Reduced-Risk Systemic Insecticides – Cucurbit Crop IPM

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Russell Groves, Anders Huseth & David Lowenstein
Department of Entomology
University of Wisconsin
Total Impact of Specialty Crop Production and Processing

*(Economic activity in $ millions per year)*

<table>
<thead>
<tr>
<th>Specialty Crop Production and Processing</th>
<th>Total Economic Activity</th>
<th>Total Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable &amp; Fruit Production</td>
<td>$1,092</td>
<td>9,900</td>
</tr>
<tr>
<td>Potatoes</td>
<td>$349</td>
<td>2,770</td>
</tr>
<tr>
<td>Cranberries</td>
<td>$300</td>
<td>3,400</td>
</tr>
<tr>
<td>Sweet Corn</td>
<td>$83</td>
<td>660</td>
</tr>
<tr>
<td>Green Beans</td>
<td>$63</td>
<td>490</td>
</tr>
<tr>
<td>Green Peas</td>
<td>$26</td>
<td>200</td>
</tr>
<tr>
<td>Carrots, Cucumbers &amp; Onions</td>
<td>$28</td>
<td>220</td>
</tr>
<tr>
<td>Ginseng</td>
<td>$16</td>
<td>130</td>
</tr>
<tr>
<td><strong>Total Specialty Crop Processing</strong></td>
<td><strong>$5,268</strong></td>
<td><strong>24,800</strong></td>
</tr>
<tr>
<td><strong>Total Impact</strong></td>
<td><strong>$6,360</strong></td>
<td><strong>34,700</strong></td>
</tr>
</tbody>
</table>

*Production estimates based on 2006-2008 average farmgate values; processing estimates based on 2007 Economic Census values. Note: Sum of impacts may not equal total impact due to rounding.*

Keene and Mitchell, 2010
## Process of an IPM program

<table>
<thead>
<tr>
<th>Component</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>monitoring and sampling</td>
<td>inspect crop</td>
</tr>
<tr>
<td>pest identification</td>
<td>what pest(s)?</td>
</tr>
<tr>
<td>decision-making</td>
<td>what action(s)?</td>
</tr>
<tr>
<td>Intervention</td>
<td>take action(s)</td>
</tr>
<tr>
<td>follow-up</td>
<td>re-inspect crop</td>
</tr>
<tr>
<td>record-keeping</td>
<td>write it down</td>
</tr>
<tr>
<td>education</td>
<td>review and learn</td>
</tr>
</tbody>
</table>

- For all farm sizes and *any* management approach (e.g. conventional, agro-ecological, or organic)
Pest management tactics for squash

Use all available tools to manage pest damage in the most economic, socially, and environmentally sound way

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

Squash IPM
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
‘Food Safety and Residues’

– 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 & reduced-risk).
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.
Key insect pests of cucurbits

- Squash bug (Anasa tristis)
- Seed maggots (Delia spp.)
- Squash vine borer (Melittia cucurbitae)
- Striped cucumber beetle (Acalymma vittatum)
Seed maggots: lifecycle and damage

Occurrence

- Overwinter in soil as pupa
- Adults emerge in early spring
- 4-5 generations per year. 2nd adult peak in May or June most serious

Damage

- Tunnel germinating seeds
- Severely distort seedlings
- Cool weather delays plant emergence increases severity
Seedcorn maggot activity in Wisconsin

Number of females/trap/3 days vs. Date

- Dates: 4/17, 5/1, 5/15, 5/29, 6/12, 6/26, 7/10, 7/24, 8/7
- Graph shows peaks in activity around 5/1 and 7/10, with a significant decrease in activity after 8/7.
Seedcorn maggot activity in Wisconsin

Date

4/17 5/1 5/15 5/29 6/12 6/26 7/10 7/24 8/7

Number of females/trap/3 days

High risk of damage in early plantings

Low risk of damage in late plantings after ~ June 21
Seed maggots: non-chemical management

**Cultural**

- Prevent egg laying and accelerate germination with row cover
- Speed up germination: mulch and warm soil
- Avoid green manure
- Transplants

**Biological**

- Predacious soil beetles
- Fungal epidemics
Insecticides registered on Wisconsin: 2014

Seed treatments

• Commercially applied to most varieties

1. thiamethoxam – FarMore® Fl400 Cucurbits
2. spinosad – Regard™ (registration 2014? ), OI-100pending OMRI approval

