Snap Bean Insect Pest Management - ECB management – SCRI Research Update

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WCMC
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Outline

• Specialty Crops Research Initiative

• Results of 2012-2014 insecticide delivery trial

• 2014-15 ECB pheromone trap network

• Future directions and new risk assessment tools for ECB
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, Colquhuon, Hutchison, Nault, Groves, Ruark)

**Objective 4:** Build critical mass of support for sustainably grown and processed vegetables.
Diamides - a new reduced-risk material

IRAC - Insecticide Mode of Action Classification
Insecticide Resistance Action Committee  www.irac-online.org

Nerve & Muscle Targets

Group 1 Acetylcholinesterase (AChE) inhibitors
  1A Carbamates (e.g. methomyl)
  1B Organophosphates (e.g. chlorpyrifos)

Group 2 GABA-gated chloride channel antagonists
  2A Cyclodiene Organochlorines (e.g. endosulfan)
  2B Phenylpyrazoles (e.g. fipronil)

Group 3 Sodium channel modulators
  3A Pyrethrins, Pyrethroids (e.g. λ-cyhalothrin)

Group 4 Acetylcholine receptor (nAChR) agonists
  4A Neonicotinoids (e.g. imidacloprid)
  4C Sulfoximines (e.g. sulfoxatral)

Group 5 Nicotinic acetylcholine receptor channel agonists (allosteric)
  5 Spinosyns (e.g. spinetoram)

Group 6 Chloride channel activators
  6 Avermectins (e.g. abamectin)

Group 9 Non-specific mode of action
  (feeding blockers)
  9B Pymetrozine
  9C Flonicamid

Group 14 Nicotinic acetylcholine receptor channel blockers
  14 Neurystoxin analogs (e.g. Cartap)

Group 19 Octopamine receptor agonists
  19 Amitraz

Group 22 Voltage dependent sodium channel blockers
  22A Indoxacarb
  22B Metalumizone

Group 28 Ryanodine receptor modulators
  28 Diamides (e.g. cyantraniliprole)

Respiration Targets

Group 12 Inhibitors of mitochondrial ATP synthesis
  12A Difenthion
  12B Organotin miticides (e.g. cyhexatin)
  12C Propargite
  12D Tetraion

Group 13 Uncouplers of oxidative phosphorylation via disruption of H proton gradient
  13 Chlorfenapyr

Group 20 Mitochondrial complex III electron transport inhibitors
  20A Hydramethylnon
  20B Acequinocyl
  20C Flucrypyrim

Group 21 Mitochondrial complex I electron transport inhibitors
  21A METI acaricides (e.g. tebufenpyrad)

Group 23 Inhibitors of acetyl CoA carboxylase
  23 Tectonic & Tetramic acid derivatives (e.g. spirolidolene)

Group 25 Mitochondrial complex II electron transport inhibitors
  25 Cyenopyrafen

Midgut Targets

Group 11 Microbial disruptors of insect midgut membranes
  11A Bacillus thuringiensis
  11B Bacillus sphaericus

Unknown

UN compounds of unknown or uncertain mode of action
  UN Azadiractin
  UN Bifenazate
  UN Pyridalyl
  UN Pyriflulquinazone

Adapted from IRAC General MoA Poster 2012  Photo John Capinera
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 neonics or pyrethroids

**Exirel 10SE (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 (?)

**Coragen™ (rynaxypyr):**
- Anthranillic diamide (MoA group 28)
  - Use rate 3.5 - 5 fl. oz / ac (foliar)
  - Control of Leps
SCRI-IPM project objectives (NY & WI)

1. Small-plot field trials
   - Evaluate reduced-risk products (e.g. diamides) for insect control in bean
   - Evaluate earlier application timings of reduced-risk products for ECB and PLH control
   - Evaluate compatibility of diamide insecticides with either fungicides or herbicides for ECB and PLH control

2. Field-scale implementation trials
   - Compare effectiveness of a new pest management program using reduced-risk products with the current approach
   - Compare effectiveness of a new sustainable pest, disease and weed control program with the current approach
Conventional management program

