Insect Pest Management – Cucurbit Crops

Wisconsin Fruit and Vegetable Growers Annual Meeting
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Presentation Outline

- Integrated Pest Management
- Key Pests of Cucurbit Crops
  - Seed corn maggot
  - Squash bug
  - Spider mites
  - Cucumber beetle
  - Squash vine borer
- Exotic Invader
  - Brown Marmorated Stinkbug (BMSB)
2012 Was The Warmest Year on Record

Chicago, IL: Jan – June, 2012

Contiguous US: June 2011 – 2012
...And 2012 Was a Very Dry Year

U.S. Drought Monitor
August 21, 2012
Valid 7 a.m. EDT

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, August 23, 2012
Author: Michael Brewer/Liz Love-Brotak, NOAA/NESDIS/NCDC
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
Components of an IPM Program

- Monitoring and Sampling (inspect)
- Pest Identification (what pest)
- Decision-making (what action(s))
- Intervention (take action (s))
- Follow-up (re-inspect)
- Record-keeping (write it down, history)
- Education (learn)
What IPM is NOT!

- IPM does **NOT** preclude the use of pesticides!
- IPM is **NOT** merely a biological or “organic” pest control program
- IPM is a decision-making process, **NOT** a stringent or rigid management regime
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.
Cucurbit Insect Control

Insect management:

• Generally similar insect pests on all

• Insects may be more severe on some crops and in different geographic regions
# Calendar of Insect Pests – Cucurbit Crops

<table>
<thead>
<tr>
<th></th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
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<tr>
<td>Aphids</td>
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<td>Flea beetles</td>
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<td>Leafminers</td>
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<td>Mites</td>
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<tr>
<td>Pickleworm</td>
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<td>Squash Bug</td>
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<tr>
<td>Squash Vine Borer</td>
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<td>Thrips</td>
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<tr>
<td>Whiteflies</td>
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<tr>
<td>Seed maggots</td>
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</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: 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.
- Moderate feeding may injure 1st leaves only giving crop a ragged appearance
- 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)
- Commercial seed treatments (Entrust)
Squash bug, *Anasa tristis*

**Occurrence**
- Adults are large black bugs which aggregate on plants
- Round eggs are laid in neat rows
- Nymphs are white/grey

**Damage**
- Phytotoxic saliva causes wilting
- Cucurbit yellow vine decline
  - Hubbard and winter squash more severely affected
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**

- Foliar insecticides (pyrethrum)
- Cultural:
  - sanitation – remove overwintering sites
  - destroy crop residue

*Squash bug egg mass*
**Squash Vine Borer**

**Occurrence**

- Adults are diurnal, wasp-like moths
- Lay eggs singly on vines
- Larvae bore into plants and destroy vascular tissues = wilting and death.
- Not a pest of watermelon, muskmelon, or cucumbers
- Emerging issue on winter squash (Hubbard) and pumpkin
- Occasional second generation
Squash Vine Borer Control

**Sampling**
- Field history: past problems = future problems
- Often more serious in smaller plantings
- Pheromone traps; emergence of adults at 1,000 DD
- Direct observation = entrance holes & frass

**Cultural**
- Practice good field sanitation
- Destroy residue

**Chemical (re-application)**
- Pyrethrum (Pyganic)
- *Bacillus thuringiensis* var. ‘kurstaki’
**Note: directed application to the first 12-16” of vine; ‘post-chicory bloom’.

**A3688 (http://www.uwex.edu/ces/pubs)
Two-spotted spider mites, *Tetranychus urticae*

**Occurrence**
- Usually occur in hot dry conditions
- More severe in dusty, roadside locations
- Multiple generations on undersurface of leaf

**Damage**
- Adults feed in large numbers on leaf surface causing “silvering”
- Lower surface often covered with webbing
- Late season pest
- Can be ‘flared’ by pyrethroids
Spider mite, Management

**Cultural**
- Maintain good plant growth, irrigate
- Avoid dusty roads

**Biological**
- Several effective predators
- Avoid broad-spectrum insecticides

**Chemical**
- Unless necessary, do not use
- ‘Hormoligosis’: boosts egg production
- Insecticidal soap, Brigade 2EC, Portal SC
Striped cucumber beetle
*(Acalymma vittatum)*
Striped and Spotted Cucumber Beetles

**Lifecycle**

- Adult beetles 8-10 mm length and 3-4 mm wide

- Striped cucumber beetle
  *Acalymma vittatum*

- Spotted cucumber beetle
  *Diabrotica undecimpunctata*

- Striped cucumber beetles overwinter in protected areas as adults and become active in mid-spring.

- Appear early, lay eggs at the base of cucurbitis, and have 2 generations / year

- Striped is most severe
Cucumber Beetles: Damage

- Defoliation
- Feeding Scars
- Pollination Interference
- Rindworms
Cucumber Beetles – Bacterial Wilt

- 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
Management – Bacterial Wilt

• Avoidance of bacterial wilt is accomplished through effective cucumber beetle control.