In-furrow & Broadcast

• Various options – drench, in-furrow, or drip injection
• Some less desirable attributes of application methods
• Requires different application technology and equipment setup
Striped cucumber beetle

(Acalymma vittatum)
Cucumber beetle damage

Defoliation

Pollination interference

Feeding scars

Rindworms
Striped cucumber beetle – Lifecycle

- Overwinters as an adult in protected non-crop areas
- Colonizes fields in early spring
- Adults feed on plants and mate
- Lays eggs at base of host plant
- Two generations per year
Cucumber beetle – Bacterial wilt

• Most damage is from bacterial wilt, *Erwinia tracheiphila*
• Closely associated with the beetle, vectored via posterior-station
• No cure for bacteria, control through vector
• Susceptibility:  
  Melons (not watermelon) >  
  Cucumbers > butternut and hubbard squash
Cucumber beetle – management

**Cultural**

- Later planting (second week of June)
- Transplants
- Early border trap crops (transplant Blue Hubbard)

**Black plastic mulch**
Cucumber beetle – management

Cultural

• Eliminate weeds, weedy edges (non-crop sanitation)
• Crop rotation
• Early season row cover
...cultural control trade-offs

**Cultural control drawbacks**

Non-crop sanitation may eliminate alternate floral resources – impacts on pollinators?

- Row cover is only effective until plants begin to bloom – pollinator access
Types of insecticide delivery tactics

- Seed treatments
- In-furrow treatments
  - Drench
  - Standard in-furrow
- Foliar sprays (thresholds) – “caution with pollinators”!!

All insecticide programs are not equal....
Cucumber beetle – Seed treatment program

Seed treatments on several different crops

**Commercially applied**

- Systemic insecticides
- thiamethoxam
- imidacloprid
- Maggot and early aphids controlled
- Early colonizing cucumber beetle
- Several cucurbit varieties available pre-treated through seed vendor
Cucumber beetle – At-plant programs

In-furrows distribute insecticide widely

Application at planting

• Systemic insecticides
• imidacloprid
• thiamethoxam
• In-furrow
• Drip irrigation application

Transplants

• Transplant water drench
• Drench transplants e.g., 4 mL (0.14 fl. oz) of Admire diluted in water to treat a flat of 200 plants
Cucumber beetle – Sampling and thresholds (foliar)

**Sampling**

- Yellow sticky cards
- Plant counts
- Colonization times critical

**Action thresholds**

- 1 beetle/plant for melons, cucumbers, and young pumpkins
- 5 beetles/plant for watermelon, squash, and older pumpkins

**Caution with pollinators**
Squash bug, *Anasa tristis*

**Occurrence**

- Adults are large brownish/black
- Bugs aggregate in high numbers
- Adults prefer larger, more mature plants
- Round eggs laid in neat rows
- Nymphs are white/grey (5 instars)
- One generation per year
Squash bug - Damage

- Phytotoxic saliva causes wilting
- Cucurbit yellow vine decline
  - Now identified in MA & VA
  - Bacterium overwinters in adult bugs
  - Hubbard and winter affected
  - Brown phloem ring
Squash bug – management thresholds

Seedling stage

- Treat if wilting and squash bugs are observed

Flowering stage

- Treat if >1 egg mass is found per plant

Control

- Often difficult to kill
- Pyrethroids & permethrins
- Foliar pyrethrum
- Destroy crop residue
- **Non-crop sanitation**

Wilting on pumpkin

Squash bug egg mass
Squash bug – overwintering habitats

- Clean cultivation
- Crop rotation common
- Less overwintering habitat

Damage

- Crop debris and old fruit harbor adults into autumn
- Many sheltered areas
- Small scale annual production builds populations
Squash vine borer, *Melittia cucurbitae*

### Occurrence

- Day-flying clearwing moth
- Adults have rusty brown abdomens
- Wingspan ~ 1-1.5 inches
- Females can lay 150-200 eggs
- Larvae ¾ - 1 inch in length
- Appear around 1,000 growing degree days
- One generation per year
Squash vine borer - management

Damage

• Single eggs laid at plant base
• Frass and entry hole very apparent
• Advanced damage may look like bacterial wilt
Squash vine borer - management

