

# Comparison of Standard Pyramid and Sticky Traps for Monitoring Brown Marmorated Stink Bug

Objective 3a. Optimize trap design for monitoring and surveillance

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**USDA** United States Department of Agriculture National Institute of Food and Agriculture  
Specialty Crop Research Initiative

*Collaborating Institutions*

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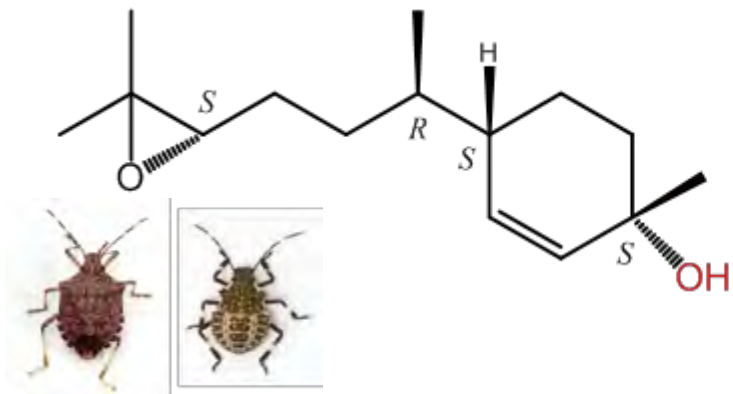
**MICHIGAN STATE UNIVERSITY**

**UC RIVERSIDE**

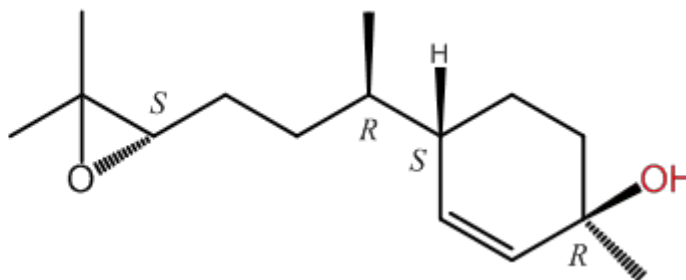
This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Specialty Crop Research Initiative under award number 2016-51181-25409.

# Two-Component BMSB Aggregation Pheromone and Synergist

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

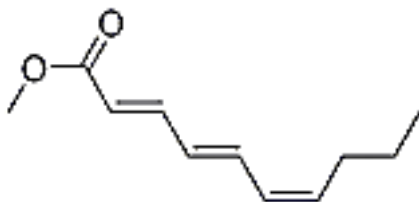


Minor component of BMSB aggregation pheromone  
(3*R*,6*S*,7*R*,10*S*)-10,11-epoxy-1-bisabolen-3-ol



+

Methyl (*E,E,Z*)-2,4,6-decatrienoate (MDT) acts as a synergist for BMSB pheromone



=

**Synergism**

# Standard Monitoring Traps



- **Visual Stimulus**
  - Large black pyramid (trunk-mimicking stimulus)
- **Olfactory Stimulus**
  - PHER + MDT
- **Capture Mechanism**
  - Tapered pyramid attached to inverted funnel jar with DDVP strip
- **Deployment Strategy**
  - Traps placed in peripheral row or border area

# Can We the Improve Pheromone-Based Trapping System For Monitoring and Use Them For Biosurveillance?

- What is the most sensitive and cost-effective trap design and lure formulation?
- Can we detect nymphal presence, i.e., reproductive populations with alternative trap designs?
- What is the size of the area sampled by the most effective trap?

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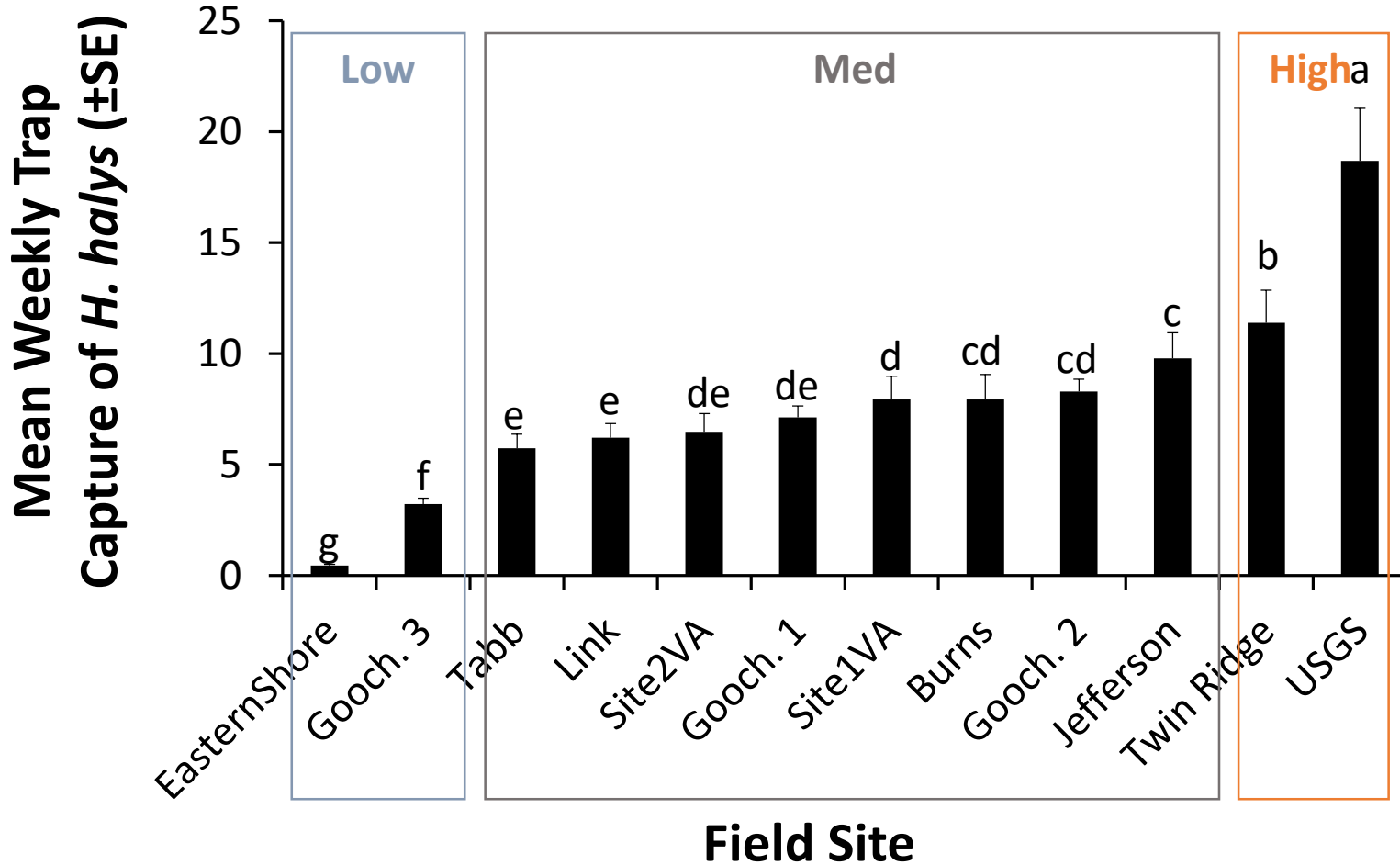
# Trap Design and Lure Formulation



- Two companies, Trece and AgBio, formulated lures.
  - Monitoring Loading (1x, 5mg PHER/50 mg MDT)
  - Surveillance Loading (4x, 20 mg PHER/200 mg MDT)
- Measured season-long captures at 12 sites in WV, MD and VA.

# Adults

**ANOVA**  
 $F_{11,384} = 516.16$   
 $P < 0.0001$   
**Tukey's HSD**

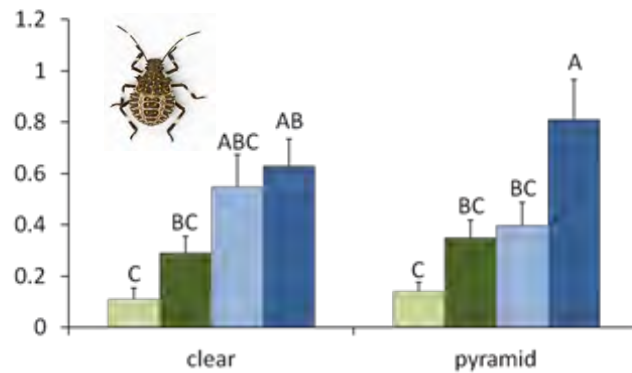
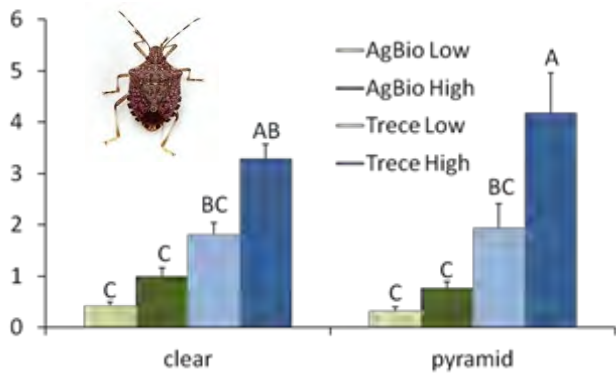


Mean Weekly Trap Capture of *H. halys* ( $\pm$ SE)

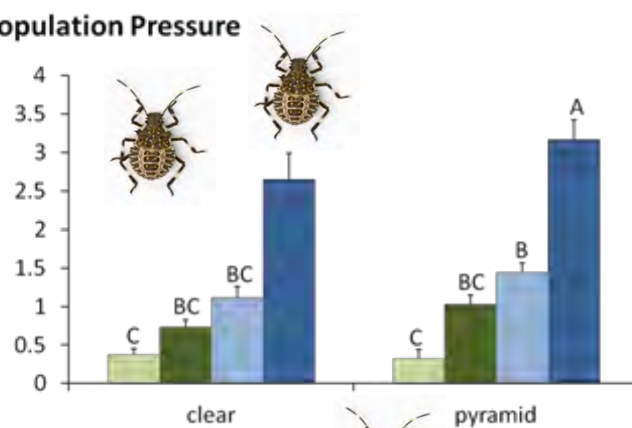
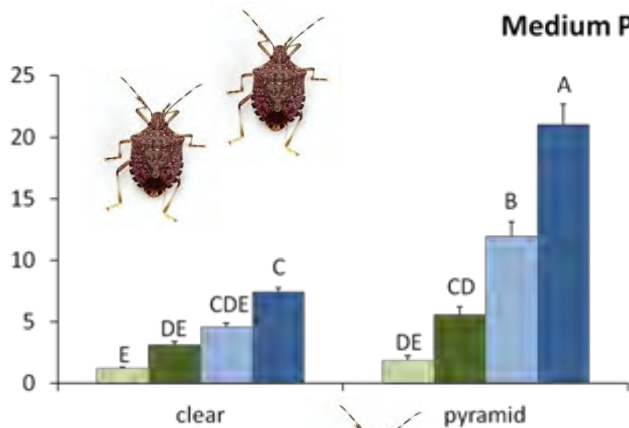
**Adults**

**Nymphs**

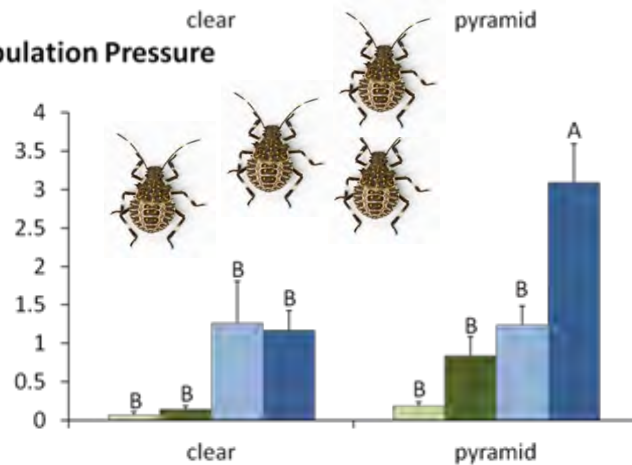
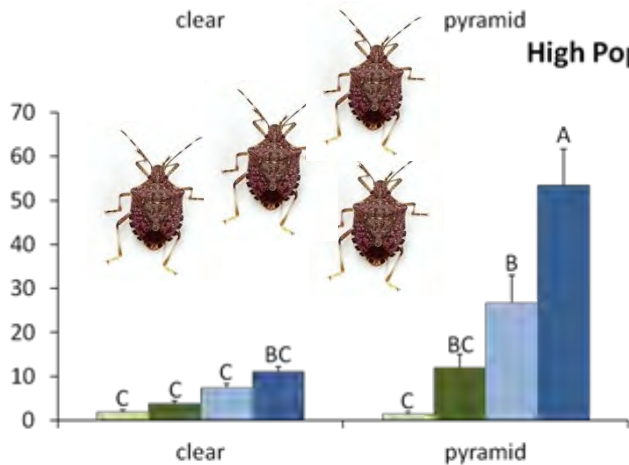
**Low Population Pressure**



**Medium Population Pressure**



**High Population Pressure**





Trap Type

Are there significant correlations between pyramid trap and sticky card trap captures with our most sensitive lures?



