

# Season-Long Patterns of Attraction of Brown Marmorated Stink Bug to Pheromone Lures and Light Traps in Orchard Agroecosystems



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# Development of Effective Detection and Monitoring Tools



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- Tools that provide accurate measurements of presence, abundance, and seasonal activity of BMSB.
- Growers can make informed management decisions.

# Key Components: Earlier Studies



- Visual Stimulus
  - Large black pyramid
- Olfactory Stimulus
  - methyl (2*E*,4*E*,6*Z*)-decatrienoate
- Capture Mechanism
  - Tapered pyramid to inverted funnel jar with DDVP toxicant strip
- Deployment Strategy
  - Traps placed in peripheral row of orchard

# Pheromone of *Plautia stali*

- Methyl (2*E*, 4*E*, 6*Z*)-decatrioneate.
- Cross attractive to brown marmorated stink bug and other pentatomids.
- Reports from Asia and U.S.





# Will BMSB Respond to Methyl (2E, 4E, 6Z)-Decatrienoate in the early-season?



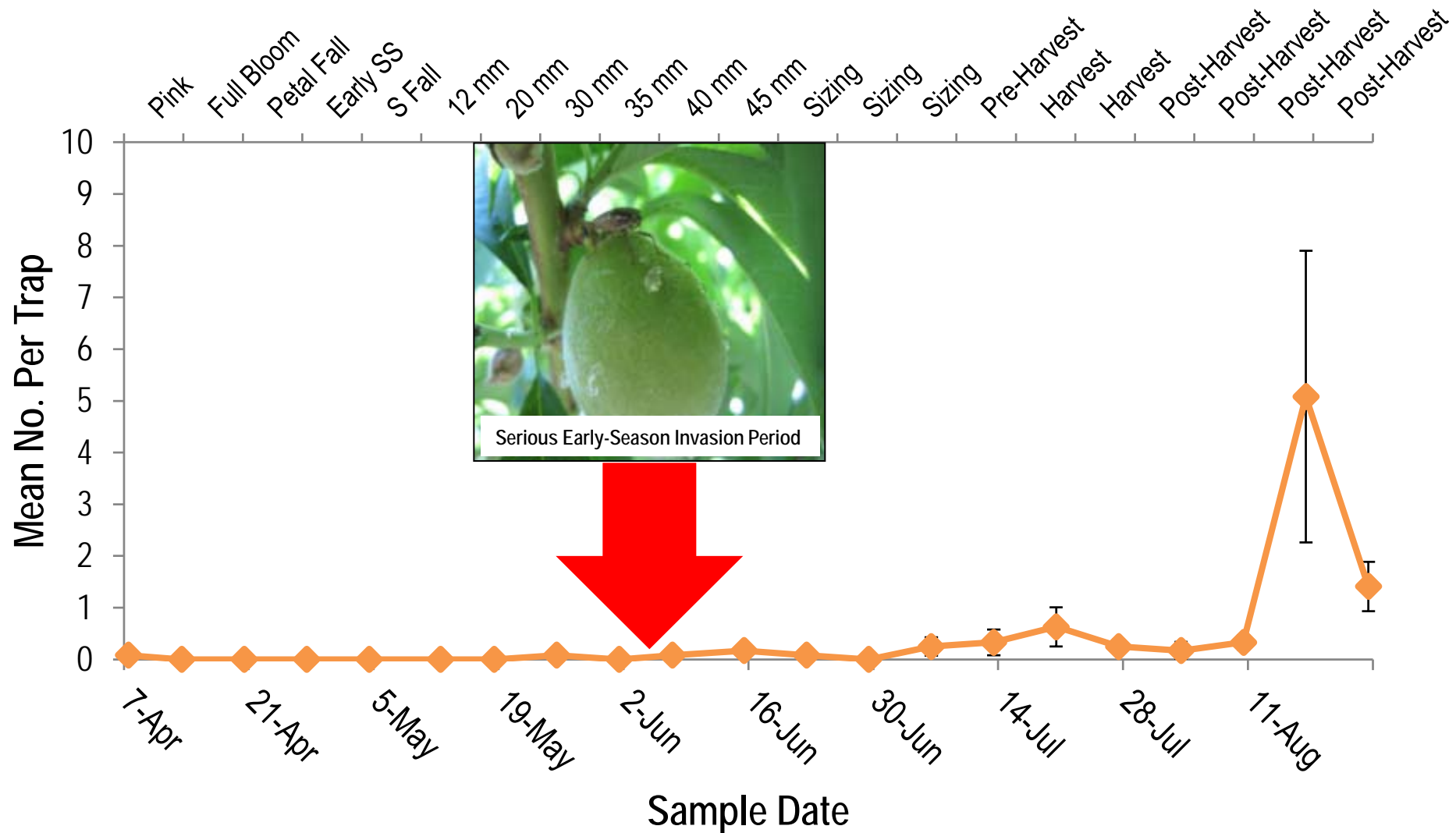
- Reports of early-season attraction in Asia.
- Previous trials had relied on low doses (<5 mg).
- Evaluated 66 mg lures.

