>
<td>Sweet corn (Fresh)</td>
<td>--</td>
<td>7,700</td>
<td>--</td>
<td>$14</td>
</tr>
<tr>
<td>Snap beans</td>
<td>1</td>
<td>82,300</td>
<td>38</td>
<td>$62</td>
</tr>
<tr>
<td>Peas</td>
<td>3</td>
<td>40,200</td>
<td>21</td>
<td>$20</td>
</tr>
<tr>
<td><strong>Minor crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cucumbers (pickles)</td>
<td>4</td>
<td>7,100</td>
<td>8</td>
<td>$9</td>
</tr>
<tr>
<td>Cabbage (fresh)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage (kraut)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Carrots</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onions (storage)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Beets (table)</td>
<td></td>
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</tr>
</tbody>
</table>

Small-acreage fresh market production continues to expand. Anecdotal statistics estimate ca. 1,900 small-acreage producers that grow over 50 crops in Wisconsin.
Factors Influencing Insect Pest Management
‘Water Quantity and Quality’

• Decreasing availability of water for agriculture
  - Agriculture is the overwhelming user of fresh water.
  - Increasing urban demand will drive irrigation efficiency.

• Drip irrigation, micro-sprinklers, hydroponics.

• Targeted application of water increases opportunity to use irrigation as a delivery system.
Factors Influencing Insect Pest Management
‘Food Safety’

– Major food retailers are setting acceptable residue levels below those set by government regulatory agencies.

“No detectable residues” will be a competitive advantage for food retailers.

– Older insecticides that do not meet these requirements are not being re-registered, resulting in increased use of novel insecticides (bio-pesticides).
Factors Influencing Insect Pest Management

‘Environmental Concerns’

– With increasing affluence reaching the developing world, there will be increasing concerns about pesticide usage and perceived environmental effects.

– This will accelerate the shift to “softer” products and technologies.
Wisconsin Vegetable Pest Management

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

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

Vegetable IPM
Research Objectives

• To determine combinations of best management practices to mitigate losses associated with key insect pests of cucurbits including seed corn maggot and cucumber beetles.

• To evaluate the efficacy of novel insecticides, chlorantraniliprole (CTPR) and cyantraniliprole (CYTP) when applied as seed and in-furrow treatments.
# 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>Aphids</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Cucumber Beetles</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Squash Bug</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Pickleworm</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Squash Vine Borer</td>
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<tr>
<td></td>
<td></td>
<td>Whiteflies</td>
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<tr>
<td></td>
<td></td>
<td>Thrips</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Leafminers</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Seed maggots</td>
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<tr>
<td></td>
<td></td>
<td>Flea beetles</td>
<td></td>
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<td></td>
<td></td>
<td>Flea beetles</td>
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</tr>
</tbody>
</table>
## Calendar of Insect Pests

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<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
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</thead>
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<td></td>
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<tr>
<td>Cucumber Beetles</td>
<td></td>
<td></td>
<td></td>
<td>Squash Bug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash Vine Borer</td>
<td></td>
<td></td>
<td></td>
<td>Mites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed maggots</td>
<td></td>
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<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
- 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.
- 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 (Lorsban 50W)

*Not registered for target
Striped cucumber beetle

(Acalymma vittatum)
Striped and Spotted Cucumber Beetles

**Lifecycle**

- Adult beetles ca. 1 cm length and 3-4 mm wide
- Striped cucumber beetles overwinter in protected areas as adults and become active in mid-spring (late Apr).
- Appear early, lay eggs at the base of cucurbits, and have 2 generations / year
- Striped is most severe – because it overwinters here!!
Cucumber Beetles: Damage

Defoliation

Pollination Interference

Feeding Scars

Rindworms
Most damage is from bacterial wilt, *Erwinia tracheiphila*.

Closely associated with beetle, vectored via posterior-station.

No cure for bacteria, control through vector.

Susceptibility:

Melons (not watermelon) > cucumbers > butternut and Hubbard squash.

Avoidance of bacterial wilt is accomplished through effective cucumber beetle control.
Systemic Neonicotinyl Insecticides

Beneficial Attributes

- **Broad spectrum**
  - Cucumber beetles, squash bugs, aphids
- **Flexible**
  - Furrow, drench, foliar
- **Long residual**
  - Rate dependant
  - Excessive rain may impact
- **Low toxicity**
  - Soil applied

Disadvantages

- **Same chemical class (Group 4 MoA)**
- **Pollinator impact as foliar applications**
Cucumber Beetle & Seed Maggot Seed Treatment and In-Furrow Trials, 2009

**Cultural**

- Row cover early
- Transplants
- Trap crops on plastic mulches

**Locations / Crops**

- Sparta, WI – pumpkin
- Cashton, WI – cucumber
- Westby, WI – cantaloupe
- Tomah, WI – watermelon

**Chemical**

- At-plant, in-furrow systemic (neonicotinoids)
- Seed treatments (new technologies)
### Cucumber Beetle & Seed Maggot Seed Treatment and In-Furrow Trials, 2009