**Table 1.** Pearson correlation coefficients between captures of *H. halys* in pyramid traps compared to clear sticky cards under low, medium, and high population pressure



| Population Pressure |  | Adults |     |        |  | Nymphs |     |        |
|---------------------|---|--------|-----|--------|---|--------|-----|--------|
|                     |   | r      | df  | P      |   | r      | df  | P      |
| <i>Trece Low</i>    |   |        |     |        |   |        |     |        |
| Low                 |   | 0.777  | 37  | 0.0001 |   | 0.883  | 37  | 0.0001 |
| Med                 |   | 0.617  | 158 | 0.0001 |   | 0.499  | 158 | 0.0001 |
| High                |   | 0.663  | 40  | 0.0001 |   | 0.414  | 40  | 0.007  |
| <i>Trece High</i>   |   |        |     |        |   |        |     |        |
| Low                 |   | 0.740  | 37  | 0.0001 |   | 0.703  | 37  | 0.0001 |
| Med                 |   | 0.528  | 158 | 0.0001 |   | 0.462  | 158 | 0.0001 |
| High                |   | 0.673  | 40  | 0.0001 |   | 0.322  | 40  | 0.04   |





Are there significant correlations between sticky card trap captures baited with monitoring (1x) and surveillance (4x) loadings?

**Table 2.** Pearson correlation coefficients between captures of *H. halys* on clear sticky cards baited with Trece Low and Trece High under low, medium, and high population pressure

| Population Pressure |  | Adults |    |        |  | Nymphs |        |   |
|---------------------|---|--------|----|--------|---|--------|--------|---|
|                     |   | r      | df | P      |   | r      | df     | P |
| Low                 |   | 0.804  | 18 | 0.0001 | 0.438   | 18     | 0.0001 |   |
| Med                 |   | 0.956  | 18 | 0.0001 | 0.812   | 18     | 0.0001 |   |
| High                |   | 0.931  | 18 | 0.0001 | 0.770   | 18     | 0.007  |   |

# BMSB SCRI Objectives

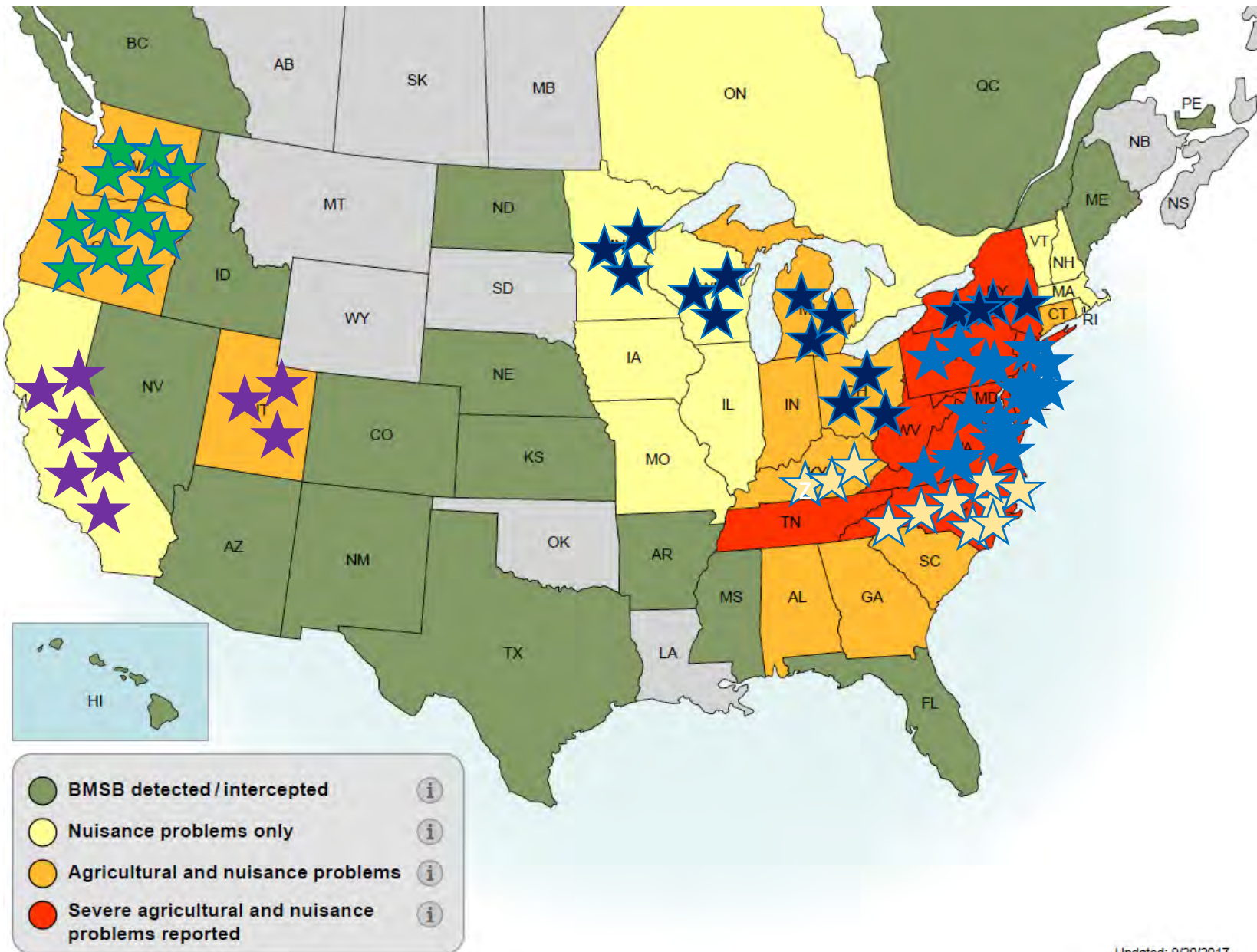
- To document seasonal phenology and population density of BMSB in the Mid-Atlantic, Southeast, Great Lakes, West and Pacific Northwest using pheromone-baited traps.
- To compare sensitivity and efficiency pyramid and clear sticky traps in these same regions.
- To potentially provide the start of a longitudinal data set for Objective 1.

# Methods

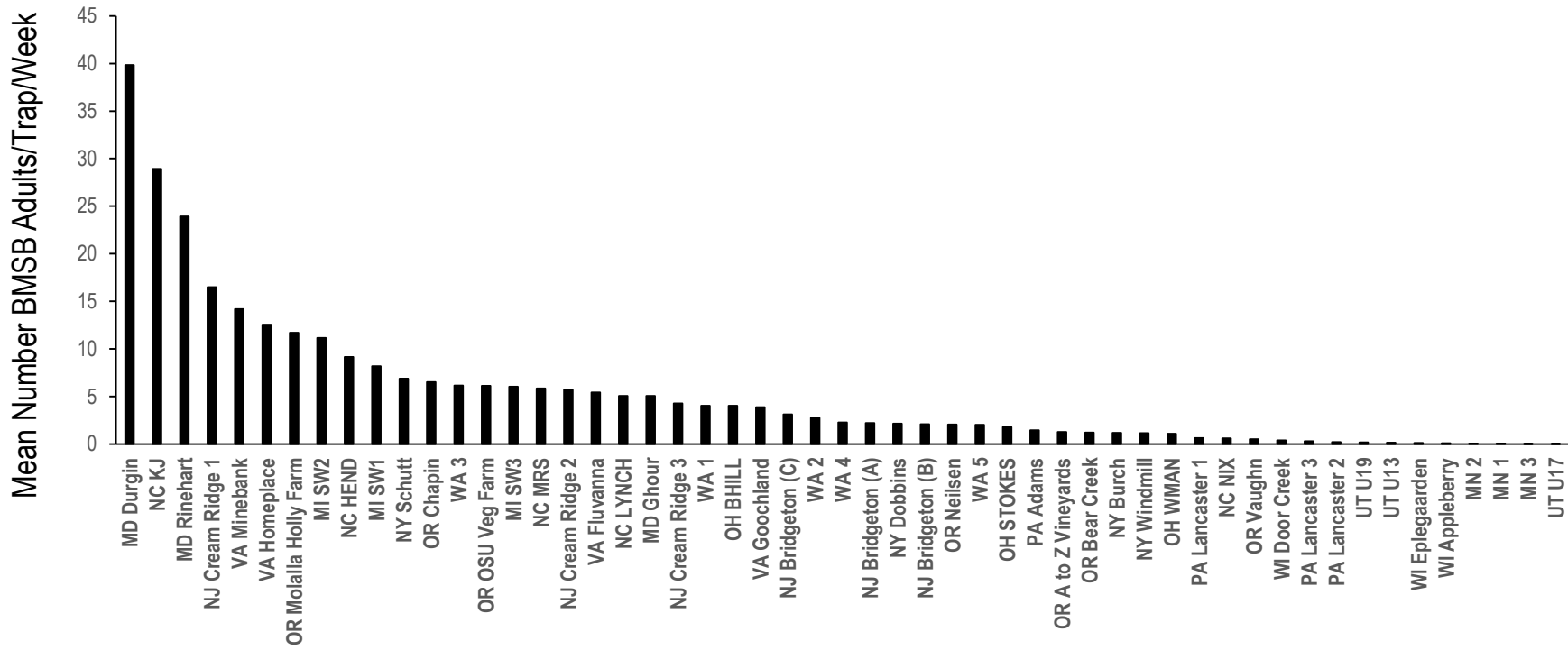
- Deploy standard pyramid and sticky traps baited with Trece 1x lures (5 mg PHER/50 mg MDT). Traps spaced 50 m apart and deployed in a transect along wooded habitat that bordered a cultivated crop. Traps checked weekly.
- Each cooperator deploys traps at 3 sites with 3 replicates per site.



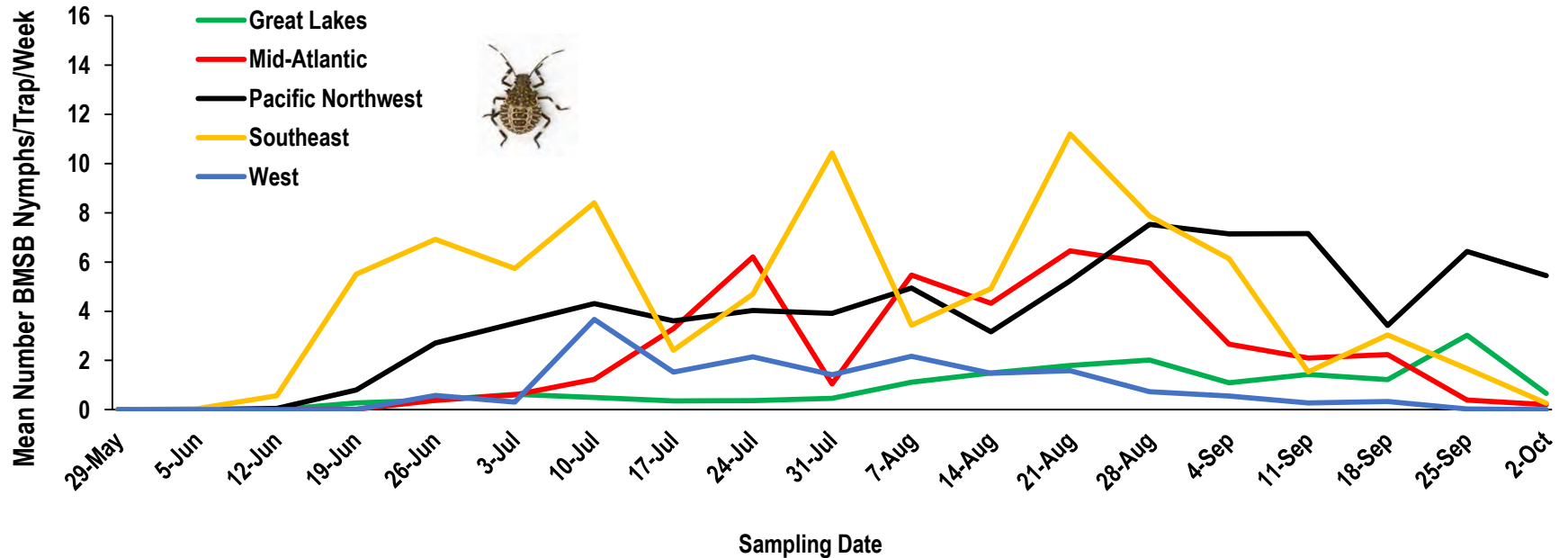
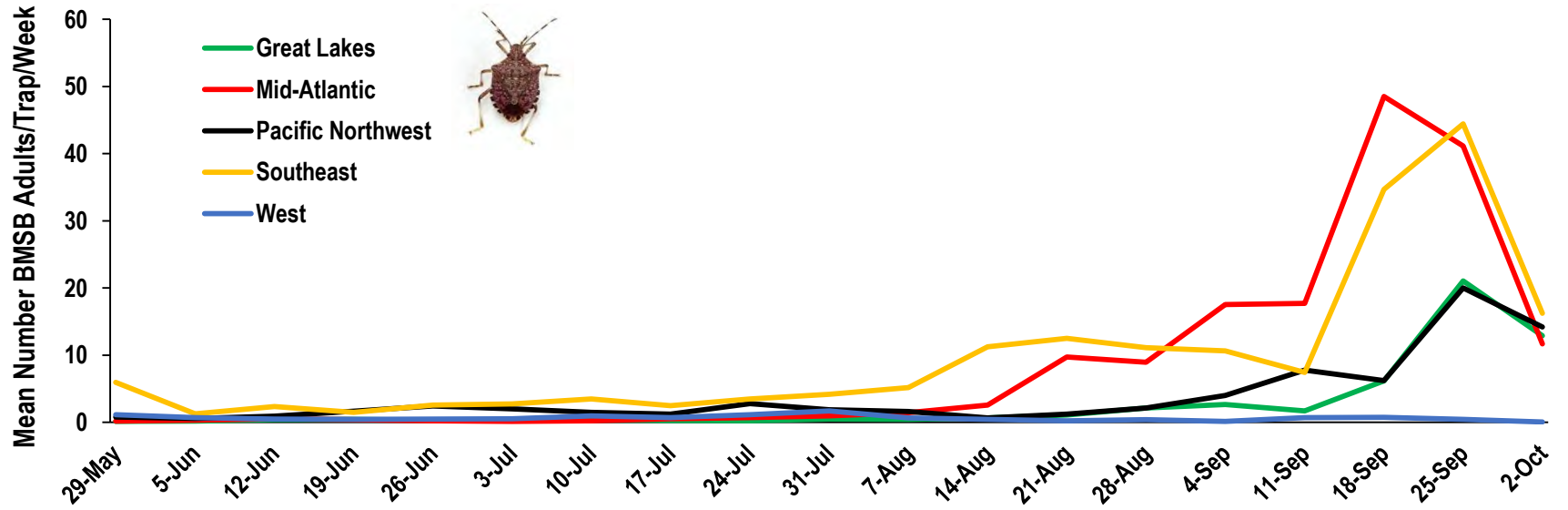
# Participating States