• Sampling can be accomplished with yellow sticky traps

• Established Thresholds (direct counts):

  ➢ 1 beetle / plant for melons, cucumbers, and young pumpkins

  ➢ 5 beetles / plant for watermelon, squash, and older pumpkins
General Approaches to Managing Cucumber Beetles

- **Chemical Control**
- **Behavioral Control**
- **Plant Resistance**
- **Cultural Control**

Managing Cucumber Beetles
Cucumber beetles: Management

Cultural
- Later planting (June 10 – 15)
- Transplants
- Trap crops on plastic mulches

Blue Hubbard

Black plastic
Cucumber beetles: Management

Cultural
- Eliminate weeds, weedy edges (sanitation) – pollinators
- Crop rotation
- Early season row cover
Cucumber Beetle Management - Row Cover and Foliar Insecticides (OMRI)

- Established Thresholds (based on bacterial wilt susceptibility):
  - 1 adult beetle / plant (cantaloupe, muskmelon, & cucumber)
  - 5 adult beetles / plant (watermelon, squash, & older pumpkins)

**Need to protect cucurbit crop from beetles for 4-6 weeks??**

- **Striped cucumber beetle**
- **Foliar Pyrethrum (Pyganic®)**
- **Row cover**
- **Cucurbit Crop**
- **Harvest**

- **15-Mar**
- **14-Apr**
- **14-May**
- **13-Jun**
- **13-Jul**
- **12-Aug**
- **11-Sep**
- **11-Oct**
Established Thresholds (based on bacterial wilt susceptibility):

1 adult beetle / plant (cantaloupe, muskmelon, & cucumber)

5 adult beetles / plant (watermelon, squash, & older pumpkins)

Need to protect cucurbit crop from beetles for 4-6 weeks?

Foliar Neonicotinoid (Actara® 25WG)

Striped cucumber beetle

Cucurbit Crop


Harvest
Cucumber Beetle Management - At-Plant Systemics

- Established Thresholds (based on bacterial wilt susceptibility):
  - 1 adult beetle / plant (canteloupe, muskmelon, & cucumber)
  - 5 adult beetles / plant (watermelon, squash, & older pumpkins)

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Need to protect cucurbit crop from beetles for 4-6 weeks?

Systemic Neonicotinoid (Platinum® 75SG)
Insects Impact Cucurbit Production

Pollinators...

European honey bee

...and Devastators

Striped cucumber beetle
Factors Harming Honey Bee Populations

- **Insecticides** (Kevan et al. 1997)
  - Do not apply to crops in bloom
  - Application timing: apply in the late afternoon or early evening
  - Choose short residual products
  - Adjust spray to weather conditions
    - **low temps extend residual**
    - **protract foraging times**
  - Application formulation (s):
    - EC > WP, WSP, D
Insects Impact Cucurbit Production

Pollinators...

...and Devastators

European honey bee

Striped cucumber beetle
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    ** protract foraging times
  - Application formulation (s):
    EC > WP, WSP, D
Drip Irrigation of Insecticides
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 4F
- Platinum 75SG
- Scorpion

**Anthranillic Diamides**
- Coragen 1.67SC
- Verimark 20SC**

**Durivo SC**

**Not currently registered**
Thiamethoxam & Imidacloprid

- **Platinum 75SG – Admire Pro 4F**
  - 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, Cucurbitas, 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.
## Cucumber 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>5.5 &amp; 3.0 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>2</td>
<td>Imidacloprid (AdmirePro®)</td>
<td>5.5 &amp; 5.0 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>3</td>
<td>thiamethoxam (Platinum®)</td>
<td>2.67 &amp; 1.0 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>4</td>
<td>dinotefuran (Scorpion®)</td>
<td>5.5 &amp; 5.0 fl oz / A</td>
<td>Injection</td>
</tr>
<tr>
<td>5</td>
<td>Untreated Control</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Note: not currently registered**
Striped Cucumber Beetle Control (2010 - Cucumber)

- 2, injections (29 May and 14 June), HAES
- Adult counts 22 July (62 dap)
Limiting Bacterial Wilt
(2010 - Cucumber)

- 2, injections (29 May and 14 June), HAES
- Infection counts 22 July (62 dap)

Bar chart showing mean percent symptomatic plants for different treatments:
- Coragen (8.5 oz)
- Admire Pro (10.5 oz)
- Platinum (3.67 oz)
- Scorpion (10.5 oz)
- Control
# 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 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>
<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.
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>
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</thead>
<tbody>
<tr>
<td>Coragen (chlorantraniliprole)</td>
<td>0.001</td>
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<tr>
<td>Imidacloprid (AdmirePro)</td>
<td>0.58</td>
</tr>
<tr>
<td>Platinum (thiamethoxam)</td>
<td>4.1</td>
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<tr>
<td>Venom (dinotefuran)</td>
<td>39.83</td>
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<tr>
<td>Vydate (oxamyl)</td>
<td>229.0</td>
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</tbody>
</table>
# Application Rates for Drip Chemigation