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Insecticide</th>
<th>Rate</th>
<th>Application Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Untreated control</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Lorsban 50W</td>
<td>2.0 oz / cwt</td>
<td>Seed</td>
</tr>
<tr>
<td>3</td>
<td>clothianadin + imidacloprid</td>
<td>1 mg + 0.33 mg a.i. / seed</td>
<td>Seed</td>
</tr>
<tr>
<td>4</td>
<td>(Supresto**)</td>
<td>0.75 + 0.25 mg a.i. / seed</td>
<td>Seed</td>
</tr>
<tr>
<td>5</td>
<td>imidacloprid (AdmirePro®)</td>
<td>10.5 fl oz / acre</td>
<td>In-furrow</td>
</tr>
<tr>
<td>6</td>
<td>thiamethoxam (Cruiser®)</td>
<td>0.75 mg a.i. / seed</td>
<td>Seed</td>
</tr>
<tr>
<td>7</td>
<td>(Platinum®)</td>
<td>11.0 fl oz / acre</td>
<td>In-furrow</td>
</tr>
<tr>
<td>8</td>
<td>row cover + thiamethoxam</td>
<td>0.75 mg a.i. / seed</td>
<td>Seed</td>
</tr>
<tr>
<td>9</td>
<td>row cover</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Note: not currently registered**
Percent Pumpkin Seedlings Damaged by Seedcorn Maggot  Sparta, WI  2009

![Diagram showing mean percent damaged seedlings for different treatments.](image)

- Seed treatments:
  - Untreated
  - Lorsban 50W
  - Supresto (1.33 mg)
  - Supresto (1.0 mg)
  - Cruiser (0.75 mg)
  - Admire Pro
  - Platinum

- In-furrow treatments:
  - Row Cover (Cruiser)
  - Row Cover

P = 0.0267, N=4
Percent Cucumber Seedlings Damaged by Seedcorn Maggot  
Cashton, WI  2009

Mean % damaged seedlings

P = 0.0597, N=4

Seed treatments

In-furrow treatments

Treatments

Untreated
Lorsban 50W
Supresto (1.33 mg)
Supresto (1.0 mg)
Cruiser (0.75 mg)
Admire Pro
Platinum
Row Cover (Cruiser)
Row Cover
Adult Cucumber Beetles per Pumpkin Plant
Sparta, WI  2009

Mean adult cucumber beetle / plant

Treatments

- Row Cover
- Row Cover (Cruiser)
- Platinum
- Admire Pro
- Cruiser (0.75mg)
- Supresto (1.0 mg)
- Supresto (1.33 mg)
- Lorsban 50W
- Untreated

In-furrow treatments:
- Row Cover (Cruiser)
- Admire Pro
- Supresto (1.33 mg)
- Platinum

Seed treatments:
- Cruiser (0.75mg)
- Supresto (1.0 mg)
- Lorsban 50W

July 2-29, 2009

P < 0.0001, N=4
Percent Bacterial Wilt / Pumpkin Plot
Sparta, WI  2009

Mean percent bacterial wilt / plot

In-furrow treatments

Seed treatments

P = 0.0084, N=4

Aug 29, 2009

©R.X. Latin
Adult Cucumber Beetles per Cucumber Plant
Cashton, WI  2009

Treatments

- Row Cover
- Row Cover (Cruiser)
- Platinum
- Admire Pro
- Cruiser (0.75mg)
- Supresto (1.0 mg)
- Supresto (1.33 mg)
- Lorsban 50W
- Untreated

Mean adult cucumber beetle / plant

P < 0.0001, N=4

Seed treatments

In-furrow treatments

July 2-29, 2009
Mean percent bacterial wilt / plot

- **Row Cover**
  - Treatment: Row Cover
  - Graphical representation: Bar graph with 'b'

- **Row Cover (Cruiser)**
  - Treatment: Row Cover (Cruiser)
  - Graphical representation: Bar graph with 'b'

- **Platinum**
  - Treatment: Platinum
  - Graphical representation: Bar graph with 'b'

- **Admire Pro**
  - Treatment: Admire Pro
  - Graphical representation: Bar graph with 'b'

- **Cruiser (0.75mg)**
  - Treatment: Cruiser (0.75mg)
  - Graphical representation: Bar graph with 'b'

- **Supresto (1.0 mg)**
  - Treatment: Supresto (1.0 mg)
  - Graphical representation: Bar graph with 'b'

- **Supresto (1.33 mg)**
  - Treatment: Supresto (1.33 mg)
  - Graphical representation: Bar graph with 'b'

- **Lorsban 50W**
  - Treatment: Lorsban 50W
  - Graphical representation: Bar graph with 'a'

- **Untreated**
  - Treatment: Untreated
  - Graphical representation: Bar graph with 'a'

**In-furrow treatments**

**Seed treatments**

**P = 0.0109, N=4**

**Treatments**

**Mean percent bacterial wilt / plot**

**Aug 29, 2009**
Cucumber Beetle & Seed Maggot 2009 Summary

- Neonicotinoid seed treatment and in-furrow uses have activity against seedcorn maggot and cucumber beetles.