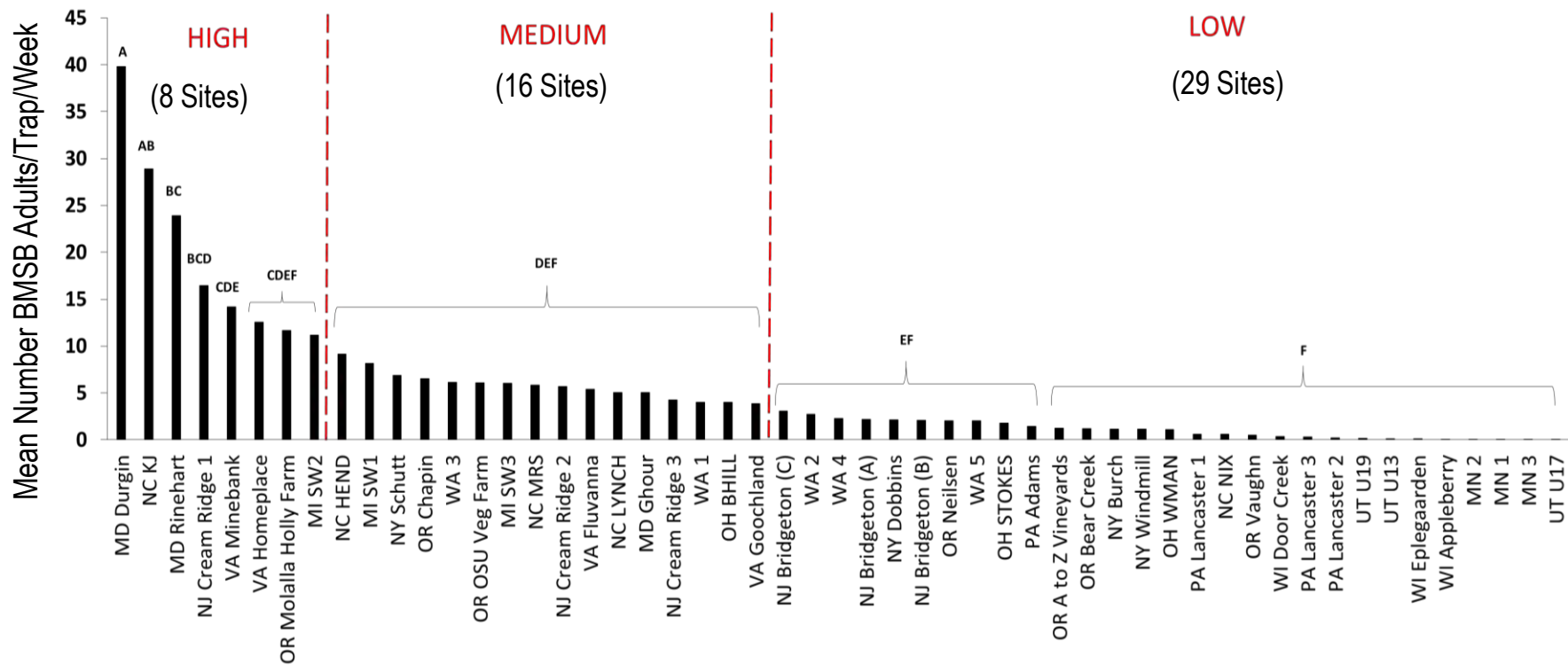
# Season-Long Trapping Period, May 29-October 7, 2017



# Seasonal Phenology Results

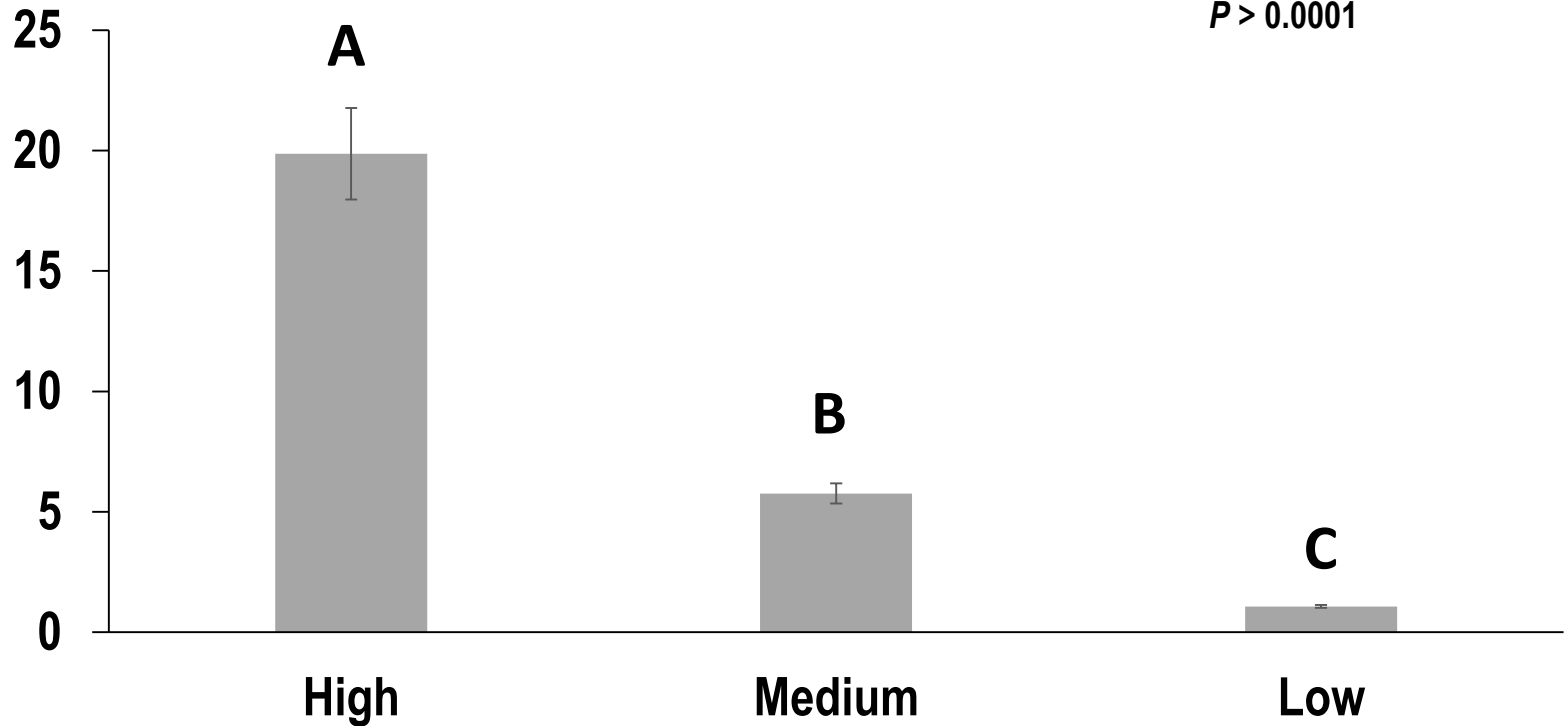


# Population Densities Across All Sites



# Population Densities Across Groups

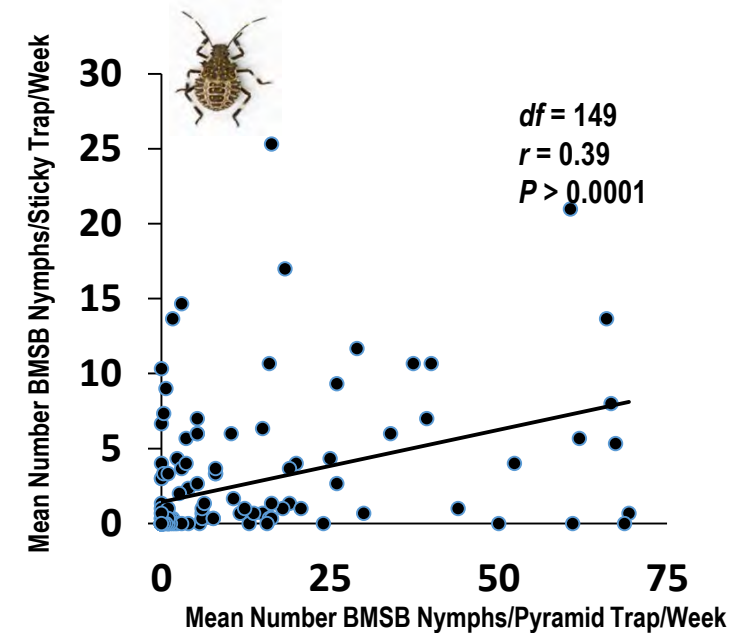
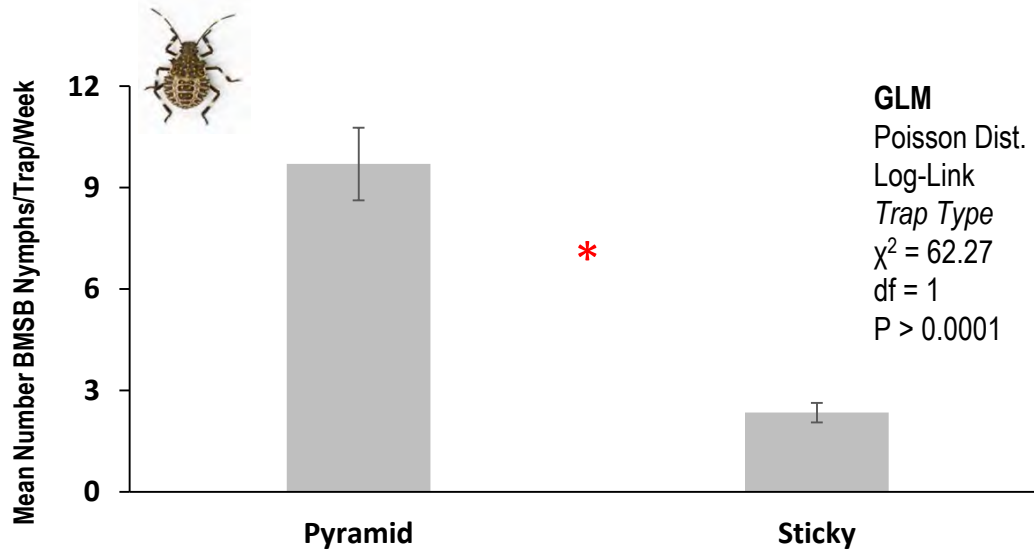
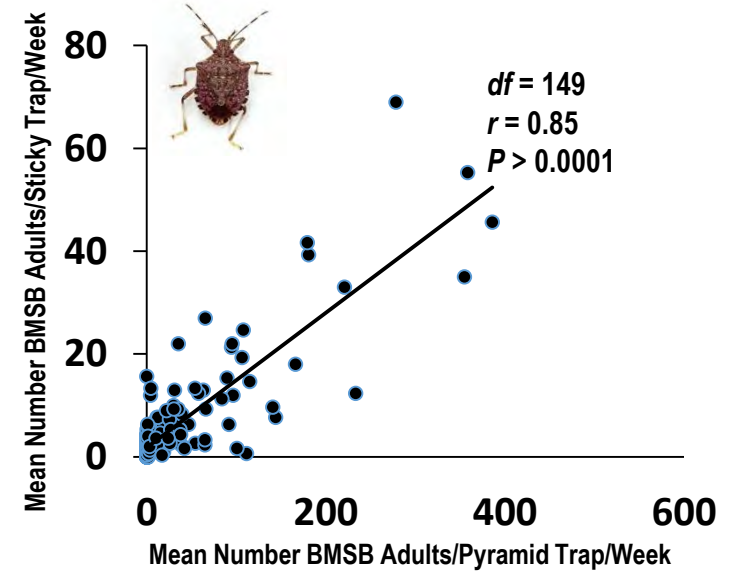
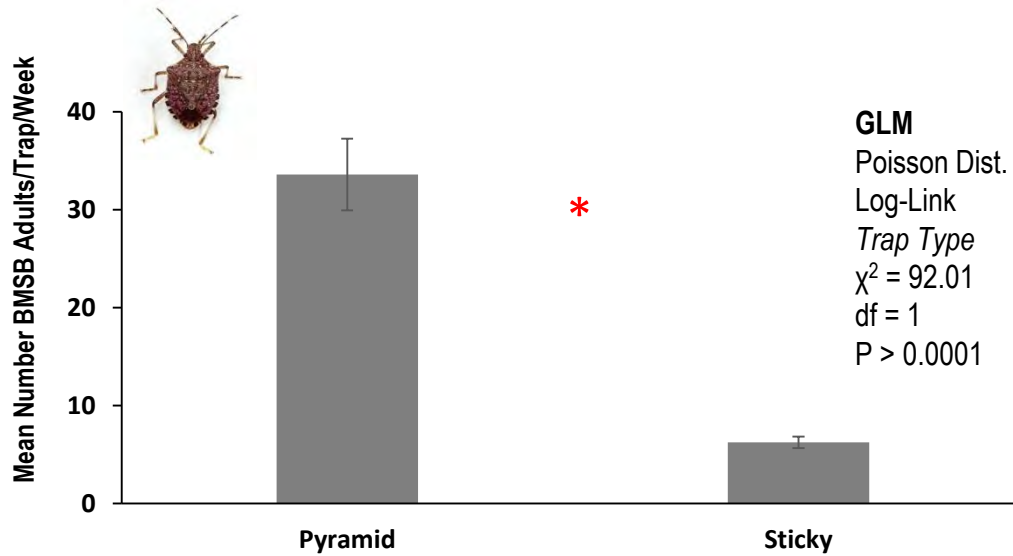
Mean Number BMSB Adults/Trap/Week



