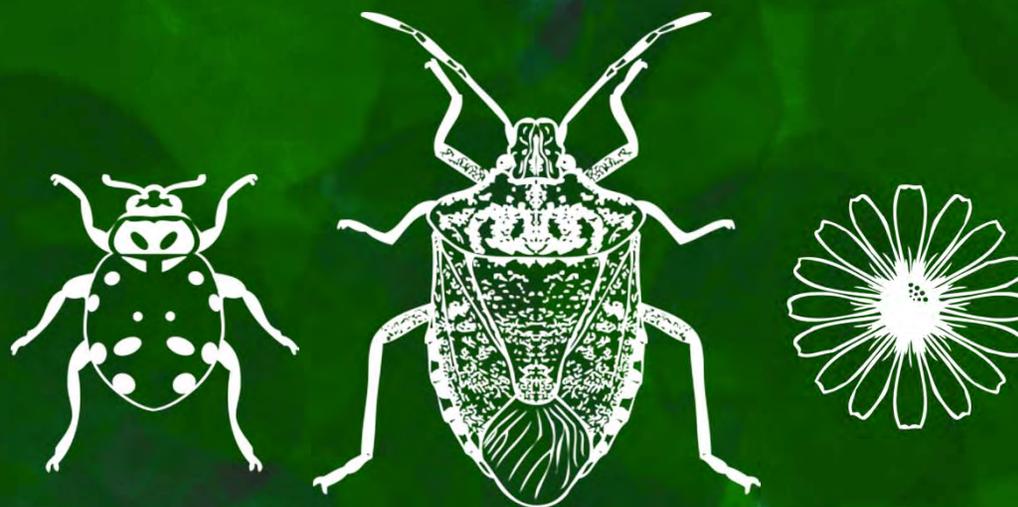


Whole-farm Organic Management of BMSB and Endemic Pentatomids through Behavior-based Habitat Manipulation



A multi-state project funded by the
Organic Research and Extension Initiative



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Project Objectives



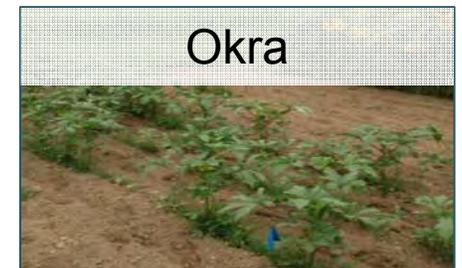
1. Develop habitat manipulation tactics based upon how host plant phenology impacts BMSB preference and dispersal.
2. Determine biotic and abiotic factors affecting adult and juvenile BMSB whole-farm movement.
3. Determine the identity and importance of extant natural enemies of stink bugs and their impact on BMSB populations.
4. Evaluate integrated management plans for BMSB and endemic stink bugs specific to organic production systems.
5. Develop and deliver extension materials for organic growers.



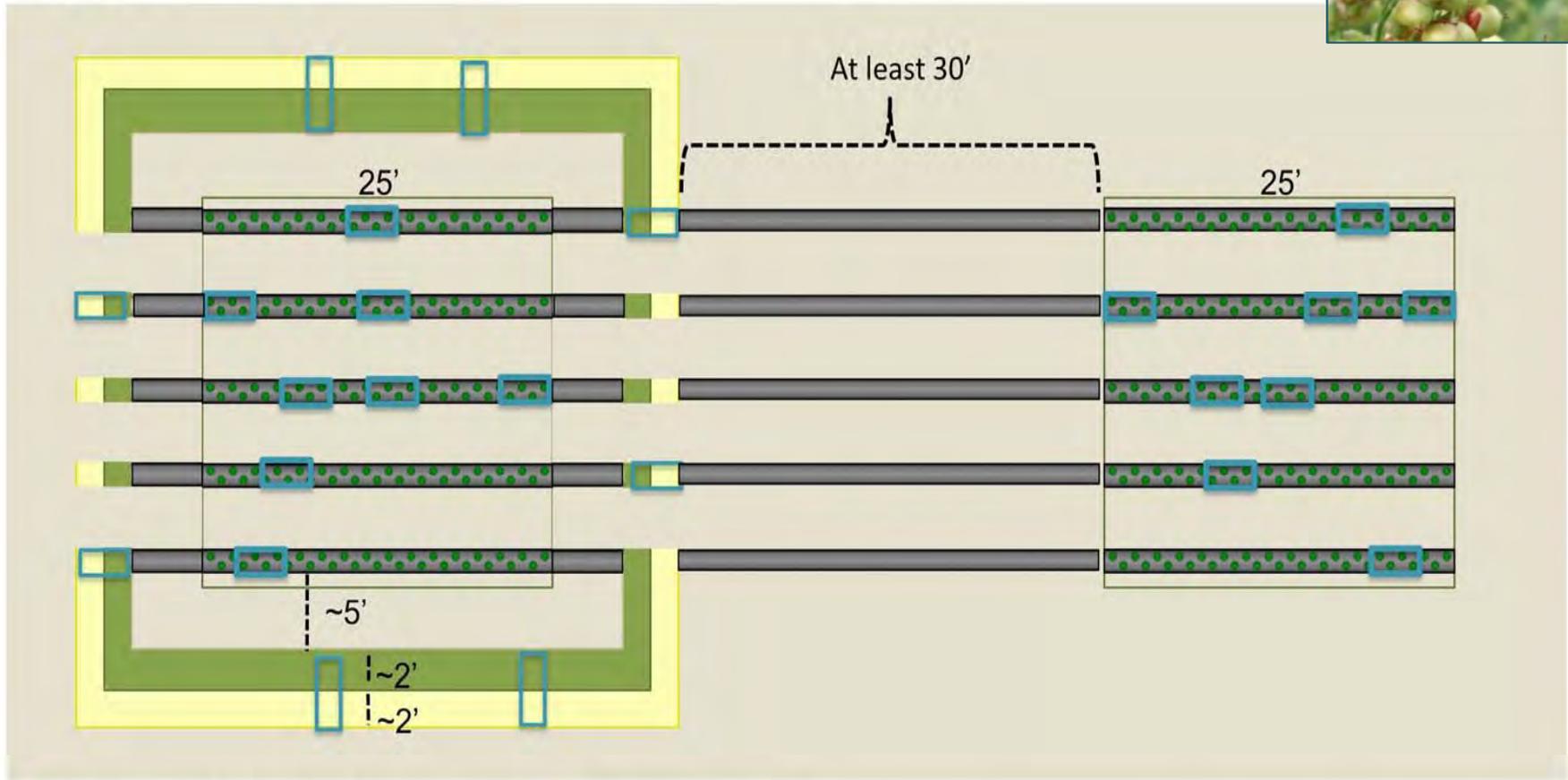
Objective 1: Trap Crops

2013:

- Evaluated 4 potential organic trap crops: sunflower, millet, sorghum, and okra
- Tested across 4 states: MD, NJ, PA, and WV
- BMSB and endemic stink bug densities were measured through weekly visual surveys for eggs, nymphs, and adults on 5 plants/plot
- Sunflower and sorghum were the most attractive

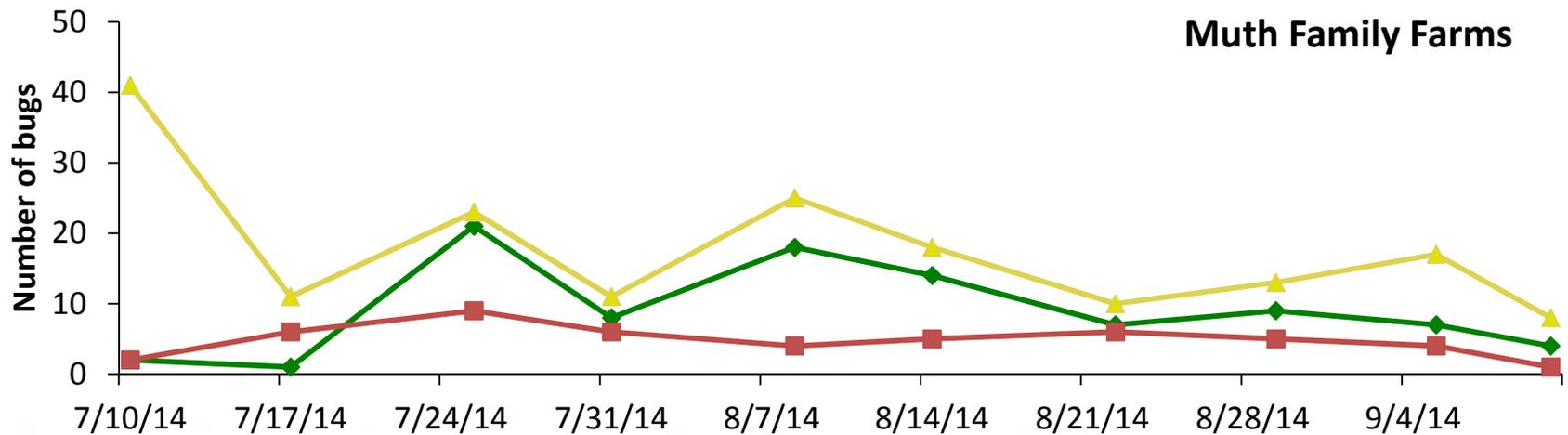
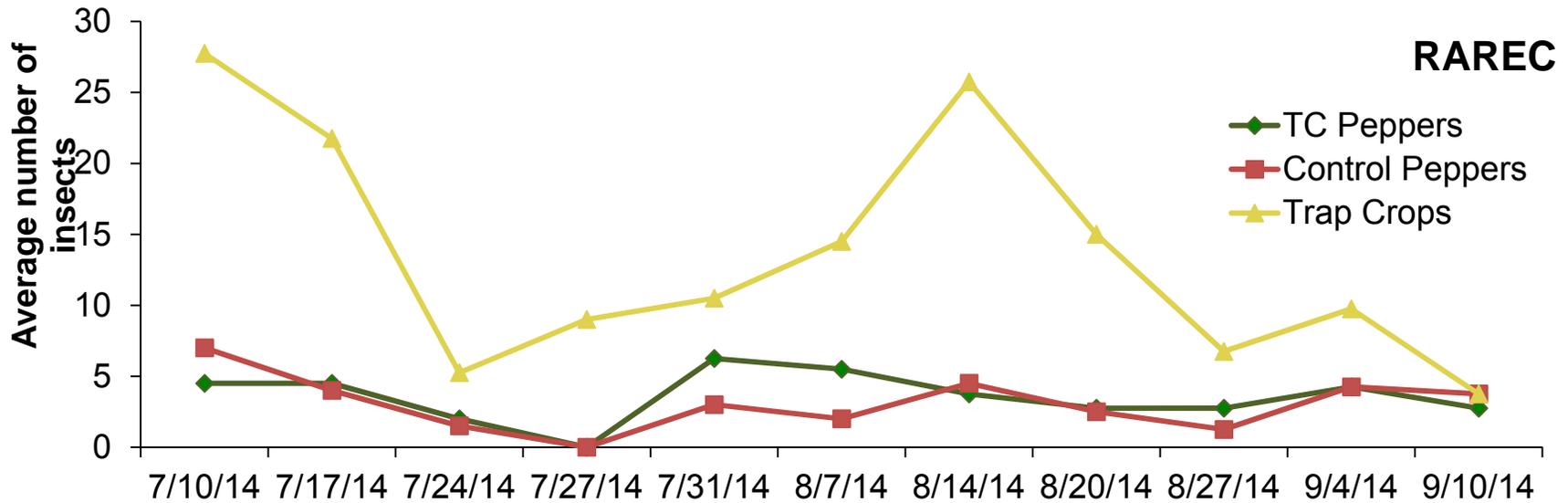


