Drip Irrigation Delivery of Reduced Risk Insecticides

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Vegetable Crop Management – Mendota I

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Wisconsin Vegetable Pest Management

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

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

*Vegetable IPM*
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.
Drip Application for Insect Control (Cucurbits, Fruiting Vegetables, Brassicas)

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

- Why use drip irrigation for insecticide application?

- What insects are controlled with drip irrigation applications?

- Regulations and tips for best results of drip chemigation.
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 – Admire Pro
  - Brassicas, Cucurbits, Fruiting Veg, Leafy Veg, Potato

- Spectrum of Activity
  - Cucumber beetles, squash bug, flea beetle, seed maggots, & CPB
  - 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)
  - Whitefly suppression at higher rates

- **Systemic activity**
  - Labeled for foliar and drip irrigation application
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, Mealybug, Whitefly

- Drip application only, 1 application/year.
- 5-day REI for honeybees.
Drip Irrigation of Insecticides
## Potato Insect Pest Management
### Drip Irrigation Injection Trials, HAES 2010

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Insecticide</th>
<th>Rate</th>
<th>Application Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>chlorantraniliprole (Coragen®)**</td>
<td>7.0 fl oz / A</td>
<td>In-furrow</td>
</tr>
<tr>
<td>2</td>
<td>chlorantraniliprole</td>
<td>3.5 &amp; 3.5 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>3</td>
<td>Imidacloprid (AdmirePro®)</td>
<td>8.7 fl oz / A</td>
<td>In-furrow</td>
</tr>
<tr>
<td>4</td>
<td>thiamethoxam (Platinum®)</td>
<td>5.0 &amp; 3.7 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>5</td>
<td>thiamethoxam (Platinum®)</td>
<td>2.67 oz / A</td>
<td>In-furrow</td>
</tr>
<tr>
<td>6</td>
<td>chlorantraniliprole + thiamethoxam (Durivo®)**</td>
<td>6.0 &amp; 7.0 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>7</td>
<td>Dinotefuran (Scorpion®)</td>
<td>6.0 &amp; 6.0 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>8</td>
<td>Untreated Control</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Note: not currently registered**
## Colorado Potato Beetle Control (1st Generation)

### Larval counts May 28 – June 18

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Larvae / 10 plants</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection</td>
<td>5</td>
<td>0.2738</td>
</tr>
<tr>
<td>In-furrow, at-plant (27 Apr)</td>
<td>10</td>
<td>0.1163</td>
</tr>
<tr>
<td>2, injections (2 and 16 June) – HAES</td>
<td>10</td>
<td>0.0861</td>
</tr>
<tr>
<td>Coragen 1.67SC</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Admire Pro</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Platinum 75SG</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Scorpion (12 oz)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Durivo (13.0 oz)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

### In-furrow, at-plant (27 Apr)

2, injections (2 and 16 June) – HAES
Colorado Potato Beetle Control (2nd Generation)

In-furrow, at-plant (27 Apr) 2, injections (2 and 16 June) – HAES

Larval Counts June 18 – July 27

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Larvae / 10 plants</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection</td>
<td>20</td>
<td>0.0105</td>
</tr>
<tr>
<td>In-furrow</td>
<td>30</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Injection</td>
<td>20</td>
<td>0.0094</td>
</tr>
<tr>
<td>In-furrow</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Scorpion (12 oz)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Durivo (13 oz)</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

Coragen 1.67SC  Admire Pro  Platinum 75SG
Colorado Potato Beetle Control (Defoliation)

In-furrow, at-plant (27 Apr) Defoliation assessed July 27
2, injections (2 and 16 June) – HAES

Mean Percent Defoliation

- Injection
- In-furrow
- Injection
- In-furrow
- Injection
- In-furrow
- Scorpion (12 oz)
- Durivo (13.0 oz)
- Control

P = 0.0725  P = 0.0469  P = 0.0833

20% Defoliation
In-furrow, at-plant (27 Apr)       PLH Counts 18, 26 June and 2 July
2, injections (2 and 16 June) – HAES