ANOVA:  
 $F_{2, 5939} = 212.38$   
 $P > 0.0001$



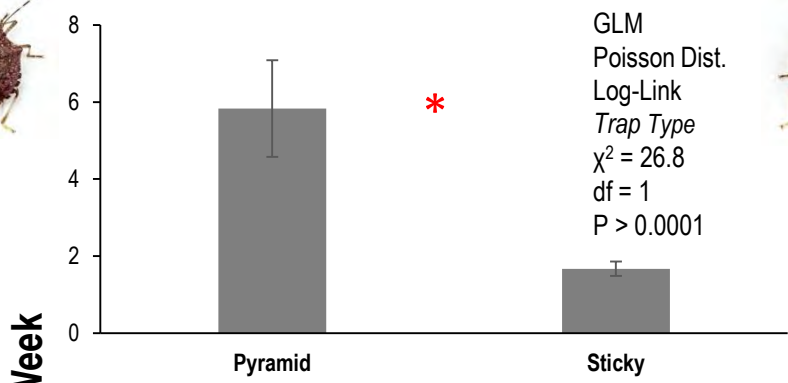
# High Population Sites



# High Population Sites

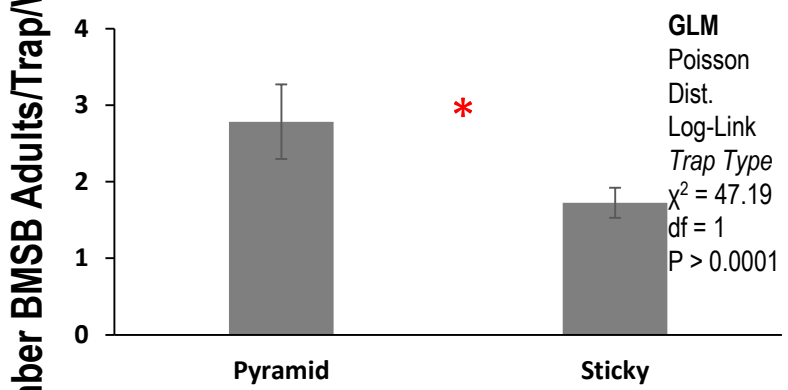
## Early

(17 Apr to 16 June)



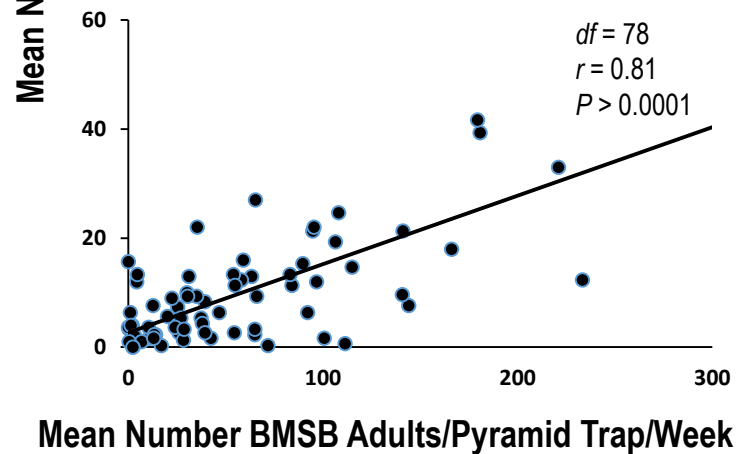
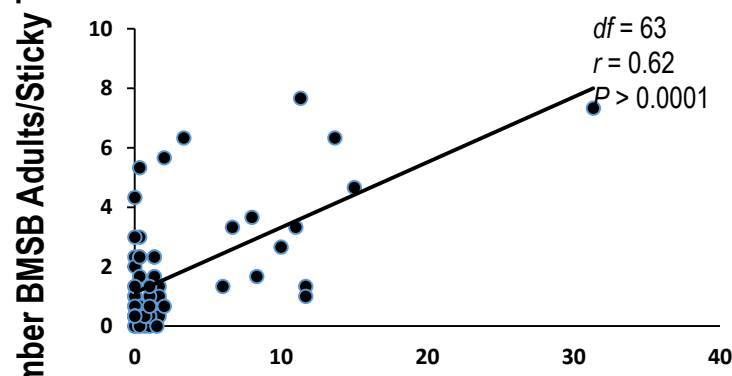
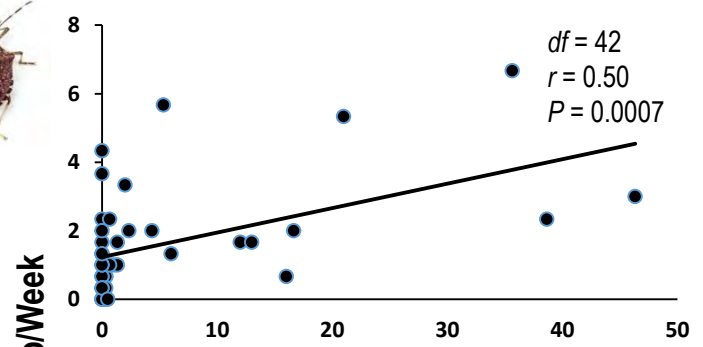
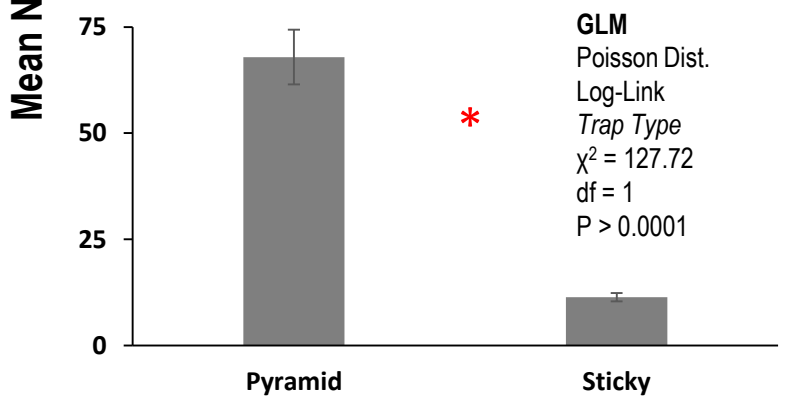
## Mid

(17 June to 11 Aug)



## Late

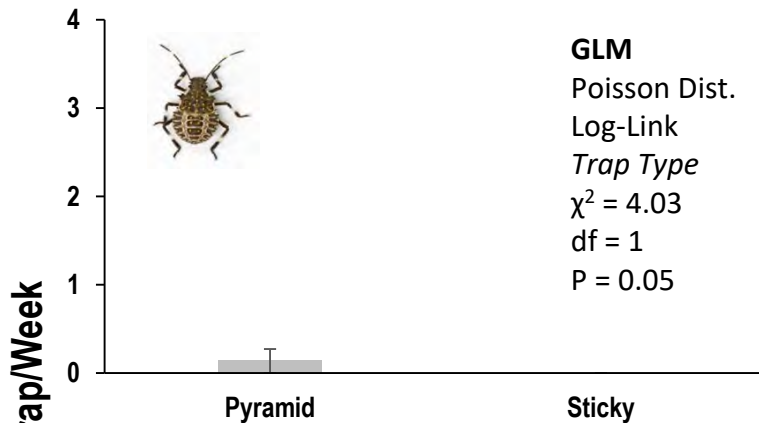
(12 Aug to 20 Oct)