# Despite Reports in the Asian Literature, Our Only Attractant Fails During the Early- and Mid-Season



Methyl (2*E*,4*E*,6*Z*)-decatricionate (MDT) attractive to adults only during the late-season. Confirmed in MD, WV, NJ, PA, VA and other states in 2011. Not attractive to adults in early- and mid-season.

# Almost No Captures in Traps Baited with MDT, Despite Very Large Immigrating Populations





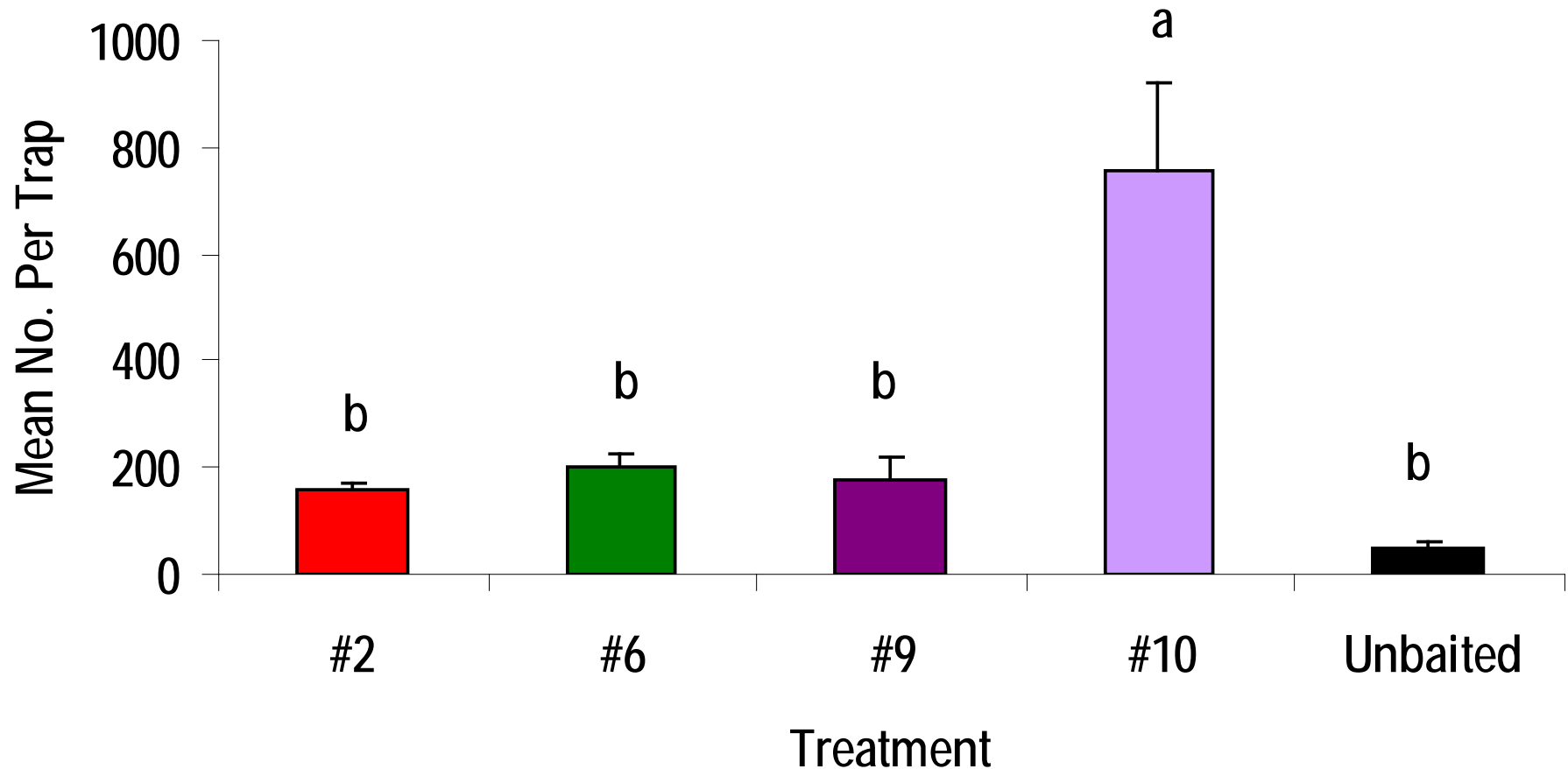
# Identification of BMSB Aggregation Pheromone