Days after planting

- planting
- harvest
- thiamethoxam seed trt.
- foliar pyrethroid
- flower
- pin to pod
- bean crop

Crop
Conventional
Fungicide & insecticide tank mix

- **planting**: thiamethoxam seed trt.
- **fungicide + diamide**
- **foliar pyrethroid**
- **bean crop**
- **harvest**: flower, pin to pod
2012, 2013 & 2014 small plot ECB trial

- RCBD (5 reps x 20 trts. + UTC)
- Three treatment windows:
  - pre-bud herbicides
  - early bloom fungicides
  - pin fungicides
- 2 insecticides – Brigade & Exirel 20SE (diamide)
  (13.5 & 20.5 fl oz./ac ± MSO)
- Herbicides: Reflex (fomesafen) + Basagran (bentazon)
- Fungicides: Topsin (thiophanate-methyl, Bravo (chlorothalonil)
- Infested with ECB neonates (n≈2,500 per plot)
Results – Proportion pods damaged

- 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 2012 and 2013, but not 2014.

- Treatment by timing interactions were not significant in either year.
Means separation by treatment and timing – NY 2013

Huseth et al. 2015
Means separation by treatment and timing – WI 2013

<table>
<thead>
<tr>
<th>Phenological stage</th>
<th>Insecticide</th>
<th>Plant damage</th>
<th>Pod damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>untreated</td>
<td>-</td>
<td>18.5±5.2 a</td>
<td>8.7±2.5a</td>
</tr>
<tr>
<td>bud</td>
<td>bifenthrin (6.4 fl oz/ac)</td>
<td>9.0±6.4 b</td>
<td>2.6±1.2 bc</td>
</tr>
<tr>
<td></td>
<td>chlorantraniliprole (5.0 fl oz/ac) (aka. rynaxypyr) – Coragen 1.67SC</td>
<td>4.1±3.3 bc</td>
<td>1.9±1.1 bc</td>
</tr>
<tr>
<td></td>
<td>cyantraniliprole (10.2 fl oz/ac) (aka. cyazypyr) – Exirel 10OD</td>
<td>1.0±0.7 c</td>
<td>0.7±0.3 bc</td>
</tr>
<tr>
<td></td>
<td>cyantraniliprole (13.5 fl oz/ac) (aka. cyazypyr) – Exirel 10 OD</td>
<td>0.8±0.5 c</td>
<td>0.6±0.2 c</td>
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<tr>
<td>bloom</td>
<td>bifenthrin (6.4 fl oz/ac)</td>
<td>0.7±0.4 c</td>
<td>1.4±0.4 bc</td>
</tr>
<tr>
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<td>chlorantraniliprole (5.0 fl oz/ac) (aka. rynaxypyr) – Coragen 1.67SC</td>
<td>0.0±0.0 c</td>
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<td>cyantraniliprole (10.2 fl oz/ac) (aka. cyazypyr) – Exirel 10OD</td>
<td>0.1±0.1 c</td>
<td>0.2±0.1 c</td>
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<td>0.0±0.0 c</td>
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</tr>
<tr>
<td>pod formation</td>
<td>bifenthrin (6.4 fl oz/ac)</td>
<td>0.0±0.0 c</td>
<td>0.0±0.0 c</td>
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<td>0.3±0.1 c</td>
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</table>
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 a in-furrow and as a liquid fertilizer pre-mix applications.
2013 & 2014 field implementation trial

- **8 conventional** fields paired with **8 novel** treatment fields planted between 6/24 & 7/23/2013 and 6/2 & 6/19/2014
- Collaborators: Seneca Foods, Nault, Dillard, & Kikkert
- cv. Huntington and Summit
- Livingston, Steuben and Yates counties
- Approximately 198 acres
- Commercial yields and ECB contaminants

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<tbody>
<tr>
<td>At-plant</td>
<td>Cruiser + fung.</td>
<td>Cruiser + fung.</td>
<td>SCM, PLH, diseases</td>
</tr>
<tr>
<td>Early bloom (10-30%)</td>
<td>Topsin + Bifenture</td>
<td>Topsin @ threshold + Coragen</td>
<td>White mold &amp; ECB</td>
</tr>
<tr>
<td>Late bloom (100%)</td>
<td>Bravo + Bifenture</td>
<td>Bravo + Coragen</td>
<td>White mold &amp; ECB</td>
</tr>
</tbody>
</table>