# High Population Sites

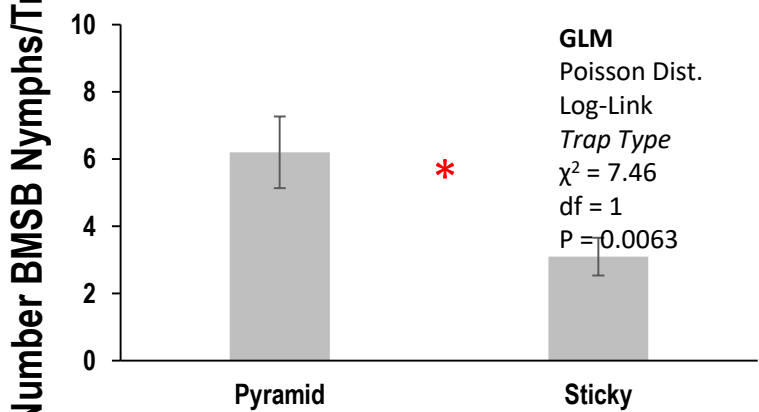
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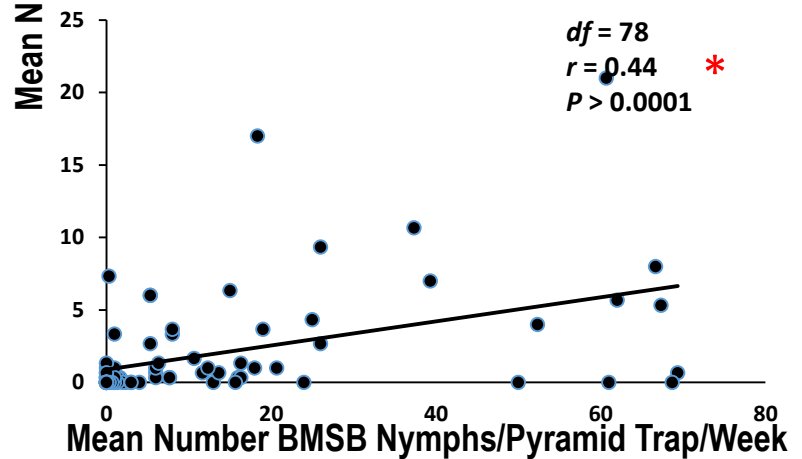
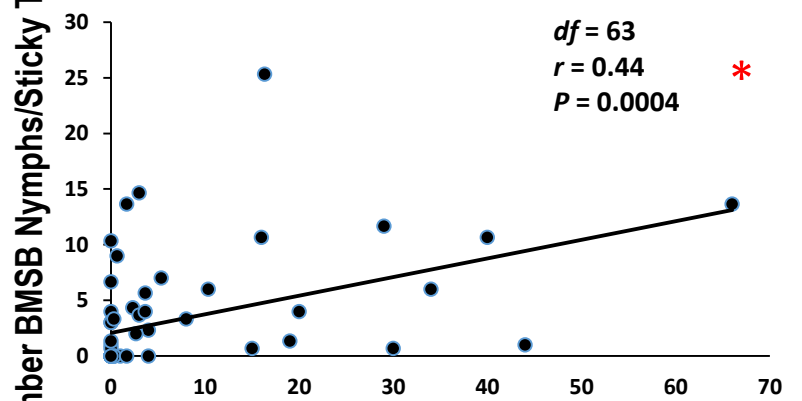
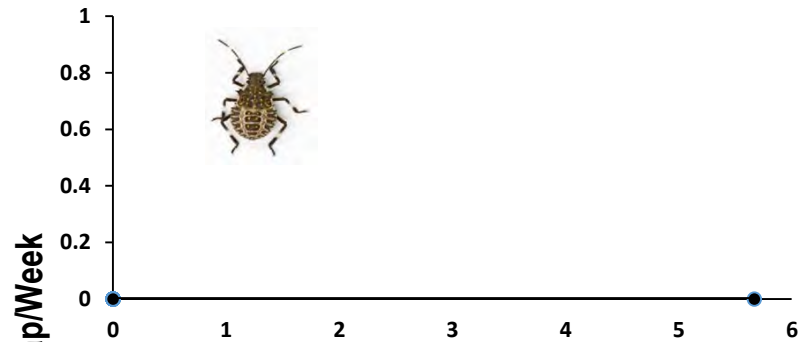
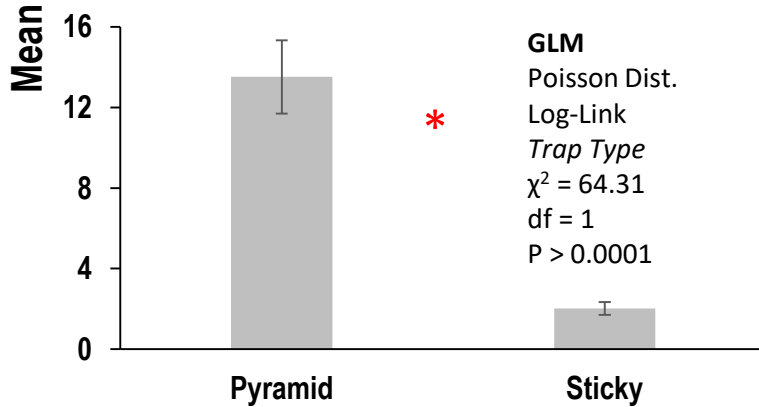
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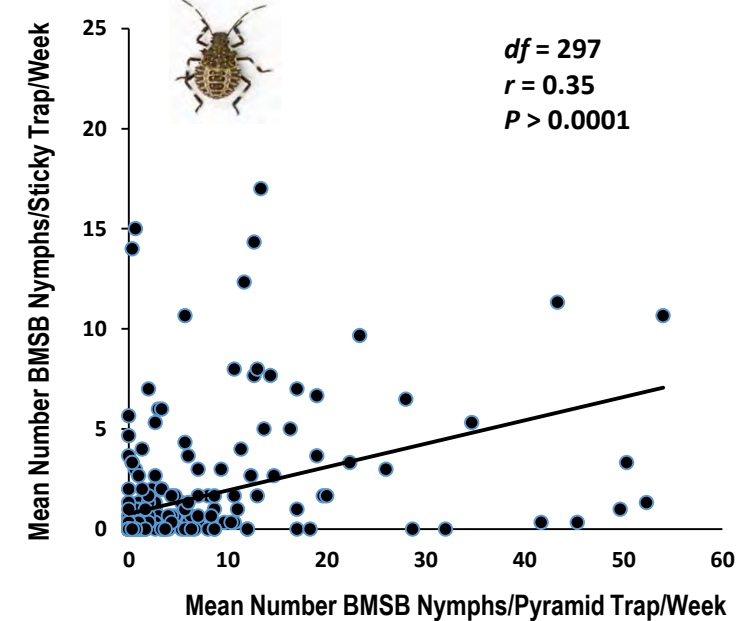
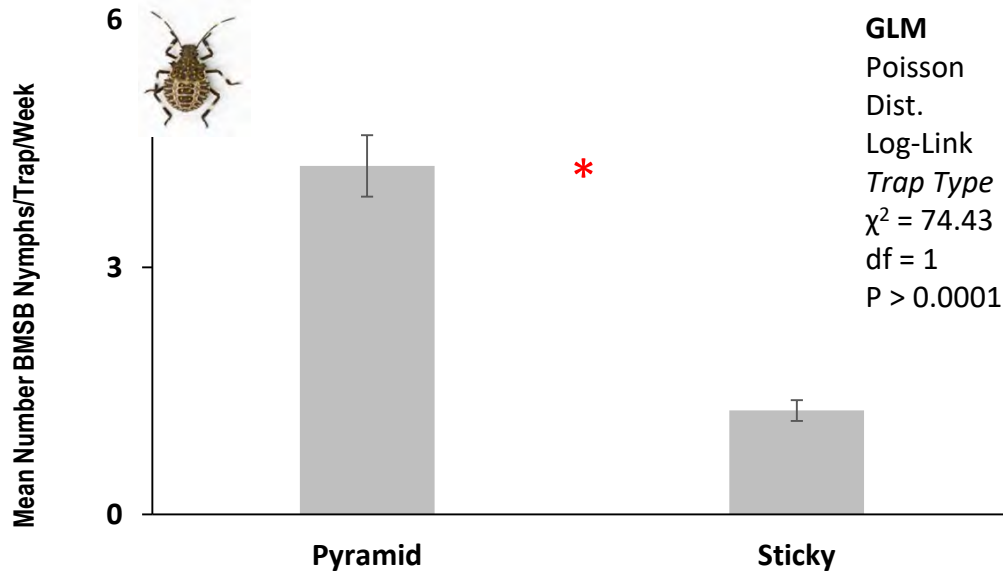
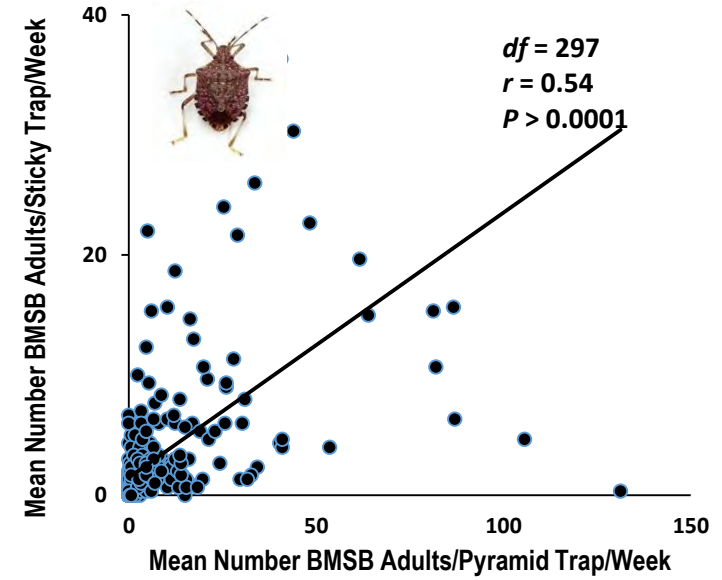
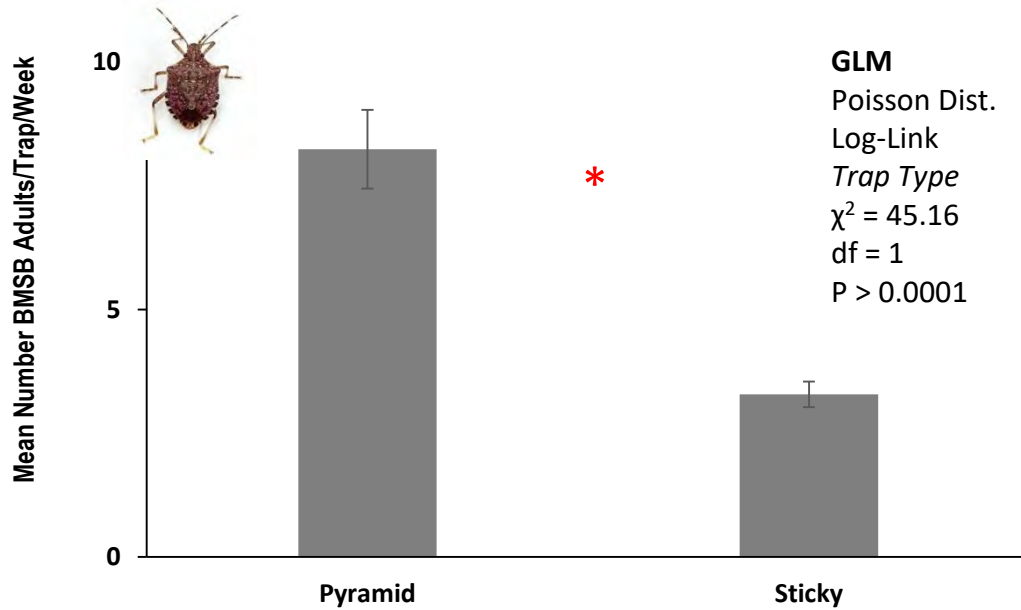


## Late

(12 Aug to 20 Oct)



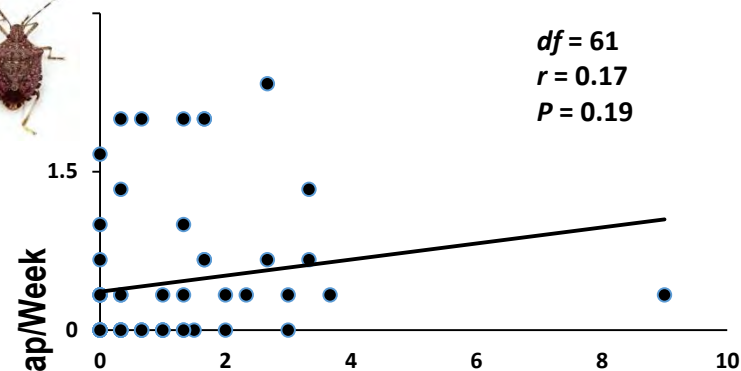
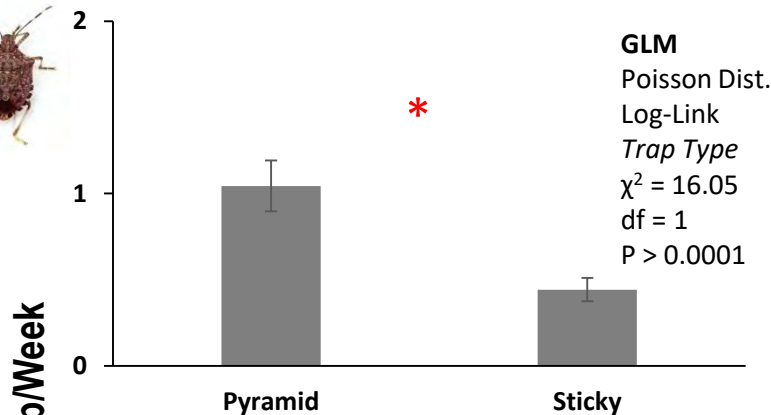
# Medium Population Sites



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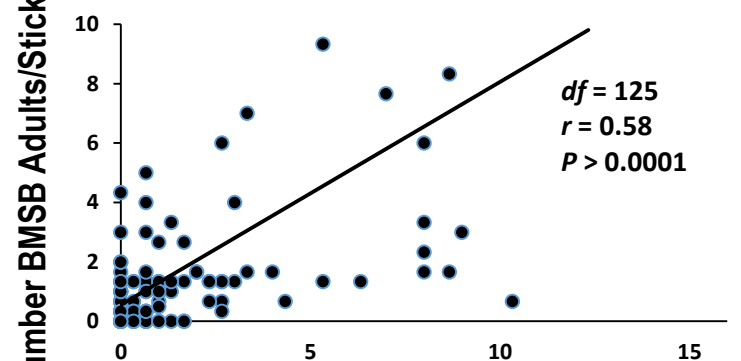
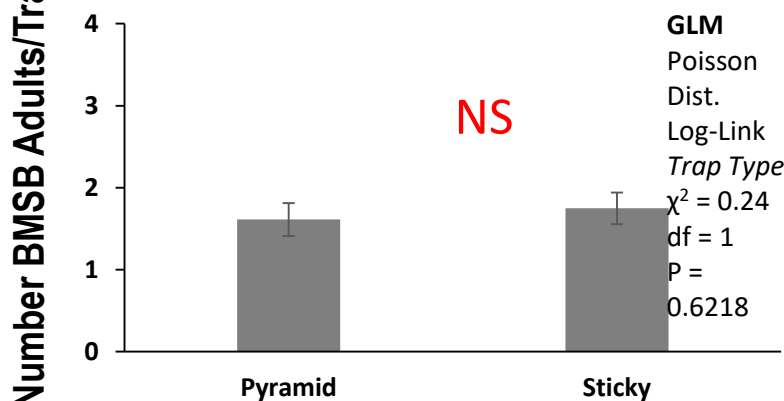
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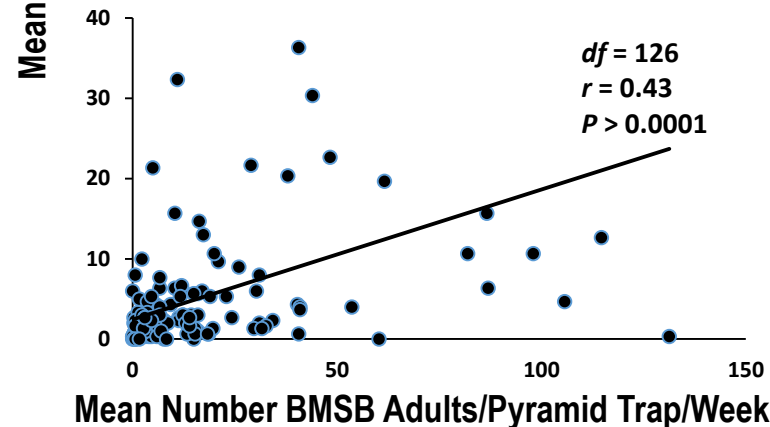
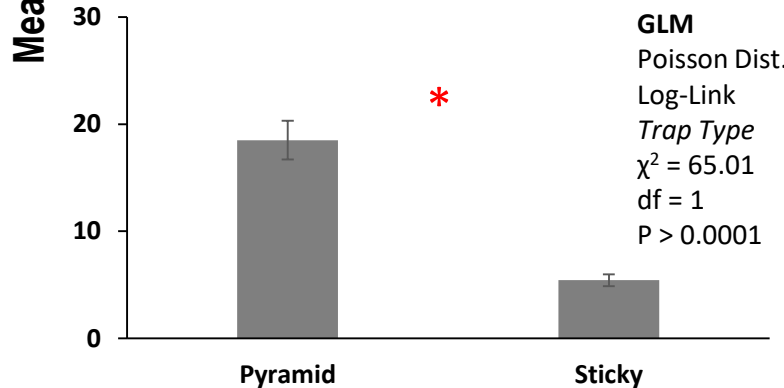
## Mid