2014: Methods

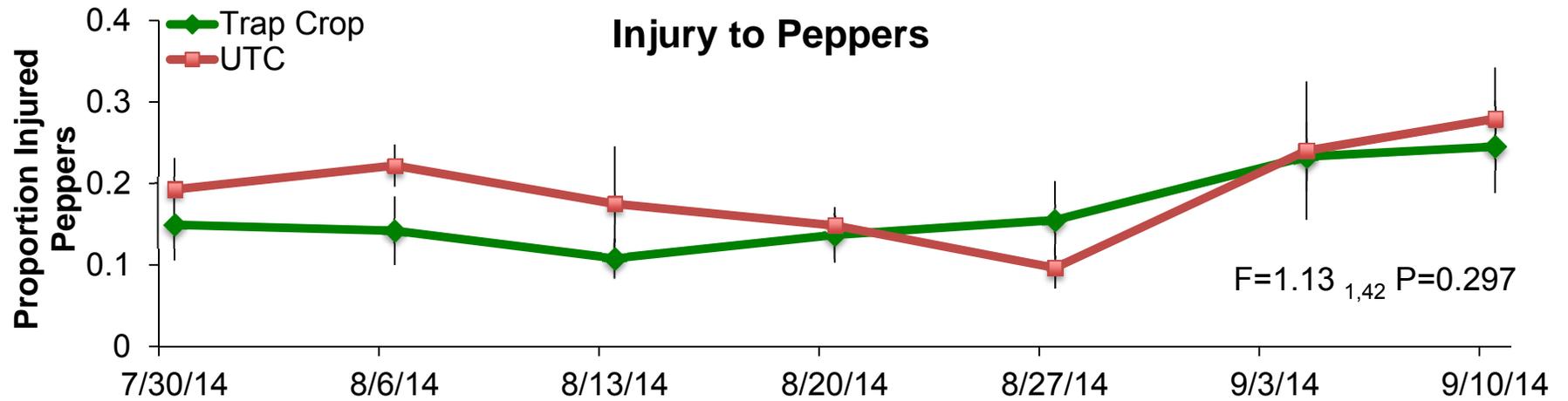
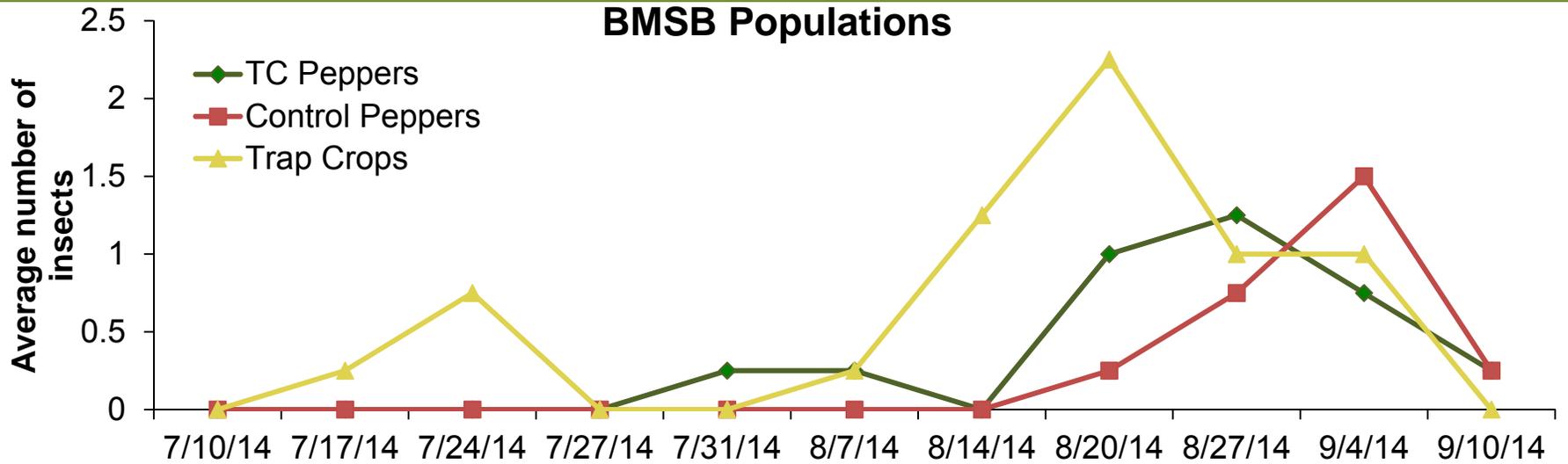


- Cash crop – Aristotle Bell Peppers
- Trap crop - Sunflower
- Trap crop - Sorghum
- Sampling area

Natural Enemy Populations



Trap Crop Results



Tracking Movement

- Protein markers

| | Sunflower | Sorghum | Pepper |
|--------|-----------|---------|--------|
| BMSB | | | |
| WV | 24 | 29 | 13 |
| NJ | 0 | 50 | 15 |
| Native | | | |
| WV | 98 | 12 | 9 |
| NJ | 67 | 16 | 4 |