\(^a\)pre-emerge (Dual), first trifoliate (Basagran & Reflex)

\(^b\)pre-emerge (none), first trifoliate (Dual, Basagran, Reflex, Select Max)
2013 & 2014 paired field treatments

Average field size:
2013: 5.1±2.3 ha
2014: 8.0±3.1 ha

Avg. pair distance:
2013: 1.0±0.5 km
2014: 1.4±1.8 km
Results – 2013 & 2014 field implementation trial

2013 commercial trial results

- No ECB detected in crop in either study year.

- 2013 average marketable bean yield in bifenthrin treated fields was 9.5±2.6 metric tonnes ha⁻¹ in 2013 and 10.3±2.2 metric tonnes ha⁻¹ in 2014.

- Average marketable bean yield in chlorantraniliprole treated fields was 10.0±3.7 metric tonnes ha⁻¹ in 2013 and 11.4±3.9 metric tonnes ha⁻¹ in 2014.

*If insects remain at low densities are insecticides always necessary?*
Future directions: ECB population decline in NY

<table>
<thead>
<tr>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<th>2012</th>
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Cumulative European corn borer catches

Location:
- adams
- auburn
- avoca
- avon
- baldwinsville
- batavia
- bellona
- conewango valley
- cortland
- edenZ
- farmington
- great valley
- hamlin
- interlaken
- kennedy
- king ferry
- kirkville
- leroy
- lockport
- medina
- olean
- oswego
- owego
- penn yan
- pike
- plessis
- preble
- sherwood
- spencerport
- waterport
- wayland
- williamson

IPM

Wisconsin University of Wisconsin-Madison
Pheromone trap locations 2008-2014

- Pheromone catch data
- Land cover data (NASS-CDL)
- Landscape-based risk model

*Has Bt corn affected pest density in Western NY?*
ECB trap data & corn production intensity
ECB landscape risk objective

Describe the influence of transgenic crop abundance on ECB abundance in alternate host crops

1. Abundance of ECB will decline with BT abundance* in the landscape that will result in an ecosystem service (benefit) to processing crops (A).

2. The abundance of pyrethroid treated sweet corn will provide a stable refugia from Bt and greater risk to processing crops in specific WNY agroecosystems (B).

*Assuming a high proportion of maize grown in WNY contains one or more Bt events that have lepidopteran activity
Estimating corn abundance in time

- Compile NASS Cropland Data Layers 2008-2013
- Reclassify crop types for each year (corn or not)
- Sum annual corn incidence
- Calculate spatiotemporal abundance from GIS output:

$$\text{Corn dominance metric} = \frac{\sum_{i=1}^{j} \sum_{i=1}^{j} T_i}{\sum_{i=1}^{j} T_i}$$
Sampled locations 2014

- 40 sampled fields
- Maintained 20 high risk & 20 low traps

ECB-E pheromone
July – mid September (N=40 sites)

Avon, NY – CDM score: 3.37
Dansville, NY – CDM score: 1.22
Sampled snap bean fields 2014 continued in 2015
European corn borer - phenology

Redrawn with permission, Brian Flood Del Monte Foods
**Insecticides for Managing Snap Bean Pests**

Recently Labeled in Wisconsin:

- Radiant SC (spinetoram)
- Coragen 1.67 SC (chlorantraniliprole) – foliar
- Blackhawk (spinosad) – foliar
- Beseige (chlorantraniliprole + lambda-cyhalothrin) (aka. Voliam Xpress)
- Belt SC (flubendiamide) – foliar
- Entrust SC (spinosad) – foliar
- Movento (spirotetramat) – foliar (sap-feeding insects only)
- Transform WG (sulfoxaflor) – foliar (cancelled)

In the Pipeline or in Review:

- Exirel, Verimark (cyantraniliprole) – 2015/16
Questions?