(17 June to 11 Aug)



## Late

(12 Aug to 20 Oct)



# Medium Population Sites

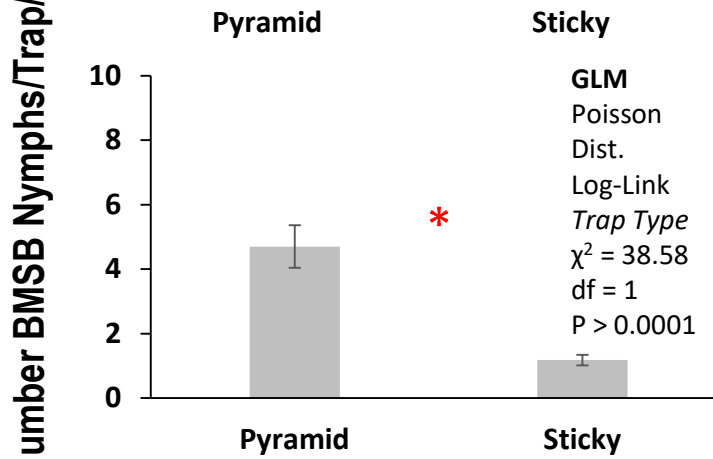
## Early

(17 Apr to 16 June)



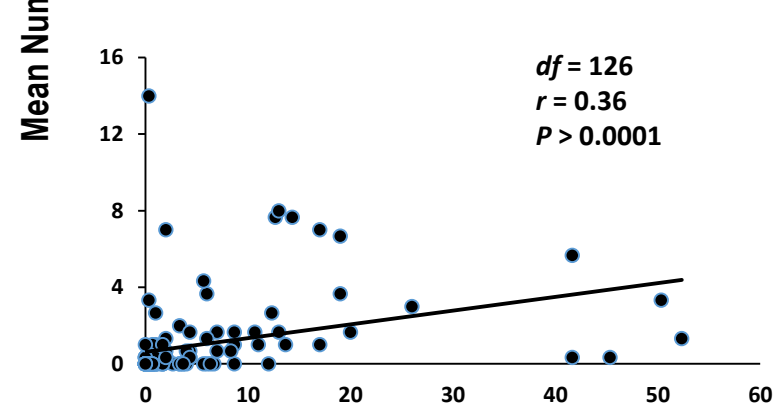
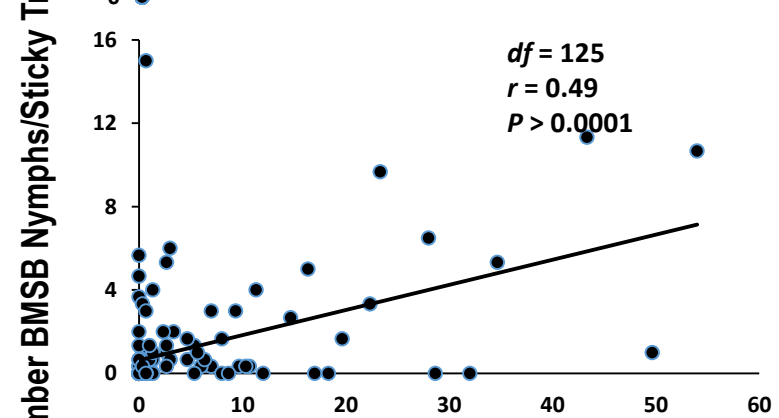
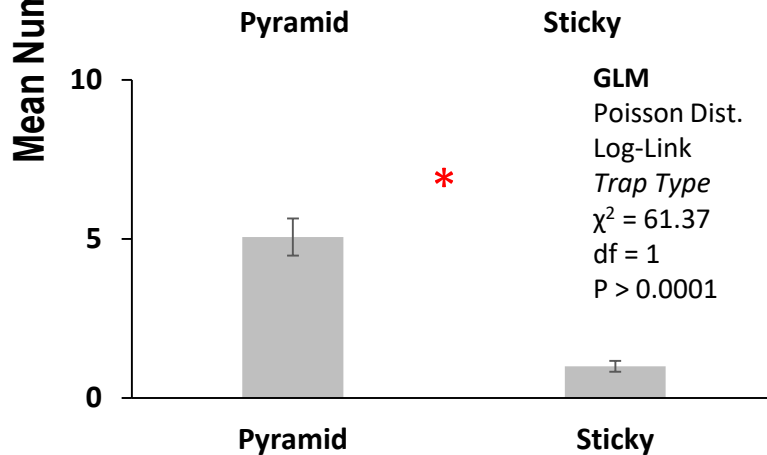
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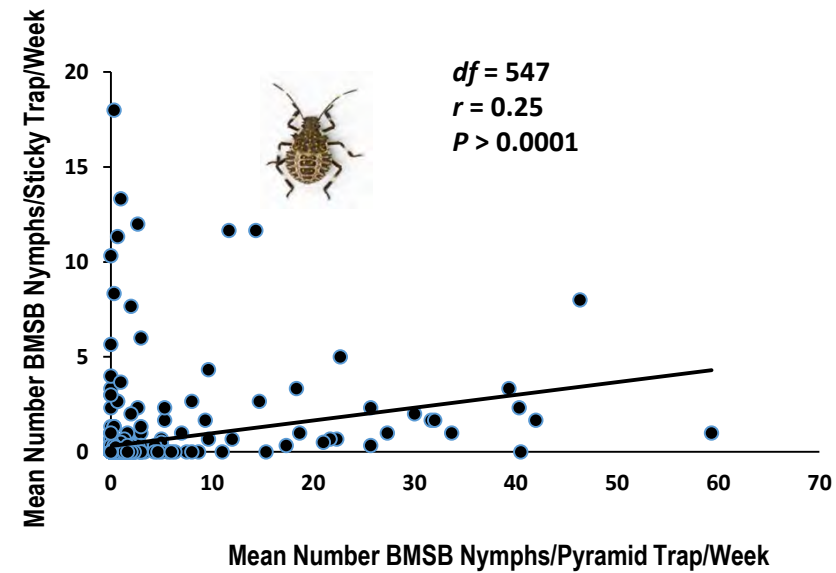
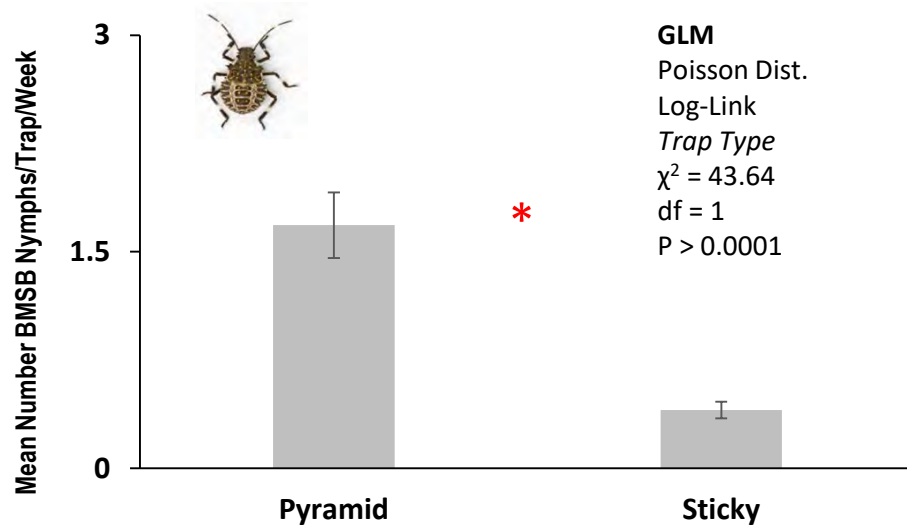
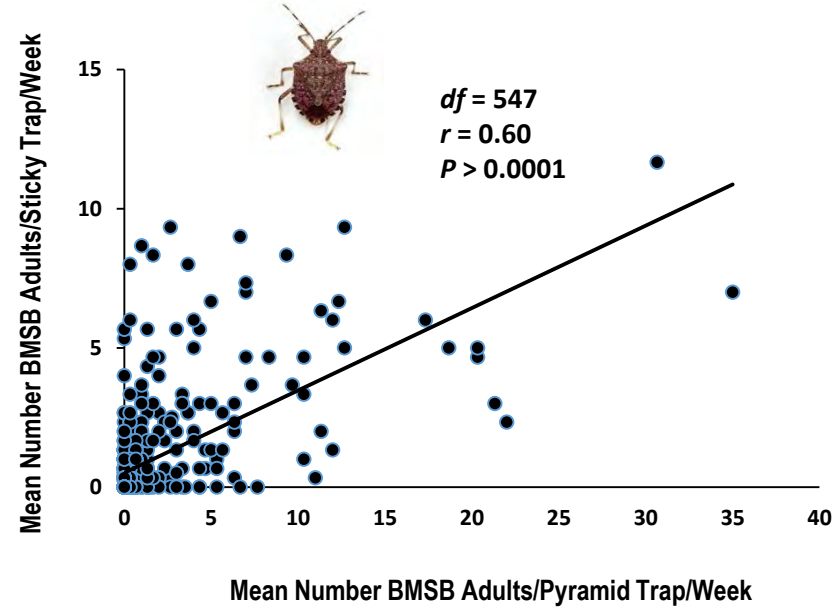
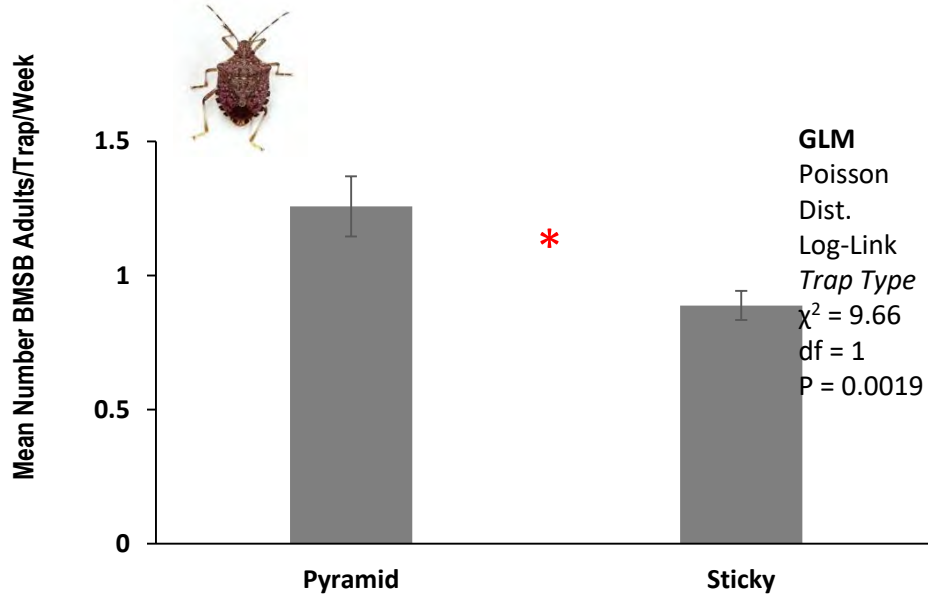
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(12 Aug to 20 Oct)