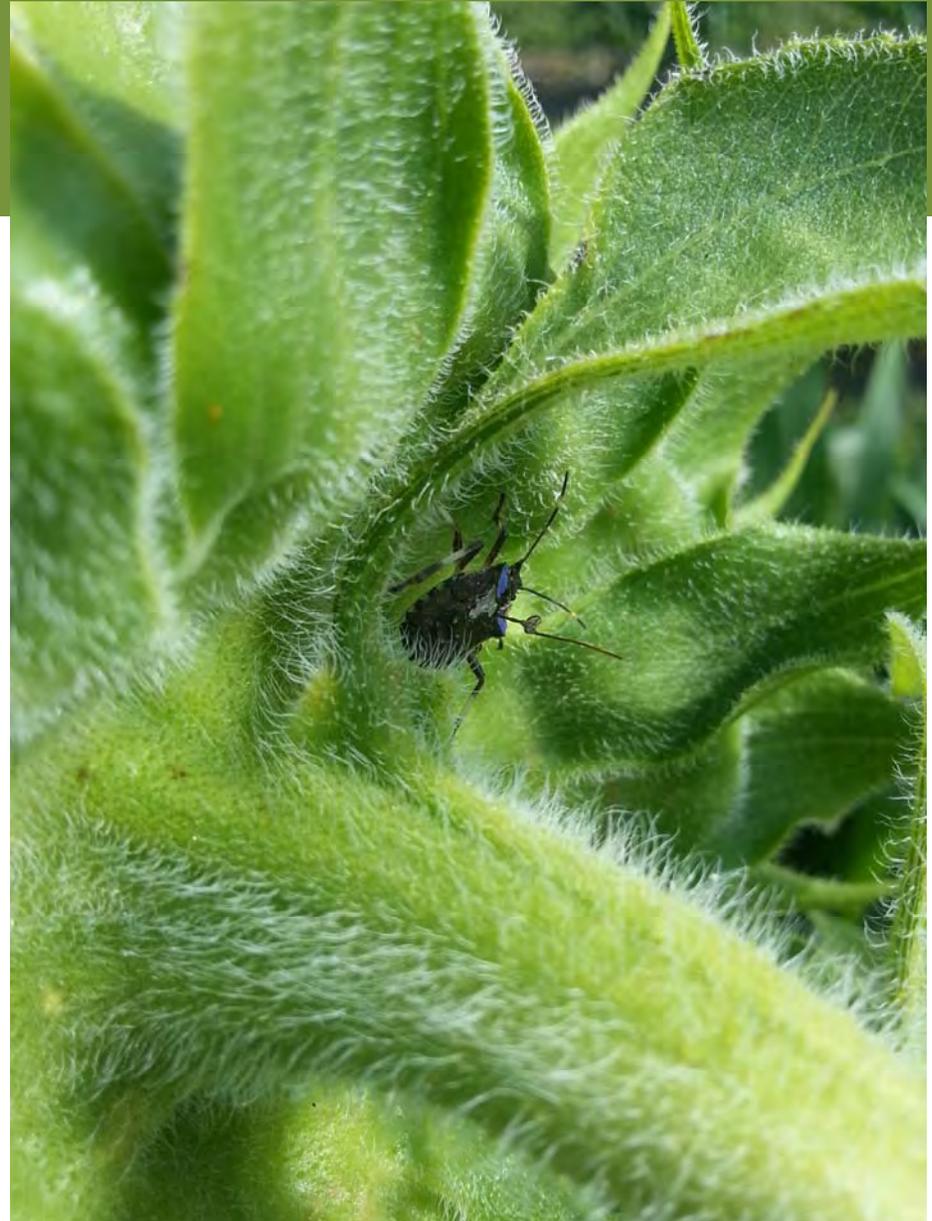


- **Harmonic radar**

- Trap crop retained BMSB
- BMSB left the peppers and moved to trap crop

- **Pull-pull**

- Deploy pheromone trap



Summary Of Trap Crops Results



- Sorghum was generally the most attractive trap crop tested for BMSB
 - Sunflower was more attractive earlier in the season with sorghum becoming more attractive in August
- Sunflower is attractive to natural enemies
- Colonization of cash crop was delayed
- Higher damage in peppers may have occurred at some sites
- Incorporation of a management method within trap crop should reduce spill over

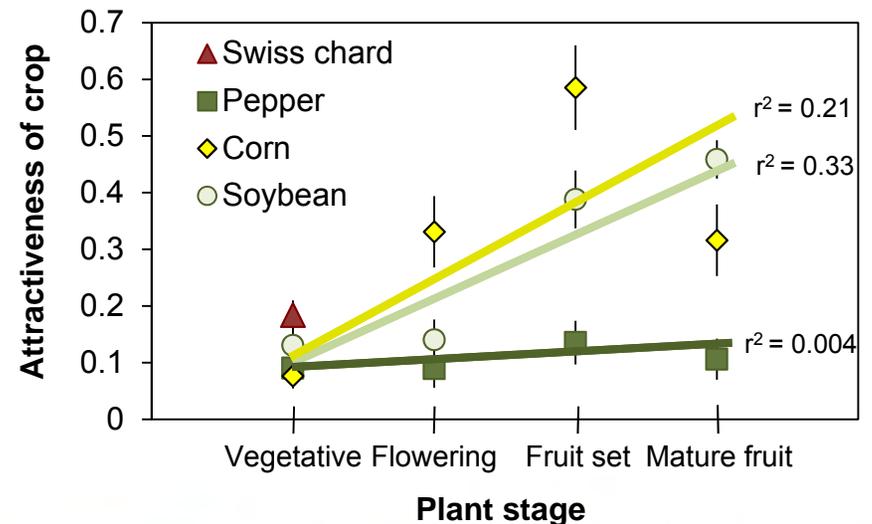
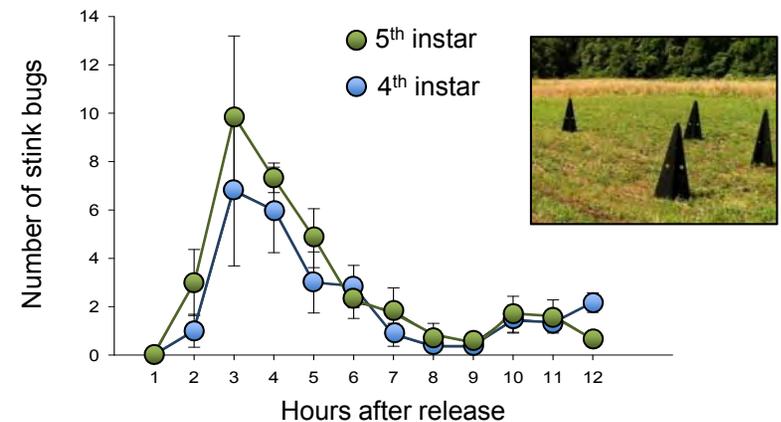
Objective 2: Determine patterns of BMSB within-farm movement

- Whole-farm sampling
- Nymphal dispersal behavior
- Overwintering behavior



Nymph Dispersal

- **Dispersal Capacity**
 - BMSB nymphs have a strong walking capacity.
 - Their capacity is affected by temperature with greater distances observed more frequently at $>25^{\circ}\text{C}$.
 - BMSB nymphs show strong response to the olfactory attractant and traverse large distances to reach source
- **Mark-release-recapture with nymphs of varying instars**
 - Nymphs make host plant choices
 - Attractiveness of host plants is dependent on plant stage
 - 2014: included plant volatile collection