P = 0.1198
P = 0.3816
P = 0.5985

1 adult PLH / sweep
Potato Aphid Control

In-furrow, at-plant (27 Apr)  
Aphid Counts 16, 23, 30 July 
2, injections (2 and 16 June) – HAES

P = 0.0277
P = 0.1619
P = 0.0503
Potato Insect Pest Management, Drip Irrigation Injection Field Trials, Coloma Farms 2010

Experimental Treatments
- Density (spacing)
- Deficit Irrigation (emitter)
- Hills vs. Beds

Insect Counts (3 zones)
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Insecticide</th>
<th>Rate</th>
<th>Generation</th>
<th>Application Type (Date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>thiamethoxam ($42/A)</td>
<td>2.67 oz / A</td>
<td>1st generation</td>
<td>Injection (June 6)</td>
</tr>
<tr>
<td></td>
<td>(Platinum® 75SG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>chlorantraniliprole ($42/A)</td>
<td>5.0 fl oz / A</td>
<td>2nd generation</td>
<td>Foliar (July 12)</td>
</tr>
<tr>
<td></td>
<td>(Coragen® 1.67SC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone 2</td>
<td>thiamethoxam ($68/A)</td>
<td>2.67 oz / A</td>
<td>1st generation</td>
<td>In-furrow (May 4)</td>
</tr>
<tr>
<td></td>
<td>(Platinum® 75SG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>spinetoram ($68/A)</td>
<td>8.0 fl oz / A</td>
<td>1st generation</td>
<td>Foliar (June 13)</td>
</tr>
<tr>
<td></td>
<td>(Radiant® SC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>chlorantraniliprole ($68/A)</td>
<td>5.0 fl oz / A</td>
<td>2nd generation</td>
<td>Foliar (July 17)</td>
</tr>
<tr>
<td></td>
<td>(Coragen® 1.67SC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone 3</td>
<td>thiamethoxam ($64/A)</td>
<td>2.67 oz / A</td>
<td>1st generation</td>
<td>In-furrow (May 4)</td>
</tr>
<tr>
<td></td>
<td>(Platinum® 75SG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>chlorantraniliprole ($64/A)</td>
<td>5.0 fl oz / A</td>
<td>1st generation</td>
<td>Foliar (June 13)</td>
</tr>
<tr>
<td></td>
<td>(Coragen® 1.67SC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.5 fl oz / A</td>
<td>2nd generation</td>
<td>Foliar (July 12)</td>
</tr>
</tbody>
</table>
Coloma Field Trial (1st Generation CPB)

Mean Larvae / 10 plants

Zone 1

Manifold

Cap

Zone 2

Zone 3

Platinum (injection) Coragen (1X foliar) ($42/A)
P = 0.1839

Platinum (in-furrow) Radiant (1X foliar) Coragen (1X foliar) ($68/A)
P = 0.0862

Platinum (in-furrow) Coragen (2X foliar) ($64/A)

P = 0.0862
Coloma Field Trial (2nd Generation CPB)

Mean Larvae / 10 plants

Manifold
Cap
Zone 2
Zone 3

Platinum (injection)
Coragen (1X foliar)
($42/A)
P = 0.5507

Platinum (in-furrow)
Radiant (1X foliar)
Coragen (1X foliar)
($68/A)
P = 0.1937

Platinum (in-furrow)
Coragen (2X foliar)
($64/A)

Zone 1

0 10 20 30
Coloma Field Trial (Defoliation - CPB)

Mean Percent Defoliation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum (injection) Coragen (1X foliar)</td>
<td></td>
<td>P = 0.2902</td>
</tr>
<tr>
<td>($42/A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum (in-furrow) Radiant (1X foliar)</td>
<td></td>
<td>P = 0.0955</td>
</tr>
<tr>
<td>Coragen (1X foliar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($68/A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum (in-furrow) Coragen (2X foliar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($64/A)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Zone 1

Platinum (injection)
Coragen (1X foliar)
($42/A)

P = 0.2902
# Drip Insecticide Program on Fruiting Vegetables

<table>
<thead>
<tr>
<th>Time</th>
<th>Insecticide (PHI)</th>
<th>Rate/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-plant transplant</td>
<td>AdmirePro (21)</td>
<td>0.44 oz / 10,000 plants</td>
</tr>
<tr>
<td>28 days after planting*</td>
<td>Coragen + Admire Pro or... Platinum (30) or Durivo (30)</td>
<td>3.5 - 5 oz/acre 7 - 10.5 oz/acre 5 - 11 oz/acre 10 - 13 oz/acre</td>
</tr>
</tbody>
</table>

*Application of AdmirePro, Plantinum or Durivo must be timed not to violate PHI.

