Update on Pheromone-Based Monitoring Tools for the Invasive Brown Marmorated Stink Bug

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Two-Component BMSB Aggregation Pheromone and Synergist

Main component of BMSB aggregation pheromone
\((3S,6S,7R,10S)-10,11\text{-epoxy-1-bisabolen-3-ol}\)

Minor component of BMSB aggregation pheromone
\((3R,6S,7R,10S)-10,11\text{-epoxy-1-bisabolen-3-ol}\)

Methyl \((E,E,Z)-2,4,6\text{-decatrienoate (MDT)}\) acts as a synergist for BMSB pheromone

\[+\]

Synergism

General Protocol

• Black pyramid traps

• Four treatments
  – 1) BMSB Pheromone (10 mg)
  – 2) BMSB Pheromone (10 mg) + Rescue MDT (119 mg)
  – 3) BMSB Pheromone (10 mg) + AgBio MDT (66 mg)
  – 4) Unbaited control

• Traps are deployed between wild host habitat and agricultural production areas.

• Traps were deployed in mid-April and left in place season-long.
2013 Season-Long Attraction To Baited Traps

Early Season
Mid-April to Mid-June

Mid Season
Mid-June to Mid-August

Late Season
Mid-August to Mid-October
2014 Coordinated Trapping Studies

• Provide feedback to commercial companies.

• Monthly assessment of lure formulations provided by commercial companies.

• AgBio/ChemTica, Rescue, Scentry, Trece, AlphaScents, and Hercon (not presented).

• Compared with our experimental standard.
  – BMSB Pheromone (10 mg) + AgBio MDT (66 mg)
AgBio and Rescue (May)

Mean # BMSB Per Trap Per Week

- **Exp. Std.**
- **#10 AgBio2x**
- **Control**
- **Rescue**

- **Adults**
- **Nymphs**

Values labeled with **a** and **b** indicate significant differences.
Scentry (June)

**Graph Description:**
- The graph compares the mean number of BMSB (Brown Marmorated Stink Bug) per trap per week for different treatments:
  - **Exp. Std.**: Blue bars represent adults, and orange bars represent nymphs.
  - **Control**: Blue bars represent adults, and orange bars represent nymphs.
  - **Scentry 1**: Blue bars represent adults, and orange bars represent nymphs.
  - **Scentry 2**: Blue bars represent adults, and orange bars represent nymphs.

**Key Points:**
- The graph shows a significant reduction in the mean number of BMSB for both adults and nymphs in the Scentry treatments compared to the Control and Exp. Std.
- The Scentry treatments are labeled with 'a' and 'b' to denote statistical significance.

**Legend:**
- **Blue Bars**: Adults
- **Orange Bars**: Nymphs
AlphaScents (August)

![Graph showing mean # BMSB per trap per week for Adults and Nymphs across different treatments. The graph indicates significant differences between treatments, with some treatments labeled with 'a' and others with 'b'.]
Multiple Comparisons (Late-Season)

<table>
<thead>
<tr>
<th></th>
<th>Exp. Std</th>
<th>Trece 1126</th>
<th>AgBio</th>
<th>Rescue</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>Nymphs</td>
<td>a</td>
<td>b</td>
<td>b</td>
<td>b</td>
<td>b</td>
</tr>
</tbody>
</table>
Tentative Conclusions

• Commercial companies have products that can be used to detect the presence, abundance, and seasonal activity of BMSB in specialty crops.

• In particular, Trece resulted in consistent attraction and has a long-lasting formulation.

• Expect that Trece, AgBio and Rescue will be selling products next year.

• Bedoukian will be manufacturing material.
Can we use biological information provided by trap captures to guide management decisions?

- Apple blocks at AFRS.
- Each block was monitored with two baited traps (10 mg pheromone + 66 mg synergist). Traps checked weekly.
- When cumulative captures of adults in either trap reached a set threshold, the block was treated with BMSB material (ARM).
- Block treated again 7-d later. Threshold was then reset.
Season-Long Insecticide Applications Made Against BMSB
BMSB Injury at Harvest

Mean % Injury at Harvest

2013
2014

Always Treated 1 Adult/Trap 10 Adults/Trap 20 Adults/Trap Never Treated

Mean Injury at Harvest
Tentative Conclusions

• Biological information provided by baited traps can be used to make management decisions for BMSB.

• A threshold of 10 adults/trap based our experimental standard lure combination reduced insecticide applications by 40% with no significant difference in injury at harvest compared with weekly ARM in 2013 and in 2014.

• A threshold of 1 adult/trap was too sensitive – triggering too many sprays, without significant reductions injury. A threshold of 20 adults/trap was not sensitive enough – missing key sprays in mid-July (new F1 adults) and in the late-season (F1s and F2s).

• Five growers adopted this provisional threshold in 2014. No differences in injury at harvest in blocks managed using grower standard or with sprays triggered by baited traps.

• As commercial companies continue to refine and tweak lure formulations, we will need to recalibrate thresholds.
Can we utilize other trap styles?

<table>
<thead>
<tr>
<th>Experimental Standard Wooden Pyramid</th>
<th>Coroplast Pyramid</th>
<th>Small Pyramid (Ground)</th>
<th>Small Pyramid (Hanging)</th>
<th>Small Pyramid (Limb)</th>
<th>Rescue (Hanging/Foliage)</th>
</tr>
</thead>
</table>

- Are captures similar among other trap types and deployment strategies compared with our experimental standard?

- Baited with 10 mg BMSB Pheromone + 66 mg MDT. Two years of data from commercial orchards.
Season-Long Trap Captures / Sensitivity

Mean *H. halys* Trap Catch (±SE)

- **Adults**
- **Nymphs**

<table>
<thead>
<tr>
<th>Trap Type</th>
<th>Adults</th>
<th>Nymphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rescue</td>
<td>C</td>
<td>c</td>
</tr>
<tr>
<td>Small Limb</td>
<td>B, b</td>
<td>B, b</td>
</tr>
<tr>
<td>Small Ground</td>
<td>B, b</td>
<td>B, b</td>
</tr>
<tr>
<td>Small Hanging</td>
<td>B</td>
<td>B, bc</td>
</tr>
<tr>
<td>Wooden Pyramid</td>
<td>B, ab</td>
<td>B</td>
</tr>
<tr>
<td>Coroplast Pyramid</td>
<td>A, a</td>
<td>a</td>
</tr>
</tbody>
</table>

*H. Halys* Trap Type

Significance:
- C, B, A: Different letters indicate significant differences.
- b, c: Different letters within a group indicate significant differences.

Statistical analysis shows significant differences in trap catches across different trap types.
Coroplast vs. Standard Wooden Pyramids

Spearman Rank Correlation
\[ \rho = 0.735 \]
\[ P < 0.0001 \]

Spearman Rank Correlation
\[ \rho = 0.900 \]
\[ P < 0.0001 \]
Coroplast vs. Small Pyramids Styles

- Coroplast Pyramid
- Small Pyramid (Ground)
- Small Pyramid (Hanging)
- Small Pyramid (Limb)
- Rescue (Hanging/Foliage)

Insect Images:
- SIG.
- SIG.
- SIG.
- SIG.
- NS
Conclusions

• Coroplast pyramid traps performed well compared with standard black pyramid traps. These are much cheaper and have held up well in the field. Tops need to be replaced annually.

• Other trap styles appear effective now that we have good olfactory stimuli. Based on correlations of trap captures with pyramid traps. However, hanging traps capture significantly fewer nymphs.

• We now have tools for reliable season-long monitoring and detection of BMSB.
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