Mean Number BMSB Nymphs/Pyramid Trap/Week

# Low Population Sites

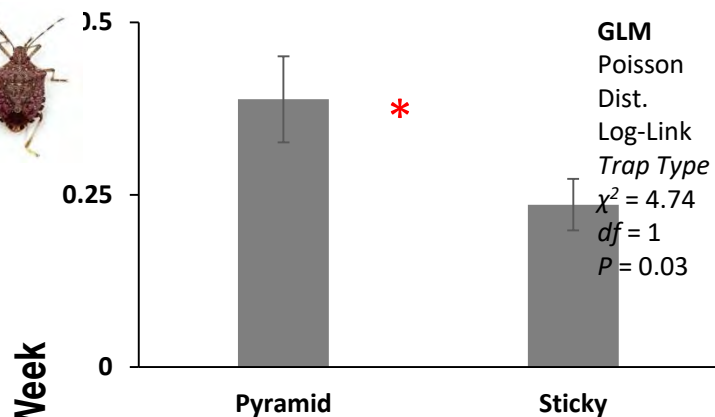


# Low Population Sites

## Early

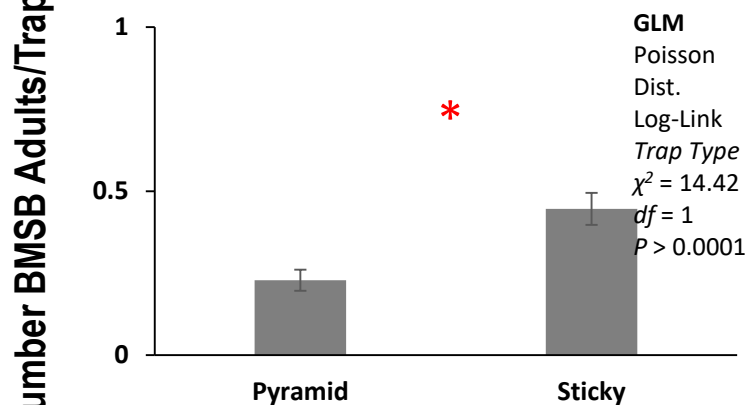


(17 Apr to 16 June)



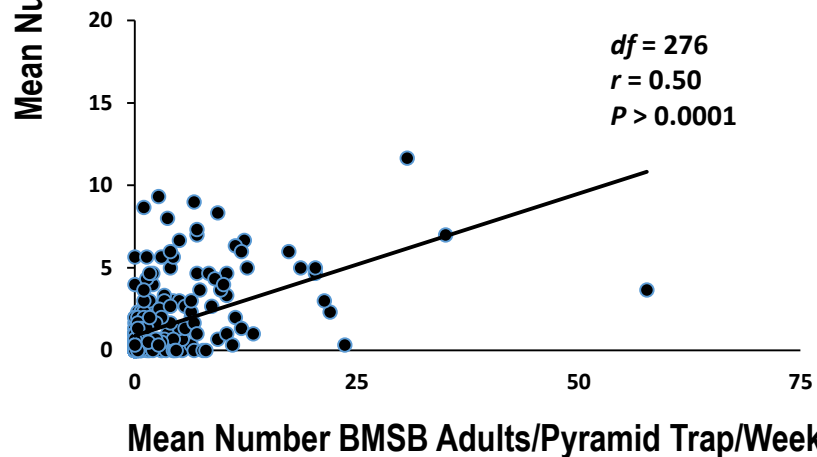
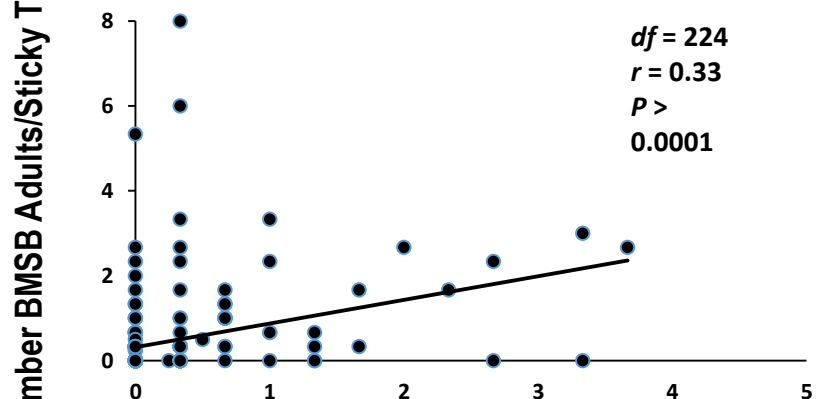
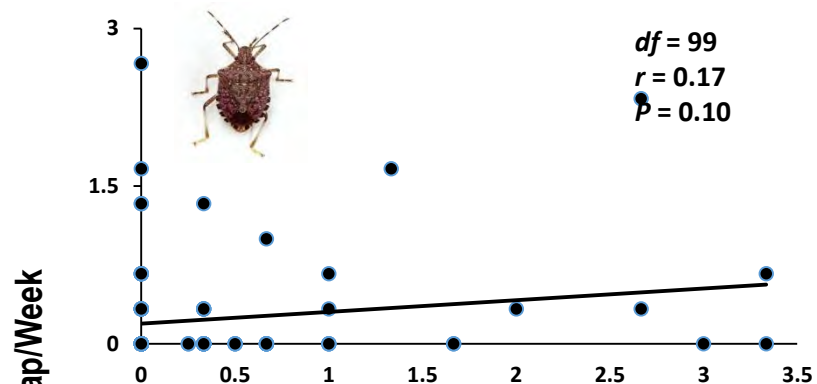
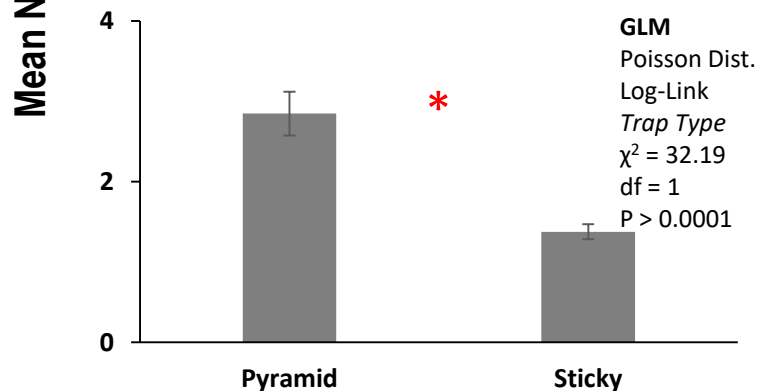
## Mid

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## Late

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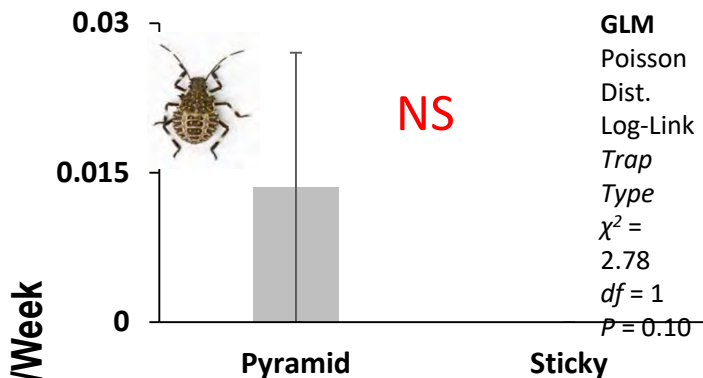




# Low Population Sites

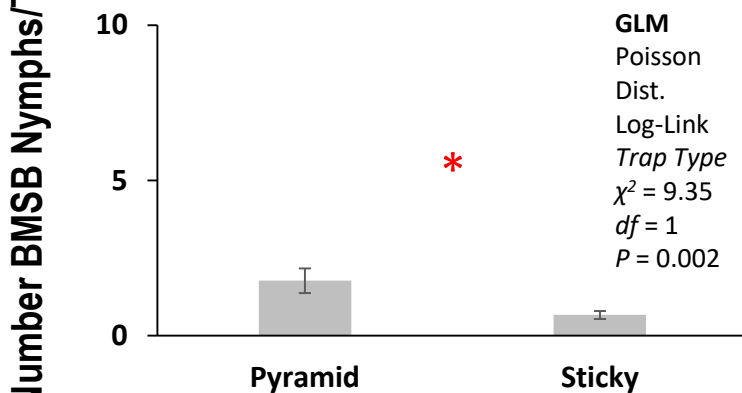
## Early

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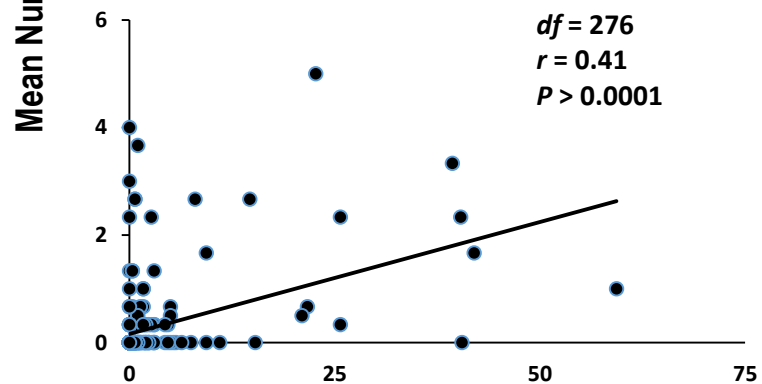
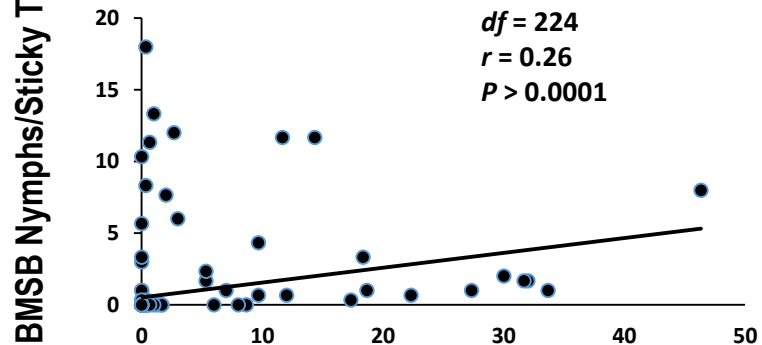
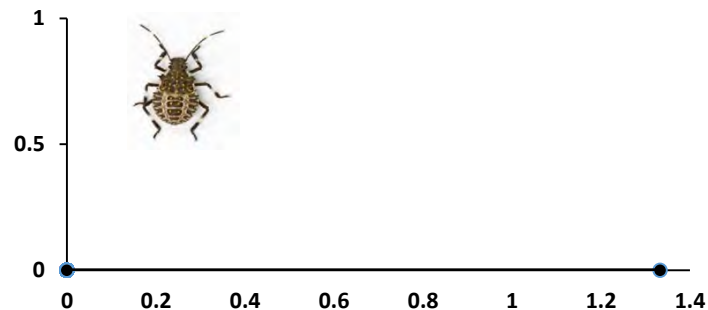
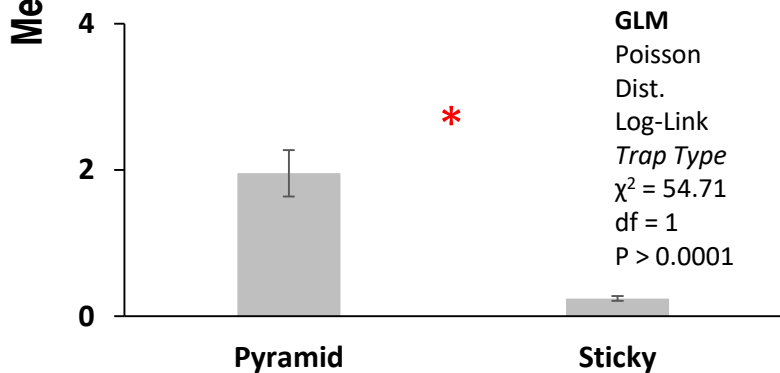
## Mid

(17 June to 11 Aug)



## Late

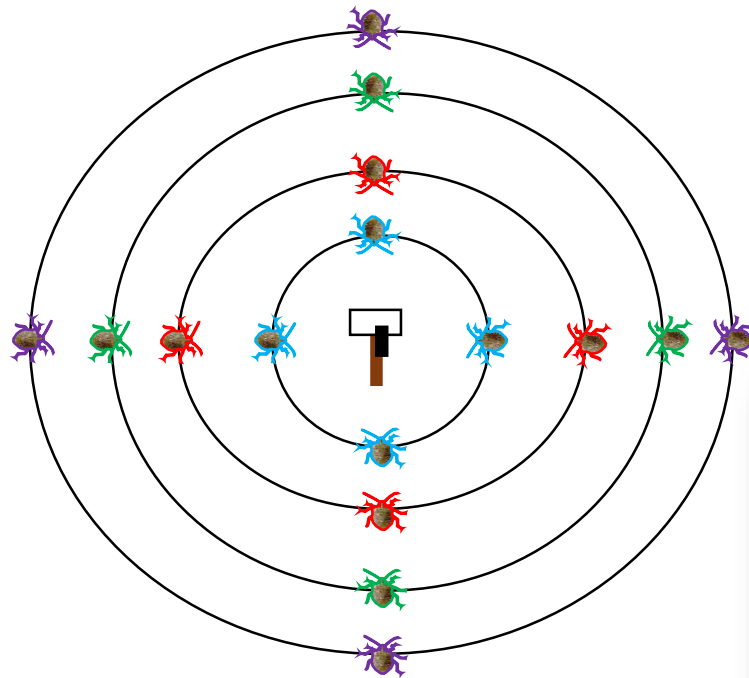
(12 Aug to 20 Oct)