**Season scouting program to determine need for supplemental insecticide sprays should focus on thrips, mites and possibly stink bugs.
**Drip Insecticide Program on Brassicas**

<table>
<thead>
<tr>
<th>Time</th>
<th>Insecticide (PHI)</th>
<th>Rate/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-plant transplant</td>
<td>AdmirePro (21)</td>
<td>0.44 oz / 10,000 plants</td>
</tr>
<tr>
<td>14-21 days after planting</td>
<td>Coragen (14)</td>
<td>3.5 - 5 oz/acre</td>
</tr>
<tr>
<td>30 days after planting*</td>
<td>Coragen + Admire Pro or…</td>
<td>3.5 - 5 oz/acre</td>
</tr>
<tr>
<td></td>
<td>Platinum (30)</td>
<td>7 - 10.5 oz/acre</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td>5 - 11 oz/acre</td>
</tr>
<tr>
<td></td>
<td>Durivo (30)</td>
<td>10 - 13 oz/acre</td>
</tr>
</tbody>
</table>

*Application of AdmirePro, Plantinum or Durivo must be timed to not violate PHI.

**Season scouting program to determine need for supplemental insecticide sprays should focus on thrips, mites and possibly stink bugs.**
## Drip Insecticide Program on Cucurbits

<table>
<thead>
<tr>
<th>Time</th>
<th>Insecticide (PHI)</th>
<th>Rate/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-plant transplant</td>
<td>AdmirePro (21)</td>
<td>0.44 oz / 10,000 plants</td>
</tr>
<tr>
<td>14 - 21 days after planting*</td>
<td>Coragen + Admire Pro**</td>
<td>Platinum (30) or...</td>
</tr>
<tr>
<td></td>
<td>or Durivo (30)</td>
<td></td>
</tr>
<tr>
<td>28 - 35 days after planting*</td>
<td>Coragen (14)</td>
<td>3.5 - 5 oz/acre</td>
</tr>
</tbody>
</table>

*Application of AdmirePro, Platinum or Durivo must be timed to not violate PHI.

**Season scouting program to determine need for supplemental insecticide sprays should focus on thrips, mites and possibly stink bugs.
Drip Application for Insect Control

- Why use drip irrigation for insecticide application?
- What insects are controlled with Drip Application?
- Regulations and tips for best results of drip chemigation.
Drip Application System Requirements of Injection of Insecticides (READ LABEL)

- Check valve, vacuum relief valve, and low pressure drain.
- Automatic, quick closing check valve in injection pipeline.
- Solenoid-operated valve on intake side of injection pump.
- Interlocking controls to shut off injection pump when water pump stops.
- Irrigation or water pump must contain pressure switch to stop water pump when pressure drops.
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
# Water Solubility of Insecticides Registered for Drip Chemigation

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Water solubility (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coragen (chlorantraniliprole)</td>
<td>0.001</td>
</tr>
<tr>
<td>Imidacloprid (AdmirePro)</td>
<td>0.58</td>
</tr>
<tr>
<td>Platinum (thiamethoxam)</td>
<td>4.1</td>
</tr>
<tr>
<td>Venom (dinotefuran)</td>
<td>39.83</td>
</tr>
<tr>
<td>Vydate (oxamyl)</td>
<td>229.0</td>
</tr>
</tbody>
</table>
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

Collaborators
AJ Bussan, UW Horticulture
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Steve and Andy Dierks, Coloma Farms, Coloma WI

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Scott Chapman
Anders Husetth
Jolyn Rasmussen

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DuPont Crop Protection
Bayer Crop Science
Syngenta Crop Protection
Gowan Company

QUESTIONS
??