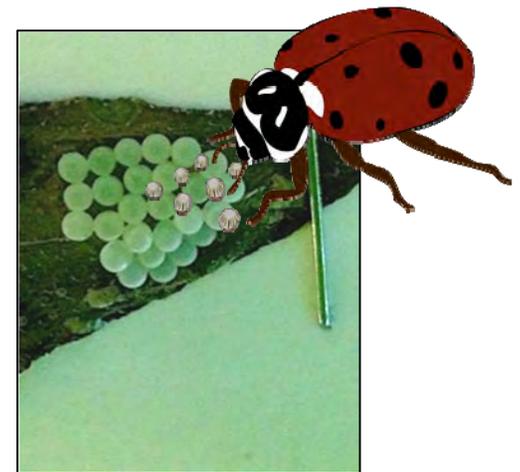


Leskey, Lee, Blaauw, Hamilton and Nielsen



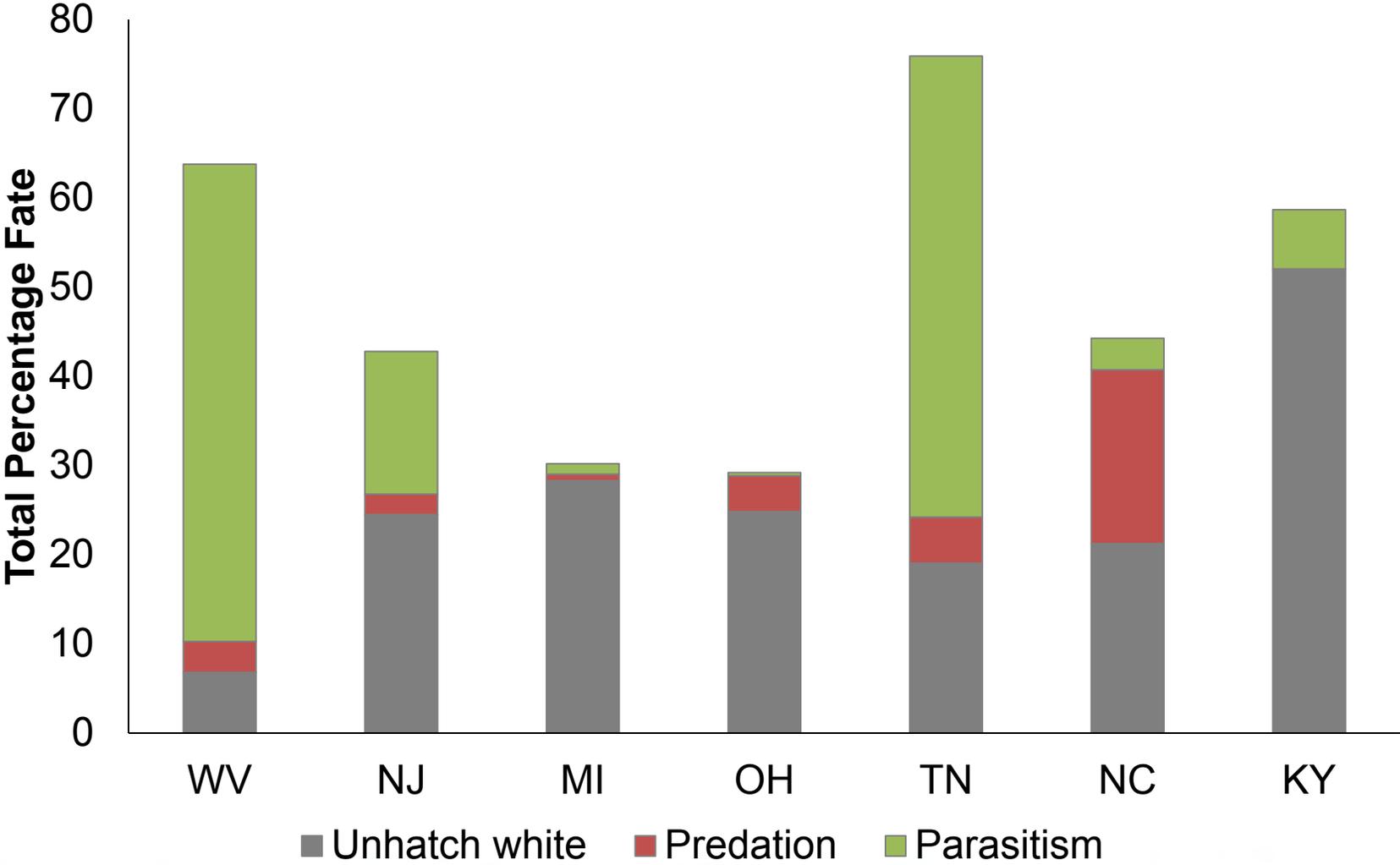
Objective 3: Determine Species Composition And Impact Of Endemic Natural Enemies On BMSB And Native Stink Bugs

- 8 states observed fate of sentinel BMSB eggs
 - Two sites per state
 - Two week intervals from June through August
- Recorded observed natural enemies
- Egg masses
 - Lab-produced sentinel egg masses (<48 hr old)
 - Wild eggs if present
- Deployment of sentinel egg masses
 - Roughly 20 egg masses/crop
 - 10-ft apart on edge of field