## Durivo Conversion Chart for Drip Linear Application

<table>
<thead>
<tr>
<th>Rate (oz./A)</th>
<th>20&quot;</th>
<th>30&quot;</th>
<th>34&quot;</th>
<th>36&quot;</th>
<th>38&quot;</th>
<th>40&quot;</th>
<th>46&quot;</th>
<th>60&quot;</th>
<th>72&quot;</th>
<th>78&quot;</th>
<th>80&quot;</th>
<th>84&quot;</th>
<th>Row Spacing</th>
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<tbody>
<tr>
<td>10</td>
<td>0.38</td>
<td>0.57</td>
<td>0.65</td>
<td>0.69</td>
<td>0.73</td>
<td>0.77</td>
<td>0.88</td>
<td>1.15</td>
<td>1.38</td>
<td>1.49</td>
<td>1.53</td>
<td>1.61</td>
<td>Linear Ft./A.</td>
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<tr>
<td>11</td>
<td>0.42</td>
<td>0.63</td>
<td>0.72</td>
<td>0.76</td>
<td>0.80</td>
<td>0.84</td>
<td>0.97</td>
<td>1.26</td>
<td>1.52</td>
<td>1.64</td>
<td>1.68</td>
<td>1.77</td>
<td>0.195</td>
</tr>
<tr>
<td>12</td>
<td>0.46</td>
<td>0.69</td>
<td>0.78</td>
<td>0.83</td>
<td>0.87</td>
<td>0.92</td>
<td>1.06</td>
<td>1.38</td>
<td>1.65</td>
<td>1.79</td>
<td>1.84</td>
<td>1.93</td>
<td>0.215</td>
</tr>
<tr>
<td>13</td>
<td>0.5</td>
<td>0.75</td>
<td>0.85</td>
<td>0.90</td>
<td>0.95</td>
<td>0.99</td>
<td>1.14</td>
<td>1.49</td>
<td>1.79</td>
<td>1.94</td>
<td>1.99</td>
<td>2.09</td>
<td>0.234</td>
</tr>
</tbody>
</table>

Rate in ounces of product per 1,000 linear feet for specified row spacing and rate per acre.
Brown Marmorated Stink Bug
Know Your Stink Bug’s

BMSB

GSB

BSB
Identifying the Brown Marmorated Stink Bug

Look for these unique identifying features…

- red eyes & ocelli
- black and white banding
- white banding

Image courtesy of David J. Shetlar
The Ohio State University
Ventral side - light colored; may have black or gray markings

Legs – brown with faint white bands

Image courtesy of David J. Shetlar
The Ohio State University
Brown Marmorated Stink Bug

- Native to Asia (China, Japan, Korea).
- First detected in Allentown, PA, in 1998.
- Wide host range, including tree fruits, many vegetables, soybeans, corn, forest trees, ornamentals, and probably mint.
- Seeks buildings, commonly homes, in the fall as overwintering sites.
- Severe economic losses in mid-Atlantic states in 2010.
- Detected in MN in 2009, IL, MO and NE this past year for the first time.
Current BMSB Distribution in the United States.

Stages of Invasion by Alien Species

Arrival ➔ Establishment ➔ Integration ➔ Spread
Factors Contributing to BMSB Abundance

- **Wide host range**
  - >300 plants are hosts
  - Allows for populations to buildup in many non-managed habitats (woods) or field crops with few insecticide sprays (i.e., soybean)

- **Absence of effective natural enemies**
  - % parasitism in US by native *Trissolcus* spp. <5%
  - % parasitism in China 50-80%

- **Highly mobile and “nervous” insect**
If you see (suspect) a BMSB or SWD…


- Stinkbugs and maggots that are suspected to be the BMSB or SWD should be sent for positive identification. Samples from Wisconsin will be processed for free at UW; please send samples to:
  
  Attn: BMSB Reports  
  Phil Pelleterri and Pest Diagnostic Clinic  
  Department of Entomology, Rm. 240  
  1630 Linden Drive,  
  University of Wisconsin  
  Madison, WI 53706

- DO NOT ship live insects. Please place dead insects in a leak-proof, crush-proof container  
  (e.g., plastic medicine bottle or film canister).

- Additional details regarding submitting insect specimens are available at: [http://www.entomology.wisc.edu/diaglab/entodiag.html#submit](http://www.entomology.wisc.edu/diaglab/entodiag.html#submit)
Vegetable IPM Resources

- **Vegetable Insect Mgmt Web-page**
  - [University of Wisconsin-Madison Vegetable Crop Entomology](http://www.entomology.wisc.edu/vegento)

- **Vegetable Disease Mgmt Web-page**
  - [UW Vegetable Pathology](http://www.plantpath.wisc.edu/wivegdis)
    - [Contents Pages/veg_crop_updates.html](http://www.plantpath.wisc.edu/wivegdis/contents_pages/veg_crop_updates.html)

- **Wisconsin Pest Bulletin**
  - [Wisconsin Pest Bulletin](http://datcpservices.wisconsin.gov/pb/index.jsp)