- Lorsban 50W seed treatments effectively controlled seedcorn maggot, but provided no control of cucumber beetles or bacterial wilt.

- Neonicotinoid in-furrow uses consistently reduced cucumber beetle populations and lowered final incidence of bacterial wilt in all crops.

- Similar patterns in cucumber seed corn maggot and cucumber beetle control were observed in cantaloupe and watermelon.
Anthranilic Diamide Insecticides, 2009

- **Active ingredients**: chlorantraniliprole (aka rynaxypyr) and cyantraniliprole (aka cyazypyr) and flubendiamide (Belt 480SC)

- **Class**: anthranilic diamide (IRAC MoA Class 28)

- **Mode of action**: ryanodine receptor modulator
  - Systemic activity
  - Most effective through ingestion
  - Insects stop feeding, become paralyzed and die within 1 to 3 days
  - Applied to soil at planting, drip chemigation and foliar spray (no data on seed treatment application)
  - Exceptionally long residual control – xylem mobile
  - Active against Lepidopterans, Coleoptera, and other pests?
Objective

• To evaluate the efficacy of chlorantraniliprole and cyantraniliprole when applied as a seed treatment, and as an in-furrow spray for control of seedcorn maggot and cucumber beetle.
# Products Evaluated for Managing Insect Pests of Cucumber in WI, 2009

<table>
<thead>
<tr>
<th>Product</th>
<th>Active Ingredient</th>
<th>Type*</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cruiser 5FS</td>
<td>thiamethoxam</td>
<td>ST</td>
<td>1.28 fl oz/cwt of seed</td>
</tr>
<tr>
<td>Dermacor X</td>
<td>chlorantraniliprole</td>
<td>ST</td>
<td>1.28 fl oz/cwt of seed</td>
</tr>
<tr>
<td>Dermacor X</td>
<td>chlorantraniliprole</td>
<td>ST</td>
<td>3.84 fl oz/cwt of seed</td>
</tr>
<tr>
<td>HGW86 60FS</td>
<td>cyantraniliprole</td>
<td>ST</td>
<td>1.28 fl oz/cwt of seed</td>
</tr>
<tr>
<td>HGW86 60FS</td>
<td>cyantraniliprole</td>
<td>ST</td>
<td>3.84 fl oz/cwt of seed</td>
</tr>
<tr>
<td>Coragen</td>
<td>chlorantraniliprole</td>
<td>IF</td>
<td>5 fl oz/acre</td>
</tr>
<tr>
<td>Coragen</td>
<td>chlorantraniliprole</td>
<td>IF</td>
<td>7 fl oz/acre</td>
</tr>
<tr>
<td>HGW86 60FS</td>
<td>cyantraniliprole</td>
<td>IF</td>
<td>6.75 fl oz/acre</td>
</tr>
<tr>
<td>HGW86 60FS</td>
<td>cyantraniliprole</td>
<td>IF</td>
<td>13.5 fl oz/acre</td>
</tr>
<tr>
<td>Durivo</td>
<td>chlorantraniliprole + thiamethoxam</td>
<td>IF</td>
<td>13 fl oz/acre</td>
</tr>
</tbody>
</table>

*ST = seed treatment; IF = in furrow application
Percent Cucumber Seedlings Damaged by Seedcorn Maggot - Almond, WI 2009

Mean % damaged seedlings (25 samples)

Treatments

Seed treatments

In-furrow spray

P = 0.0097, N=4

- Untreated
- Cruiser 5FS
- Dermacor (low)
- Dermacor (high)
- HGW86 (low)
- HGW86 (high)
- Coragen (low)
- Coragen (high)
- HGW86 20SC (low)
- HGW86 20SC (high)
- Durivo

Agricultural treatments and their effects on cucumber seedlings damaged by seedcorn maggots.
Cucumber Beetle Adult and Percent Bacterial Wilt
Almond, WI 2009

Treatments

Untreated
Cruiser 5FS
Dermacor (low)
Dermacor (high)
HGW86 (low)
HGW 86 (high)
Coragen (low)
Coragen (high)
HGW86 (low)
HGW86 (high)
Durivo

P = 0.5618 N=4
P = 0.1145 N=4

Seed treatments

In-furrow treatments

Cucumber beetles / plant
Bacterial wilt / plot
Chlorantraniliprole and cyantraniliprole have activity against seedcorn maggot, more information is needed to determine effects on cucumber beetles and other Lepidopteran pests.

Clorantraniliprole and cyantraniliprole were effective against the target pests when applied as seed treatments and as in-furrow sprays.
Future Research

• Repeat experiments in 2010 in WI and attempt to generate efficacy data for major pests

• Refine rates of chlorantraniliprole and cyantraniliprole, especially for seed treatments

• Assess the *actual* contribution of at-plant crop protectants in commercial pickling cucumbers (e.g. Dively et al. 1993-94) - compensation
Acknowledgements

Collaborators
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Jerry Schneider & Lisa Riniker, Sparta, WI
Chris Hershberger, Westby, WI
Joe Kauffman, Cashton, WI
Mike and David Warzynski, Almond, WI

QUESTIONS