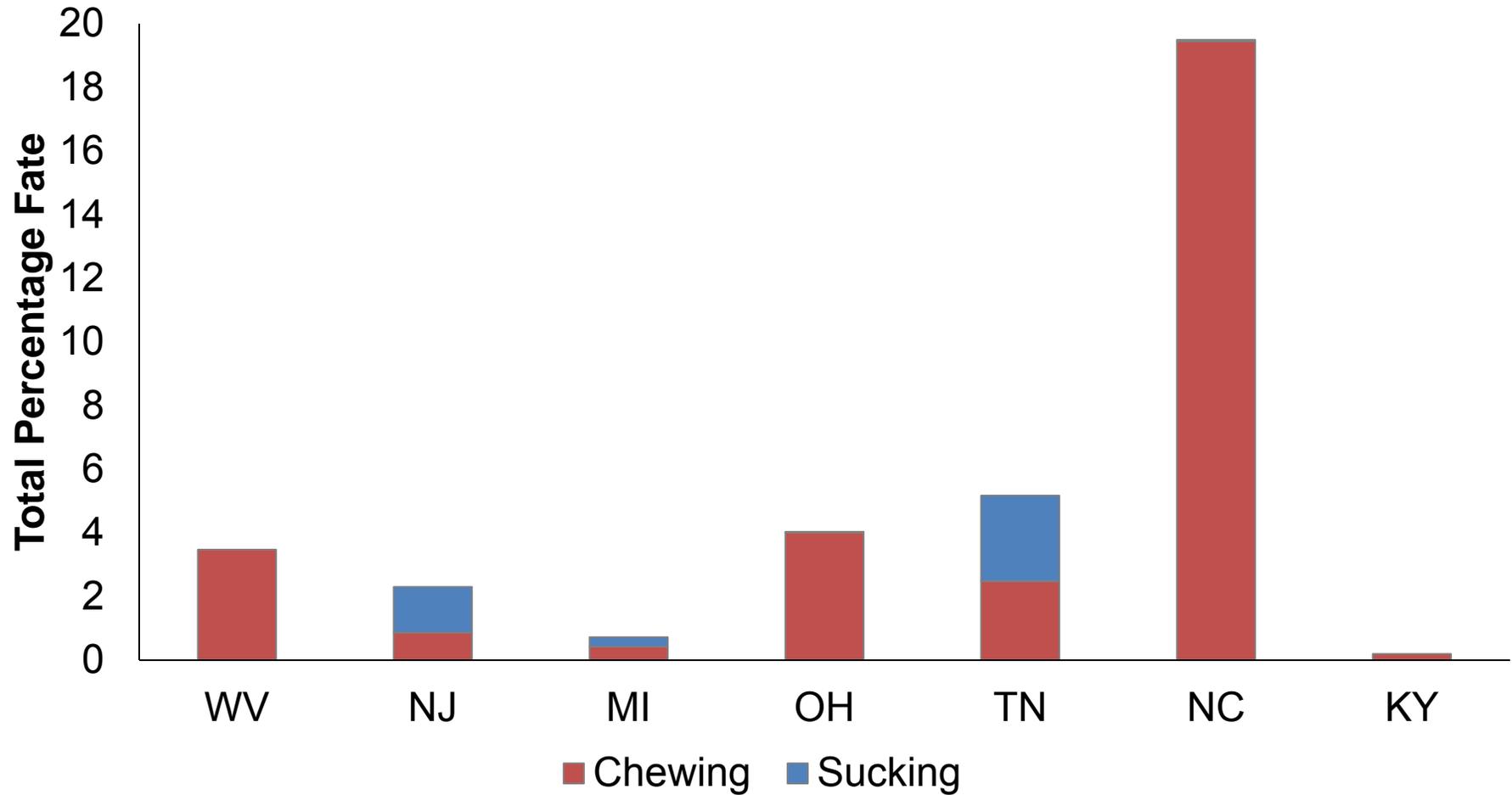


Nielsen, Pote, Park, Pfeiffer, Hooks, Hoelmer, Bessin, Walgenbach, Welty, Rogers, and Grieshop

BMSB Mortality



Predation



Additional Biocontrol Surveys

- In Michigan and New Jersey, video cameras were used to monitor sentinel egg masses
 - Timing of BMSB egg attackers
 - What natural enemy groups attack BMSB eggs?



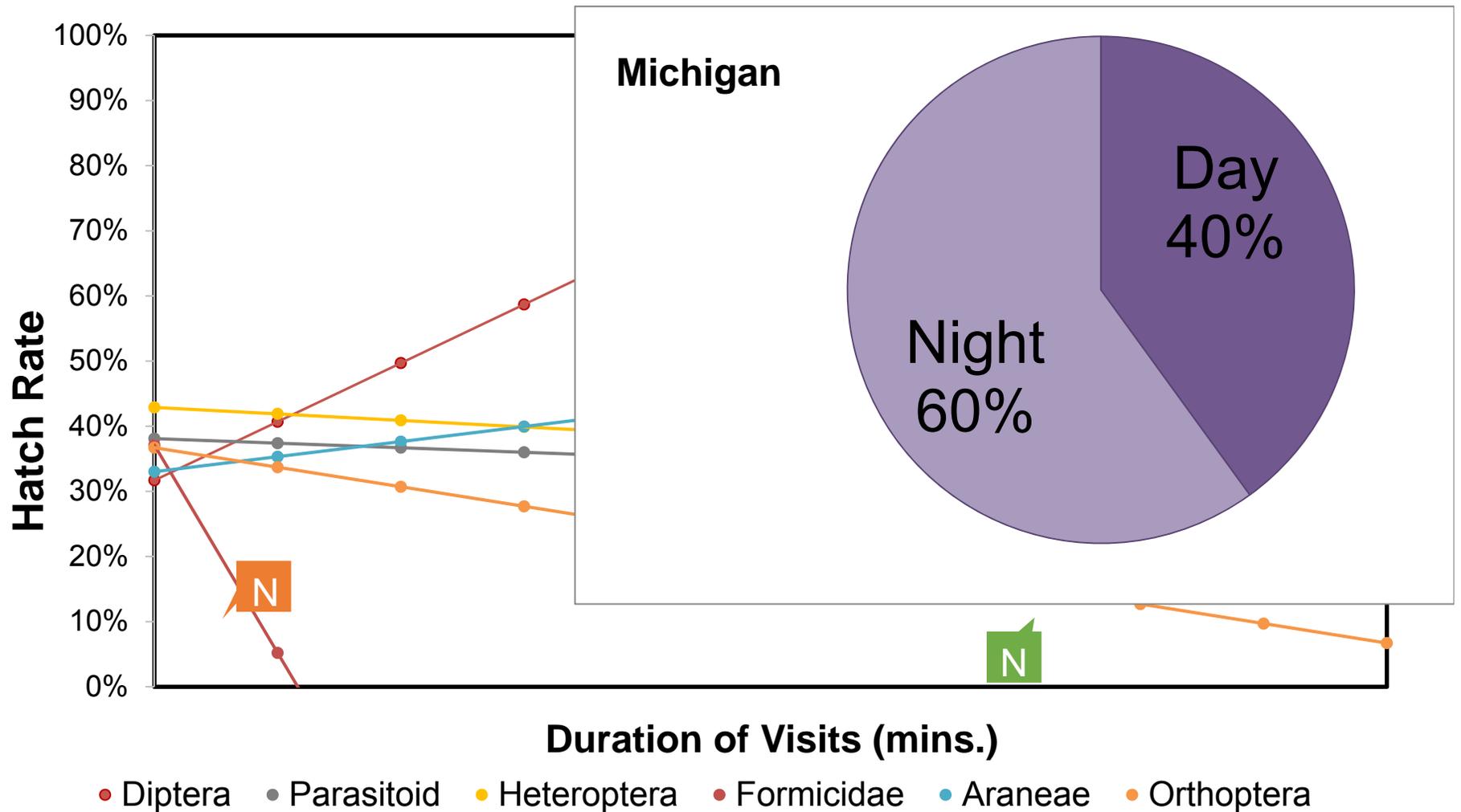
- In Michigan, 63% of visits occurred at night
- Katydid consumed whole egg masses
- Visitation rate does not equal consumption!