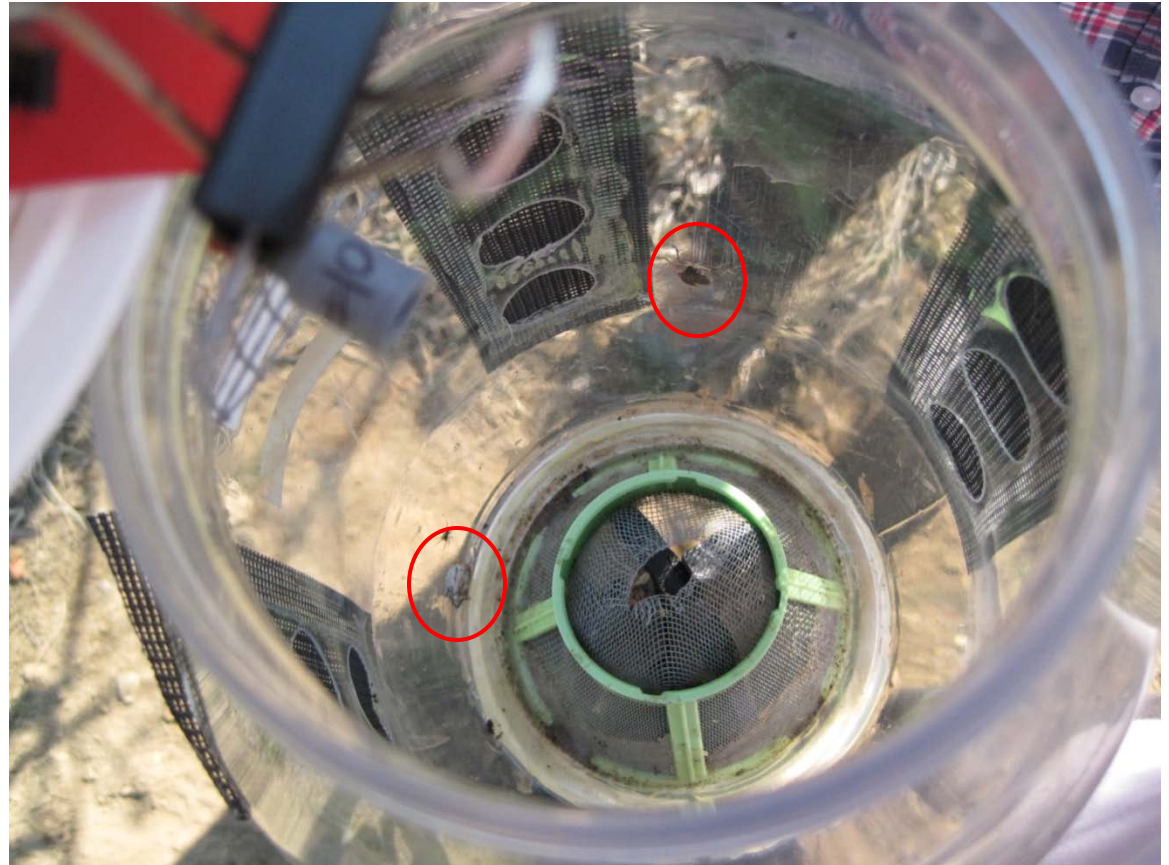
# Identification of the BMSB Aggregation Pheromone

