Patterns and predictions for visual sampling of the brown marmorated stink bug

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Halyomorpha halys (BMSB)

Detection in Peaches

Sampling Methods
- Timed visual
- Beat sheet
- Blacklight
- Pheromone

Research Topic: Diel Sampling

To characterize the relationship between timed visual observations of brown marmorated stink bugs and the time of day sampling occurred at.

Null hypothesis: average BMSB field counts will not differ between times of the day.
Study Sites

Rutgers Agricultural Research and Extension Center

Rutgers Fruit and Ornamental Research Extension Center
Study Design: Diel Sampling

- Two minute visual counts were used as the method of detection.
- Data were collected once a week from June through August at 0, 2, 4, 7, 10, 12, 15, 18, and 21 hours past sunrise.
Study Design: Diel Sampling

- Night time counts were performed using head lamps.
- Start times were randomized over the course of the summer.
Results: Nymphs

Columns with the same letters are not significantly different at $p \leq 0.05$, Pairwise Wilcoxon Rank Sum Test

Average nymphs per tree (+/- SE) vs. Hours Past Sunrise

- Columns A, B, and C indicate significant differences at $p \leq 0.05$.
Results: Adults

Columns with the same letters are not significantly different at $p \leq 0.05$, Pairwise Wilcoxon Rank Sum Test.

Average adults per tree (+/− SE)

Hours past sunrise

0 2 4 7 10 12 15 18 21
Results: RAREC Nymphs 2013

Average nymphs per tree (+/- SE)

<table>
<thead>
<tr>
<th>Hours past sunrise</th>
<th>Average Nymphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>D</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td>7</td>
<td>A</td>
</tr>
<tr>
<td>10</td>
<td>B</td>
</tr>
<tr>
<td>12</td>
<td>B C</td>
</tr>
<tr>
<td>15</td>
<td>E</td>
</tr>
<tr>
<td>18</td>
<td>E</td>
</tr>
<tr>
<td>21</td>
<td>F</td>
</tr>
</tbody>
</table>

Columns with the same letters are not significantly different at $p \leq 0.05$, Pairwise Wilcoxon Rank Sum Test.
Results: RAREC Adults 2013

Columns with the same letters are not significantly different at $p \leq 0.05$, Pairwise Wilcoxon Rank Sum Test
High vs Low Populations

Summer 2013: Nymphs

- Average nymphs per tree (+/- SE)

Summer 2014: Nymphs

- Average nymphs per tree (+/- SE)

Hours past sunrise
All Life Stages Love Peaches
Ratio of Nymphs to Adults

- 8.1 to 1
- 1.3 to 1
- 11.7 to 1
- 7.9 to 1
Temperature

Temperature 2014

Degree Celsius

Hours Past Sunrise

- CR Day 1
- CR Day 2
- CR Day 3
- CR Day 4
- CR Day 5
- CR Day 6
- RAREC Day 1
- RAREC Day 2
- RAREC Day 3
- RAREC Day 4
- RAREC Day 5
- RAREC Day 6
Research Topic: In-Tree Movement

To characterize the position of BMSB within a peach tree over the course of a 24 hour period.
Study Design: In-Tree Movement

- Six minute visual counts were used as the method of detection.
- Nymphs were marked with fluorescent powder when they were spotted.
Study Design: In-Tree Movement

- At night, 6 minute counts were broken into 4 minutes with one the UV flashlight followed by 2 minutes with that in addition to a white head lamp.

- Black light flashlights were used to confirm previous marking.
Several metrics of tree location were recorded for each BMSB observed.

### Data Sheet

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Hours</th>
<th>Row</th>
<th>Tree</th>
<th>Number</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/17/2014</td>
<td>9:43</td>
<td>4</td>
<td>2</td>
<td>17</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
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<td>9:43</td>
<td>4</td>
<td>2</td>
<td>19</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7/17/2014</td>
<td>9:43</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
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<td>9:43</td>
<td>4</td>
<td>2</td>
<td>17</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>Surface</th>
<th>Height</th>
<th>Outside</th>
<th>Cluster</th>
<th>Clock</th>
<th>Observer</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>7 Allison</td>
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<tr>
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<td>2</td>
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<td>0</td>
<td>1</td>
<td>7 Daniel</td>
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<tr>
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<td>1</td>
<td>3 Jaswin</td>
</tr>
<tr>
<td>...</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>7 Allison</td>
</tr>
</tbody>
</table>
Results: Color & Stage

= Previously observed

%
Results: Surface & Height

- Fruit
- Leaf
- Branch

0 2 4 7 10 12 15 18 21
Results: Outside & Clock

- Inside
- Outside

A A A A B B B B

0 2 4 7 10 12 15 18 21
Research Topic: Observer Variance

To characterize the effect that different observers have on the comparability of data sets.

Null hypothesis: All observers will detect the same number of BMSB.
Study Design: Observer Variance

- Two minute visual counts were used as the method of detection.
- All observers sampled the same set of trees in series.
Results: Observer Variance

Columns with the same letters are not significantly different at $p \leq 0.05$, Blocked ANOVA Test
Conclusions

- There are differences in BMSB visual counts depending on the number of hours past sunrise sampling occurred at.
- 10 hours past sunrise (mid-day) is the time of peak activity.
- Data collected by different observers does not vary significantly.
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Questions?

Thank you!