Integrated Pest Management of Ginseng

2010 Spring Ginseng Growers Meeting
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1) Current challenges of managing insect pests

2) Key insect pests of ginseng and new insecticide products

3) Novel delivery systems for water-soluble insecticides
## 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>
<td></td>
</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>
<td></td>
</tr>
<tr>
<td>Ginseng</td>
<td>1</td>
<td>1,650</td>
<td>81%</td>
<td>$58</td>
</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.
Macro-Factors Influencing Insect Pest Management

- Increasing population and changing demographics
- Changes in food consumption
- Decreasing arable land
- Decreasing availability of water
- Food safety
- Concern for the environment
- Global agricultural trade
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.
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.
Wisconsin Insect 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
1) Current challenges of managing insect pests

2) Key insect pests of ginseng and new insecticide products

3) Novel delivery systems for water-soluble insecticides
Varied Ginseng Insect Pests

**Key Pests**
- Wireworms
- White Grubs
- Cutworms - armyworms

**Sporadic Pests**
- Four-lined plant bugs
- Leaf rollers
- Aphids

**Intermittent Pests**
- Thrips
- Scale
- Mealybugs
- Stem borers

White grub (*Phyllophaga* spp.)
Ginseng Insect Pests

Pest Management Strategic Plans (Hausbeck 2007)

Top research priorities identified during the 2007 PSMP Workshop:

1) *Identify new active ingredients effective against grubs, cutworms and wireworms; and*

2) Identify pathogens that may be seedborne and identify effective treatments;

3) Develop management strategies for root rot diseases, including *Phytophthora, Cylindrocarpon, and Fusarium.*
Mint Insect Control: Variegated & Black Cutworm

- Early season leaf damage / stand loss
- Mid to later season leaf damage / localized
Cutworm & Looper Control

Established Thresholds: Undetermined (2-3 larvae ft²)

Early Season:

Diazinon AG600 WBC (0.75 – 1.0 pt / ac)

Candidate Options:

Bifenture EC (0.08 - .1 lb ai/ac)
Coragen (0.046 – 0.065 lb ai/ac)
Avaunt 30 WDG (0.065 – 0.11 lb ai/ac)
Radiant SC (0.03-0.09 lb ai/ac) (2008)
Reduced-Risk Foliar Registrations (2009-10)

- **Radiant® SC (spinetoram)**
  - Macrocyclic lactone (spinosad: MoA group 5)
  - Use rate 4 - 12 oz / ac (Lepidoptera)
  - 10-14 days persistence (improved photostability)
  - Very low impact on beneficials

- **Coragen™ (chlorantraniliprole)**
  - Anthranilic diamide (MoA group 28)
  - Use rate 3 - 6 oz (Lepidoptera) +MSO 5% v/v
  - 14+ days persistence
  - Very low impact on beneficials and low toxicity
  - Ovicidal activity
  - IR-4, Under review

Corn earworm larvae ‘dead’
Wireworms & White Grubs

**White grub (June beetle)**
- 2-3 year life cycle
- Adults lay eggs in grass
- Larvae feed on tubers 2-3 years

**Wireworm (click beetle)**
- 4-6 year life cycle
- Adults lay eggs on grass
- Larvae feed 3-5 years on tubers
Wireworms & White Grubs

- Soil-dwelling larvae (grubs) of June and click beetles
- Worldwide in distribution
- Many different species, all with unique lifecycles
- Can be a pest on a wide range of crops:
  - cereals, vegetables, soft fruit, and potatoes

White grub larva

Wireworm larvae
Generalized Wireworm Lifecycles

- Varied, taking 3 – 4 years to develop from egg to adult.
- Nearly all spent in larval stages: egg & pupa = 1 month
- Overwinter at 10 – 24”, movement > 55°F
- Females emerge to mate, then burrow and re-emerge to oviposit

![Diagram showing the life cycle of a wireworm, including stages such as eggs, larvae, and adult emergence.](image-url)
Wireworm Damage

Field corn

Sweetpotato

Transplant Cucumbers

Beans

Peanuts
Wireworm Risk Assessments: Surveillance and Monitoring

- **Placement of bait stations:** spring or fall with warm soils.

- **Polyethylene to warm the surrounding soil and liberate CO₂.**

- **Be mindful of field history for placement. Problems have often been associated with past cropping history (e.g. grasses).**

- **Pheromone traps:** (future evaluation needed)
### Wireworm Action Thresholds: Interpreting Trap Counts

<table>
<thead>
<tr>
<th>Mean No. wireworms per station</th>
<th>Risk of Damage</th>
<th>IPM Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Low (&lt; 10%)</td>
<td>Control Not Needed</td>
</tr>
<tr>
<td>&lt; 0.5</td>
<td>Moderate (33%)</td>
<td>Resample soil</td>
</tr>
<tr>
<td>0.5 &lt; X &lt; 1.0</td>
<td>50:50</td>
<td>Resample soil</td>
</tr>
<tr>
<td>1.0 &lt; X &lt; 2.0</td>
<td>Probable (&gt; 50%)</td>
<td>Resample soil</td>
</tr>
<tr>
<td>2.0 &lt; X &lt; 4.0</td>
<td>High (&gt; 75%)</td>
<td>Apply insecticide at-planting</td>
</tr>
<tr>
<td>&gt; 4.0</td>
<td>Extreme</td>
<td>Do not plant</td>
</tr>
</tbody>
</table>
Summary of wireworm insecticide trials - Kuhar et al. 2007

On average, all treatments provide ~60-70% control.
Physical placement of insecticides:

Potato seed and in-furrow, banded insecticide in newly planted field

Developing crop and residual insecticide at harvest
Possible explanations for increasing damage to crops

• Increased rotations with grasses for soil conservation or small grain, corn production
• Relatively mild winters in the last several years
• Changes in the culture of primary rotation crops
• The loss of registration of insecticides with long residual soil activity
  – “Older chemistries (slated for removal by EPA-FQPA) are finally dissipating”. Some materials had a half-life of 20 years.
Important Considerations

- Broadcast treatments sometimes work better than in-furrow treatments, or vice versa.
  - Broadcast good in field with random sources of CO$_2$ (i.e. green manure).
  - In-furrow good in well fallowed fields.