9-30 September 2011



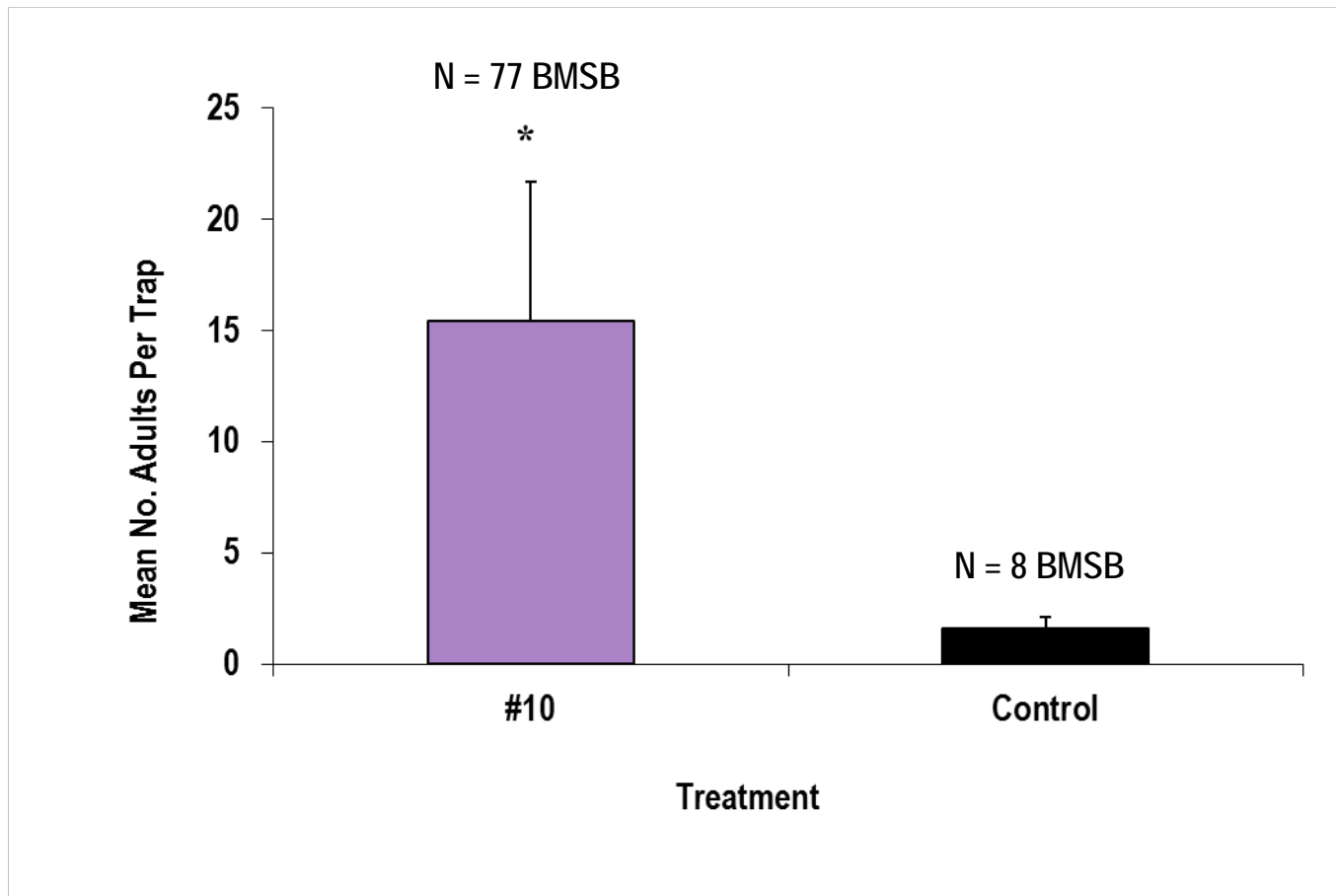
*Traps baited with #10 captured ~15x more than control and ~3-4x more than other treatments.*

