Development of Trap-Based Monitoring: A Critically Needed Tool for the Grower Community

Tracy C. Leskey, Starker E. Wright, Brent Short, Cameron Scorza, Torri Hancock, John Cullum, Rebecca Posa and Bryan Butler

USDA-ARS
Appalachian Fruit Research Station
Kearneysville, WV 25430  USA
What We Know

• Growers require a tool that will allow them to detect presence, abundance, and seasonal activity of BMSB in various cropping systems.

• Provide information for making management decisions.

• Reliable detection for nationwide survey/monitoring efforts.
Development of a Behaviorally Based Monitoring Tool for BMSB

- Visual Cues
- Olfactory Cues
- Capture Mechanism
- Deployment Strategy
- Responses to visual stimuli associated with trap bases.
- Baited with methyl (2E, 4E, 6Z)-decatrienoate or left unbaited.
- Traps deployed at the periphery of orchards blocks
- Captures from October 7-November 17, 2009 and July 23-October 14, 2010.
Greatest Adult and Nymphal Captures in Baited Traps with Dark Visual Base

2009 Adult Captures

2010 Adult Captures

2010 Nymphal Captures
Visual Cues

Behavioral Responses to Wavelengths and Intensities of Light
Light Bioassay

1. [Image of the bioassay setup]
2. [Image of the light source]
3. [Image of a light source in the dark]
4. [Image of a bug illuminated by the light]
Trial One - *Light Intensity*

- Release single individuals into center of arena. Simple choice experiment.
- Treatments include sex and light intensity.
- Light Intensity (Indirect Light, Fixed Full Spectrum)

<table>
<thead>
<tr>
<th>0 Lux (Control)</th>
<th>Darkness</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Lux</td>
<td>100 Lux</td>
</tr>
<tr>
<td>200 Lux</td>
<td>200 Lux</td>
</tr>
<tr>
<td>400 Lux</td>
<td>400 Lux</td>
</tr>
<tr>
<td>800 Lux</td>
<td>800 Lux</td>
</tr>
<tr>
<td>1600 Lux</td>
<td>1600 Lux</td>
</tr>
</tbody>
</table>

- Trial duration up to 15 minutes.
- Outcomes
  - Non-responder – remains in release zone.
  - Responds To Treatment – positively phototactic, but does not accept stimulus (does not enter treatment zone).
  - Accepts Treatment – positively phototactic and accepts stimulus.
Stimulus Acceptance
Stimulus Rejection
Response to Light Intensity

$\chi^2 = 34.60$
$\text{DF} = 5$
$p < 0.001$

$\chi^2 = 21.35$
$\text{DF} = 5$
$p < 0.001$
Trial Two - *Wavelength*

- Release single individuals into center of arena

- Treatments – Wavelength (Indirect Light, Fixed Intensity)
  - Full Spectrum
  - 320 nm, Long Pass Filter (Ultraviolet and above)
  - 400 nm, Long Pass Filter (*Visible Light, Purple and Above*)
  - 495 nm, Long Pass Filter (*Visible Light, Blue and Above*)
  - 610 nm, Long Pass Filter (*Visible Light, Yellow and Above*)
  - Control
Olfactory Stimuli

- Aldrich et al. (2007) and Khrimian et al. (2008) confirmed that the aggregation pheromone of *Plautia stali* Scott, methyl (2E,4E,6Z)-decatrienoate (Sugie et al. 1996), is cross-attractive to BMSB, as reported in Asia (Lee et al. 2002, Tada et al. 2001 a,b).

- Adults are reliably attracted only early (Tada et al. 2001a) and late in the season (Tada et al. 2001a).
Are BMSB attracted to methyl \((2E,4E,6Z)-\text{decatrienoate}\) early in the season?
Commercial Orchard Studies

• 10 commercial orchards in MD and WV.

• Monitoring ~5 acre peach and apple blocks at each orchard.

• 4 black pyramid traps deployed in the border row of each block, spaced ~50 m apart, and baited with methyl \((2E, 4E, 6Z)\)-decatrienoate.

• Additional sampling in two orchards; sweep netting, beat trays, and visual sampling.
21 May – 3 June

BMSB INCURSIONS

Early Season Trap Captures Do Not Reflect BMSB Activity
Additional SB Sampling Techniques

- One commercial orchard in WV and one in MD.
- Monitoring ~5 acre peach and apple blocks at each orchard.
- Sampling began 11 May.
- Beat sample on 8 trees in border row and sample each side of the tree.
- Sweep net samples in peripheral area. Three replicates (25 sweeps per replicate) each covering 50 m.
- Three-minute visual sampling of 8 additional trees.
Visual Sampling Provided Best Indication of In-Orchard Activity
Trap Type Experiment

Black Light Trap
Visual Stimulus – UV Light
Olfactory Stimulus – methyl (2E,4E,6Z)-decatrienoate OR Unbaited
Capture Mechanism – Principally Flight
Deployment Strategy – Hanging, Perimeter of Natural Overwintering Sites

Commercial Pyramid Trap
Visual Stimulus – Dark Upright Trunk Mimic
Olfactory Stimulus – methyl (2E,4E,6Z)-decatrienoate OR Unbaited
Capture Mechanism – Principally Walking
Deployment Strategy – Ground-Deployed, Perimeter of Natural Overwintering Sites

Prototype Pyramid Trap
Visual Stimulus – Dark Upright Trunk Mimic
Olfactory Stimulus – methyl (2E,4E,6Z)-decatrienoate OR Unbaited
Capture Mechanism – Principally Walking
Deployment Strategy – Ground-Deployed, Perimeter of Natural Overwintering Sites
Black light captures reflected immigration period, but captures have subsequently dropped off despite field presence and activity.
Conclusions and Questions

• BMSB adults do not respond to methyl (2E,4E,6Z)-decatrienoate early in the season.

• Visual sampling provides some information, but in general, sampling techniques for others SBs are not providing accurate information reflective of in-orchard activity.

• BMSB respond to full spectrum light as a point-source at lower intensities and likely aggregate near high intensity sources.

• BMSB response to UV light may reflect movement patterns and/or be associated with a particular physiological/behavioral state.
Next Steps

• Continue with current experiments season-long.

• Establish a behavioral foundation for responses to wavelengths and intensities of light. Physiological/behavioral state (age, mating status, etc.)

• Critical need for olfactory stimulus that is attractive earlier in the season.

• Develop a trap that incorporates attractive visual and olfactory stimuli, effective capture mechanisms, and deployment strategies.
Acknowledgements

- USDA-ARS, NIFA Critical Issues Grant # 2010-37610-21845, and the Maryland State Horticultural Society