Mean Number BMSB Nymphs/Pyramid Trap/Week

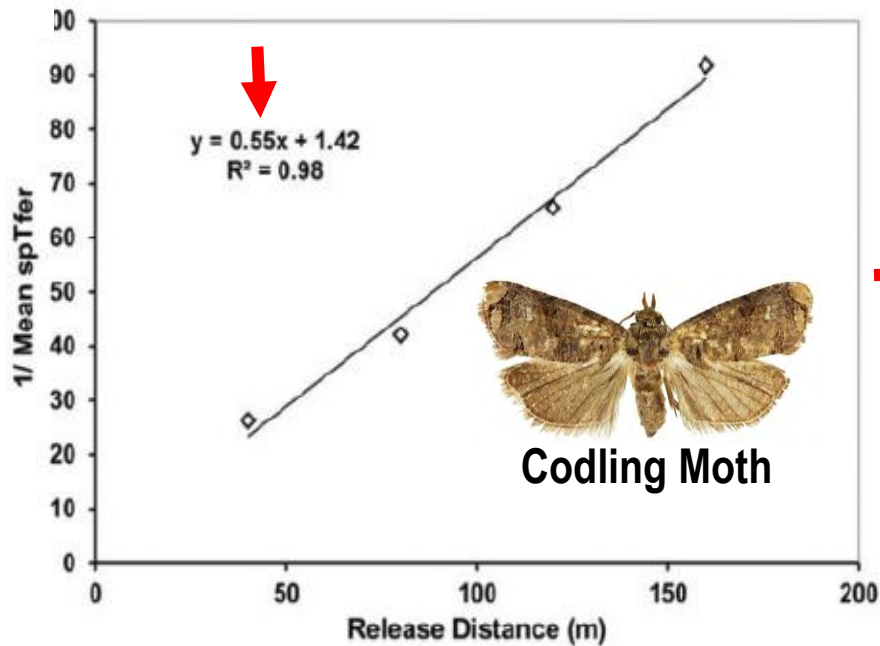
# What is the approximate trapping area of a sticky card baited with a 1x lure?

- Mark and release known numbers of BMSB adults at pre-determined distances in 4 cardinal directions from the pheromone source (open grassy field/food desert).
- Calculate the proportion of bugs caught at each distance.

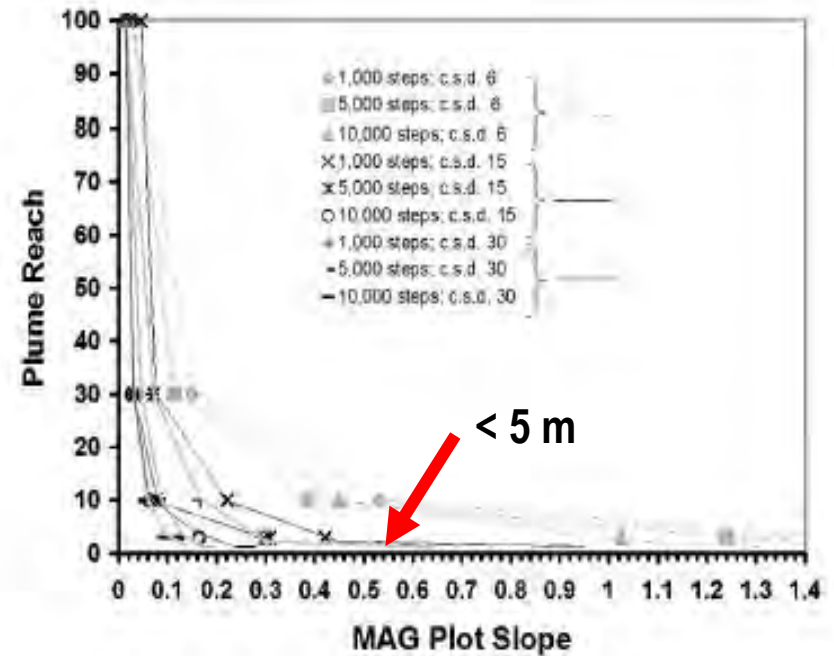


# Concept Used to Calculate Trapping Area of Codling Moth

## 1/Proportion of insects caught



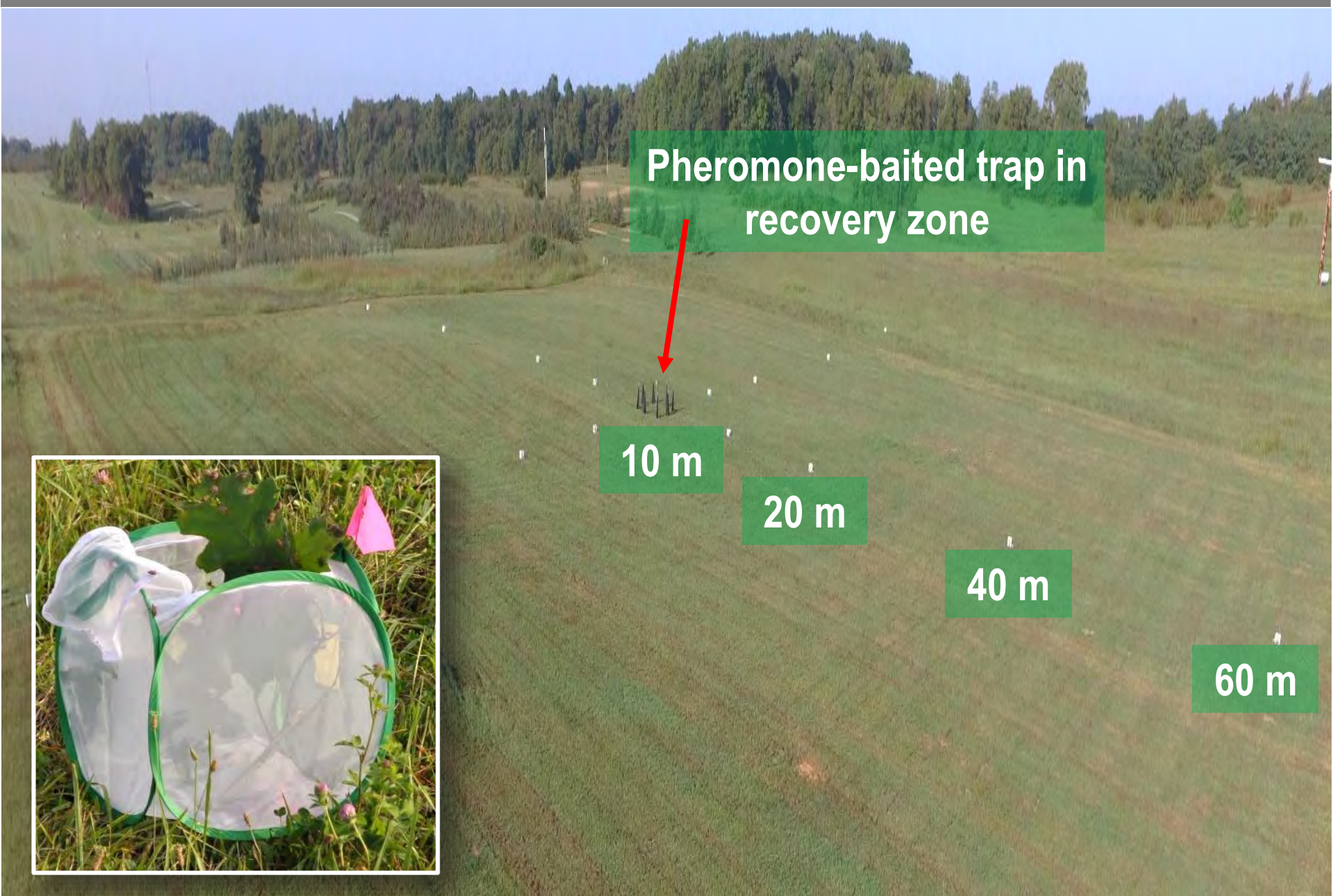
## Plume Reach



Adams, C. G., et al. (2017). "Maximizing Information Yield From Pheromone-Baited Monitoring Traps: Estimating Plume Reach, Trapping Radius, and Absolute Density of *Cydia pomonella* (Lepidoptera: Tortricidae) in Michigan Apple." *Journal of Economic Entomology* 110(2): 305-318.

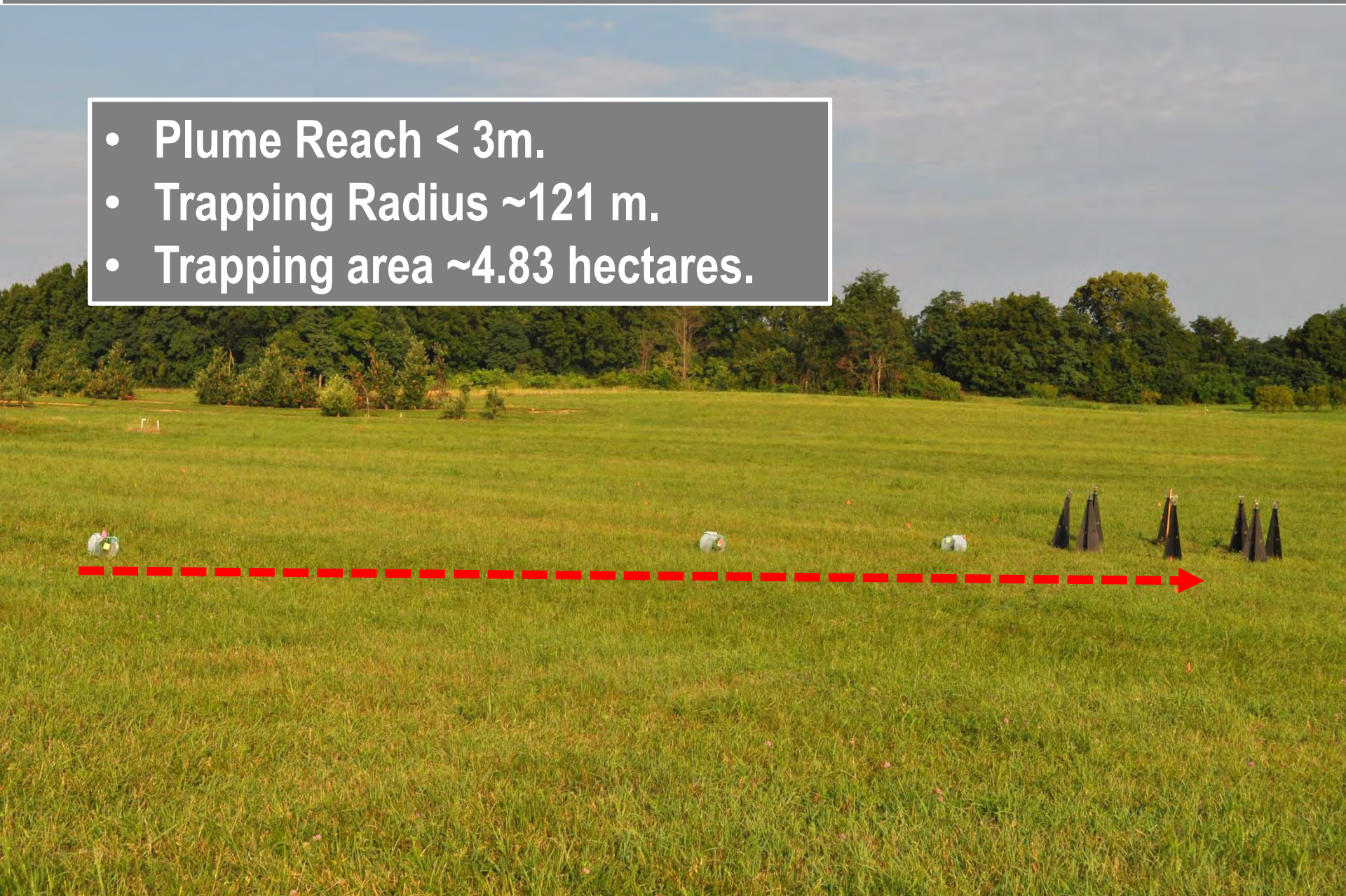
Miller, J. R., et al. (2015). *Trapping of small organisms moving randomly: principles and applications to pest monitoring and management*, Springer.

# Preliminary Mark Release Recapture Study



# Preliminary Results

- Plume Reach < 3m.
- Trapping Radius ~121 m.
- Trapping area ~4.83 hectares.



# Summary

- Adult seasonal phenology indicated that largest populations in Mid-Atlantic and Southeast, followed by PNW and Great Lakes, with lowest populations in the West.
- Reliable adult and nymphal captures with 1x Trece lures deployed in association with pyramid and sticky traps at all BMSB densities.
- Calculating trapping area for standard sticky trap unit. Based on preliminary results, we expect to capture ~4% of the population inhabiting 4.83 ha in ~12h.

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