- Treatments expected to work well (e.g. Thimet) sometimes give mediocre results.

- It should be noted, land prep is a critical variable and should always be considered and recorded.

- For growers, they should be informed that competing CO$_2$ sources at planting (e.g. green manure) will reduce pesticide efficacy.
Another Explanation: Climate and Species Composition

D. A. Johnson, 2008
Not all wireworms are created equal

- Different species of wireworms express different responses to insecticides, leading to:
  - Varying levels of crop protection (e.g. potato)
  - Varying levels of intoxication
  - Varying levels of mortality
  - Varying levels of repellency

- Knowing the wireworm(s) we are dealing to the species level is a must if we want to accurately report and compare data.
Changing Cultural Management of Field Corn

- Bt transgenics:
  - Activity against European corn borer, corn earworm, rootworms, cutworms, and armyworms: not wireworm.

- Adoption of transformants continues to increase:
  - 2004 (22%) to 2007 (49%)

- RR Technology has lead to grass competition: armyworm
  - Burn down dates have been extended.

- Land removed from conservation reserve program (CRP):
Difficult Pest Management

- Incomplete understanding of wireworm biology
- Limited availability of completely effective chemicals
- Lack of efficient and labor-friendly monitoring tools which would allow growers to predict likelihood of damage or to assist in decisions about the necessity of insecticide treatment
1) Current challenges of managing insect pests

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Drip Application for Insect Control (Cucurbits, Fruiting Vegetables, Brassicas, Potatoes)

• Why use drip irrigation for insecticide applications?

• What insects are controlled with drip application?

• Regulations and tips for best results of drip chemigation.
Pesticide Drift

- Amount of pesticide lost due to drift estimated at 5 to 65%.
- Less than 0.1% of pesticide reaches target insect.
- Consequences of pesticide drift
  - Exposure of humans
  - Exposure of water resources
  - Exposure of wildlife
Limitations of Spraying Insecticides

• Weather conditions
  – Wind
  – Rain
  – Wash-off

• Re-entry intervals

• Pre-harvest intervals
Advantages of Drip Application of Insecticides

• Reduced risk to environment and farm workers
  – Drift to non-target areas is eliminated
  – Farm workers do not come into contact with residues on exterior of plant
  – Beneficial organisms not directly exposed

• Longer residual activity
  – Not subject to loss from rain and UV light
  – Not subject to plant growth dilution effects

• More cost-effective
What Insecticides Can Be Applied in Drip Irrigation Systems

- **Must move systemically through plant.**
- **Label must specifically state that product can be applied via drip irrigation**

**Neonicotinoids**
- Admire
- Platinum
- Venom

**Diamides**
- Coragen
- Synapse
- **HGW86**

**Carbamates**
- Vydate

**Durivo**
Thiamethoxam & Imidacloprid

- **Platinum 75SG** (1.7 – 4.0 fl oz/ac)
- **Admire Pro** (4.4 – 10.5 fl oz/ac)
  - Brassicas, Cucurbits,
  - Fruiting Veg, Potato, and Ginseng

**Spectrum of Activity**
- Wireworms, white grubs, plant bugs
- Suppression of aphids, thrips, whiteflies

**Systemic activity**
- Labeled for foliar and drip irrigation application
Chlorantraniliprole (Rynaxypyr)

- **Coragen 1.67SC**
  - Brassicas, Cucurbits, Fruiting Veg, Leafy Veg, Potato

- **Spectrum of Activity**
  - Lepidopterans, some beetles (CPB)
  - Wireworm and white grub suppression at higher rates

- **Systemic activity**
  - Labeled for foliar and drip irrigation application

**Not currently labeled for Ginseng**
Chlorantraniliprole + Thiamethoxam

- **Durivo 1.67SC**
  - 2:1 mixture of thiamethoxam & chlorantraniliprole
  - Brassicas, Cucurbits, Fruiting Veg, Leafy Veg

- **Spectrum of Activity**
  - Lepidopterans, leafhoppers, cucumber beetle
  - Aphids, Beetles, Plant & Stink Bug, Thrips, White grubs and Wireworms

- Drip application only, 1 application/year.
- 5-day REI for honeybees.

**Not currently labeled for Ginseng**
Drip Irrigation of Insecticides
ATCP 29 Rule, Pesticide Use and Control, Revised September 2009. ATCP 29.54 Chemigation.

http://datcp.state.wi.us/cp/consumerinfo/cp/cp_laws/pesticides/pesticide_use.pdf
For Best Results with Drip-Applied Insecticides

- Repair all leaks before chemigating.
- Before injection of insecticide begins, system must be fully pressurized.
- **Minimum** injection time should be time for water to move from injection point to most distant emitter.
- **Water solubility and soil texture affects movement in soil, and timing of injection.**
  - Low solubility = limited movement
  - High solubility = readily moves in soil
Conclusions

• Drip application of insecticides offers several advantages over foliar application, including safety, flexibility and longer residual control.

• Combinations of several insecticides with different MoA can achieve broad spectrum insect control.

• Be sure irrigation system is legal for chemigation, and provides uniform distribution of water.
Acknowledgements

Wisconsin Ginseng Growers

QUESTIONS ?