Grieshop, Pote, and Nielsen

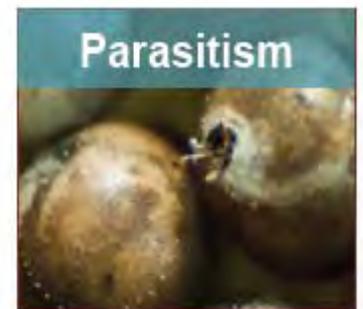
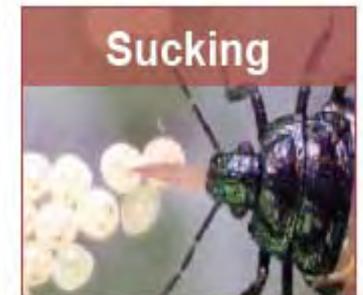
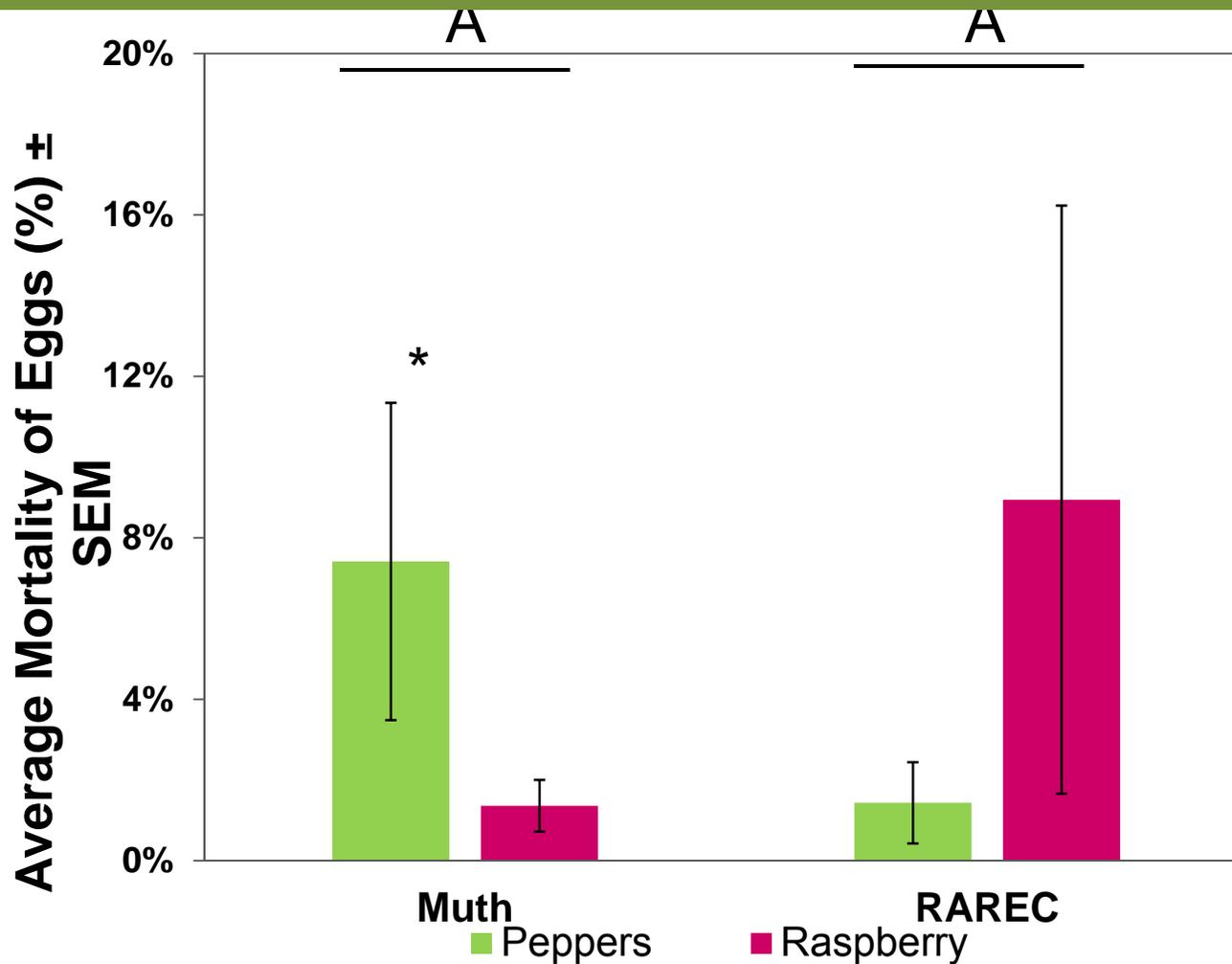
Insectary Plants



Regression Models of Visitor Duration and Hatch Rate, 2014



Biocontrol of Sentinel Egg Masses



Native flowering plants

- Five species

- Perennial:

- Cup plant, *Silphium perfoliatum*
- Golden Alexanders, *Zizia aurea*
- Horsemint, *Monarda punctata*
- Sand coreopsis, *Coreopsis lanceolata*

- Annual

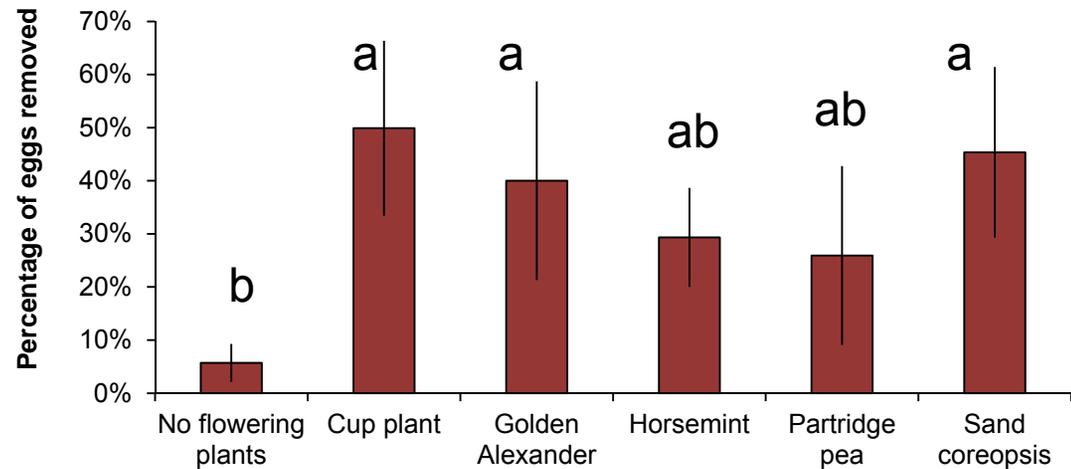
- Partridge pea, *Chamaecrista fasciculata*