**Monitoring**

- Scout crop around 1,000 GDD threshold
- Water pans for adults in crop
- Pheromone lures available through Great Lakes IPM

**Control**

- Rarely an issue in commercial production. Serious garden pest
- Insecticides often difficult to time & apply properly
- Flubendiamide (restricted use)
- pyrethrin + azadiractin
Season long management plans

- Early season control with seed treatment or cultural methods
- Timing of foliars dependent on flowering stage of the crop
- Scouting for pests will save money and reduce extra sprays
- Read labels and active ingredients

How does pest management fit into the broader sustainability picture?
Balancing trade-offs, improving sustainability

**Pest control and pollination services**

- Insecticides remain a cornerstone of cucurbit production

- Exposure of several pollinator guilds to agro-chemicals are thought to reduce beneficial insect health

**Growers can adjust management to reduce exposure**

- Avoid applying to crops in bloom or blooming
- Apply late in the day/evening
- Choose short residual products
- Insecticide formulations are not equal: \( EC > WP, WSP, D \)
Neonicotinoid insecticides in the News

**About Pesticides**

**Integrated Crop Management NEWS**

**FARM CHEMICALS INTERNATIONAL**

**ARE NEONICOTINOIDS KILLING BEES?**

**Our Commitment to Bee Health**

**Neonicotinoid Seed Treatments and Honey Bee Health**

**France Plans Ban on Seed Treatment, Escalating Bee Issue**

Synlenta: ‘Dark day for French and European agriculture.’

June 1, 2012

Syngenta’s Cruiser OSR seed treatment for oilseed rape faces suspension in France.

According to reports, the French government is set to ban the product on the recommendation of ANSES, the French agency for food, environmental and occupational health and safety. ANSES says it based its decision on new study published in the journal Science, which highlights sub-lethal issues of the active ingredient thiamethoxam on the ability of forager bees to return to the hive.

Thiamethoxam is a neonicotinoid class insecticide – the type increasingly blamed for the bee mystery called Colony Collapse Disorder. However, the underlying causes of CCD are still unclear and most likely manifold, according to most published scientific research.

Syngenta, in an email to Farm Chemicals International, called it a “dark day for French and European agriculture and in particular those in the OSR Seed chain. The intention to suspend has been taken on the basis of one experimental study which has not been validated by expert panels and is at odds with the reality in the field.”

For more information:

* VEIL
  * This publication is a collaborative effort from the European agricultural research network
  * Carried out within the project financed by the EU Seventh Framework Programme

Neonicotinoids are a relatively new class of chemicals to control insects. They are now widely used and blamed for being persistent and toxic in soil and water. Some field crops in Europe have a neonicotinoid seed treatment. Common examples of neonicotinoid insecticides include clothianidin (Poncho® R), thiamethoxam (Chaser® R) and imidacloprid (Gaucho® R). Active ingredient rates range from 2.5-1.25 nanograms per panne (adult or 25-125 parts per million).

Neonicotinoids are extremely toxic to bees. A lethal LD50 value (the rate at which half of the exposed population dies) for clothianidin is 22-64 nanograms per panne for direct contact and 2.3-7 nanograms per panne for oral ingestion. In other words, a single corn kernel with a 1.25% rate of neonicotinoid seed treatment contains enough active ingredient to kill over 60,000 worker bees.

There has been an increased public awareness of pollinator health and the decline of bees in North America. Researchers have identified multiple contributing factors for honey bee decline, including: climate indices, disease-causing pathogens, habitat loss, malnutrition, and the intensity of migratory pollination services and pesticides (Fig. 1).

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Key findings include:

Parasites and Disease Present Risks to Honey Bees:
The parasitic Varroa mite and new virus species have been found in the U.S. and several of these have been associated with Colony Collapse Disorder (CCD).

Increased Genetic Diversity is Needed:
Genetic variation improves bees thermoregulation, disease resistance and worker productivity.

Poor Nutrition Among Honey Bee Colonies:
Bees need better forage and a variety of plants to support colony health.

Need for Improved Collaboration and Information Sharing:
Best Management Practices associated with bees and pesticide use, exist, but are not widely or systematically followed by members of the crop-producing industry.

Additional Research is Needed to Determine Risks Presented by Pesticides:
The most pressing pesticide research questions relate to determining actual pesticide exposures and effects of pesticides to bees in the field.
Questions?