Egg Consumption Was Increased Whereas Egg Viability Decreased

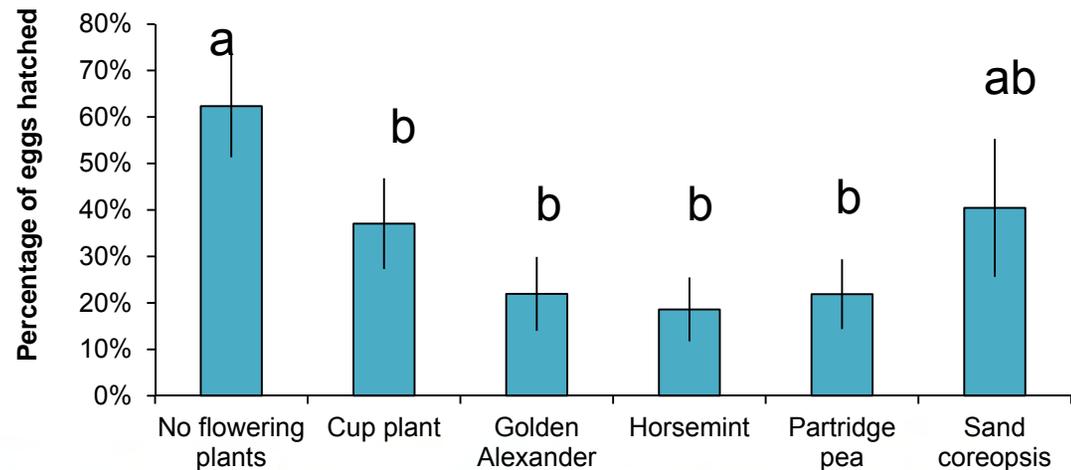
- No emergence of parasitoids
- Consumption corresponds to hatch rate

Egg consumption



$F_{5,24}=1.54, P=0.21, n=280$

Egg hatch



$F_{5,24}=2.75, P=0.04, n=280$

Natural Enemy Summary

- A diverse group of native predators and parasitoids have been found to attack BMSB eggs
- Most predators are unlikely suspects
- Low levels of parasitism were found in all states
- Field crops hosted the highest levels of predation
- Video showed that BMSB eggs were attacked by katydids and grasshoppers
- Biological control may be enhanced through flowering resources



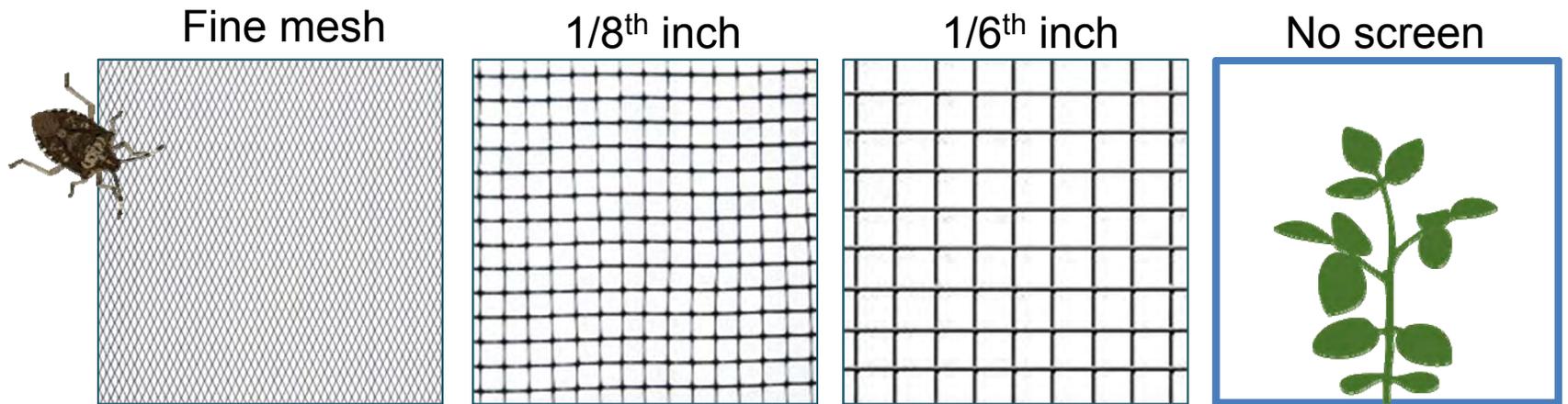
Objective 4: Evaluate Barrier Fabrics For BMSB And Endemic Stink Bugs Management

- Investigated efficacy of barrier fabrics
- Used 'Aristotle' bell peppers as test crop
- 4 reps, 4 cage treatments
 - 13 plants per cage (4 ft tall, 5 ft long, 6 ft wide)
 - Treatments:
 - Fine mesh
 - 1/8" mesh
 - 1/6" mesh
 - No screen
- Scouted pepper plants weekly for:
 - BMSB and native stink bugs
 - Natural enemies
- Peppers were harvested and assessed for damage



Rogers, Moore, and Bessin

Barrier Protection Of Peppers From Stink Bugs



| | Fine mesh | 1/8 th inch | 1/6 th inch | No screen |
|-------------------------|-----------|------------------------|------------------------|-----------|
| Sunscald | Low* | Medium | Medium | High |
| Production | Lowest | Medium | Medium | Highest* |
| Good bugs | Lowest | Medium | Medium | Medium |
| Marketable fruit | Highest* | Medium | Medium | Lowest |
| # stink bugs | Fewest* | Few | Few | Many |

Rogers, Moore, and Bessin



For more information, please visit our project website:

<http://eorganic.info/brown-marmorated-stink-bug-organic>