# Is #10 Attractive in the Early Season? Pre-Trial (March 20-April 17, 2012)



# Early Season Attraction Documented for BMSB

## March 20-April 17, 2012





# *Biology, Ecology, and Management of Brown Marmorated Stink Bug in Orchard Crops, Small Fruit, Grapes, Vegetables, and Ornamentals*

## USDA-NIFA SCRI Project

- USDA-ARS
  - Appalachian Fruit Research Station, Kearneysville, WV
  - Beneficial Insects Introduction Research Unit, Newark, DE
  - Invasive Insect Biocontrol and Behavior Laboratory, Beltsville, MD
  - Horticultural Crops Research Unit, Corvallis, OR
- The Pennsylvania State University
- Washington State University
- North Carolina State University
- Virginia Polytechnic Institute and State University
- Rutgers University
- Northeastern IPM Center
- Oregon State University
- University of Maryland
- University of Delaware
- Cornell University



# Broad Validation in Multi-State Trial

- Is BMSB attracted to #10 in the early season?
- Is BMSB attracted to #10 season-long?
- How attractive is this stimulus relative to MDT and unbaited traps?
- WV, MD, VA, PA, NJ, NY, DE, NC, OR, WA, and OH





Total of 350 Traps  
Deployed Across  
12 States

Leveraged and In-Kind Support

USDA-ARS

USDA-APHIS

AgBio

Sterling/Rescue



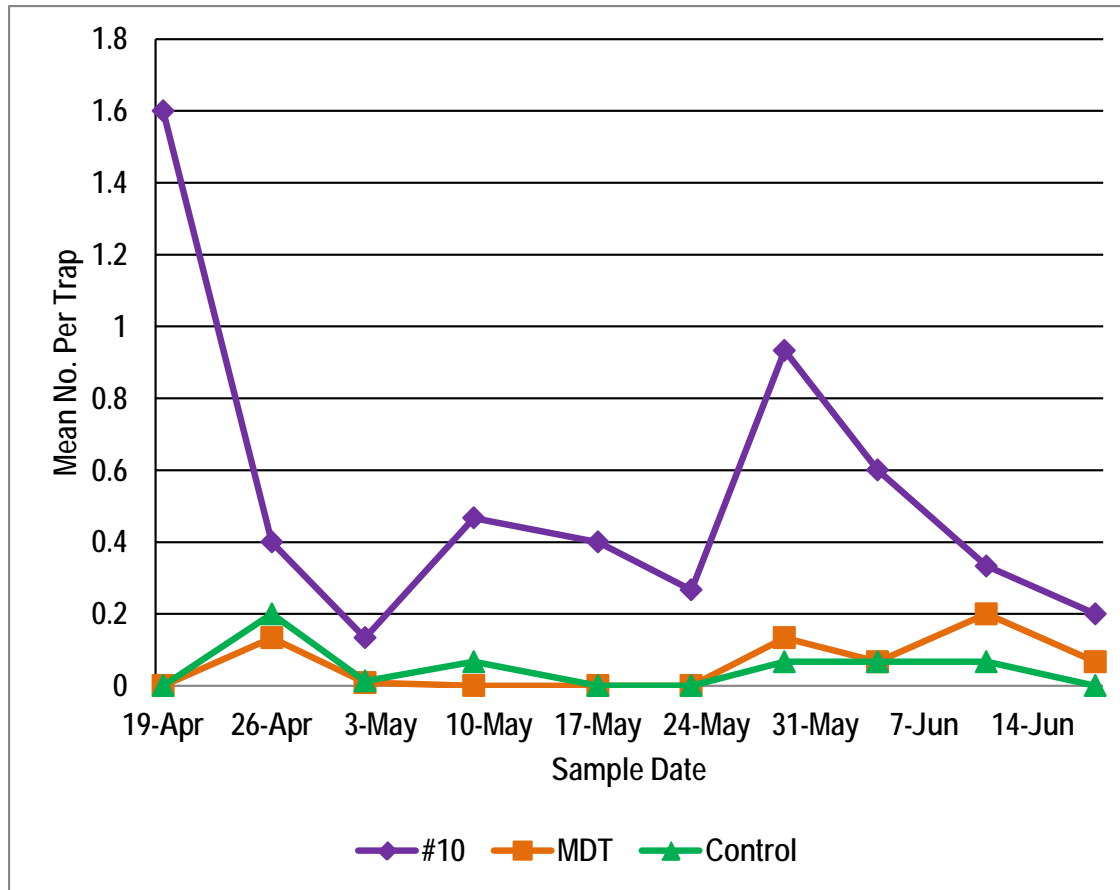
# General Protocol

- Black pyramid traps
- Three odor treatments
  - 1) #10 (10 mg)
  - 2) MDT (> 100 mg)
  - 3) unbaited control
- Traps are deployed between wild host habitat and agricultural production area.
- Traps were deployed in mid-April and left in place season-long.



# Early Season Summary

## Mid-April to Mid-June 2012



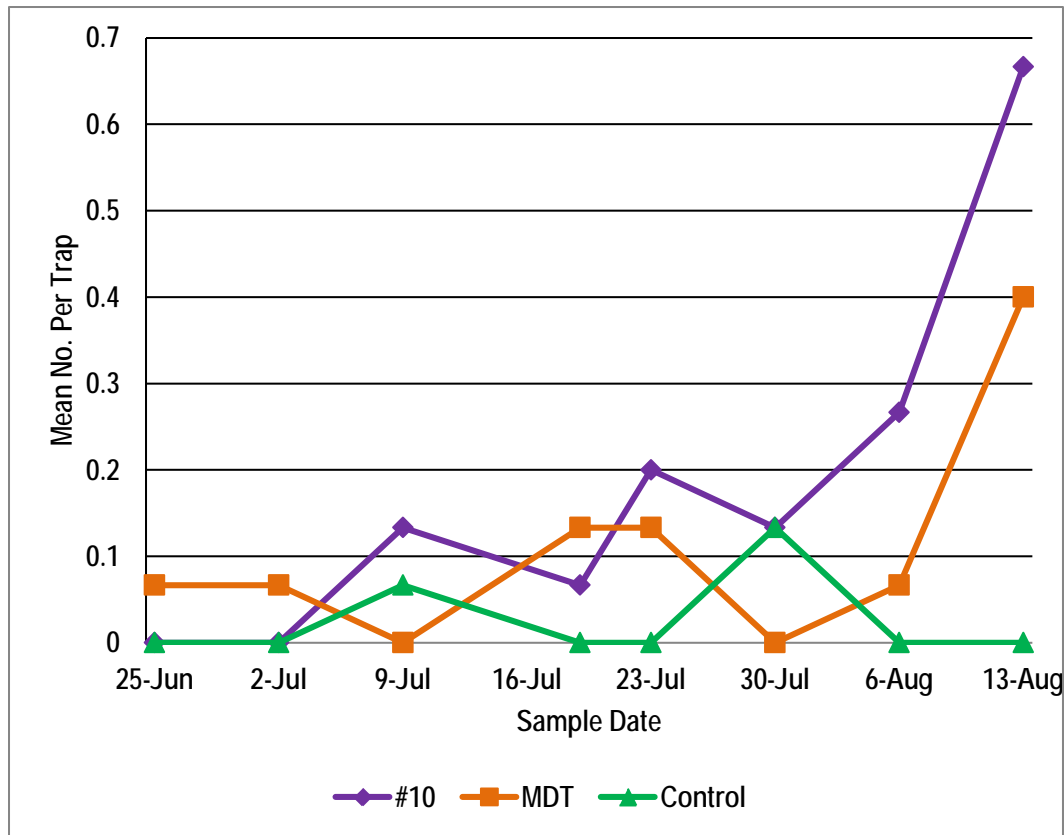
### Trap Capture Ratios

#10:Unbaited	11 : 1
MDT:Unbaited	1 : 1
#10:MDT	9 : 1

- BMSB reliably captured by traps baited with #10.
- These captures represents invading overwintering adults during early season.

# Mid-Season Summary

## Mid-June to Mid-August



### Trap Capture Ratios

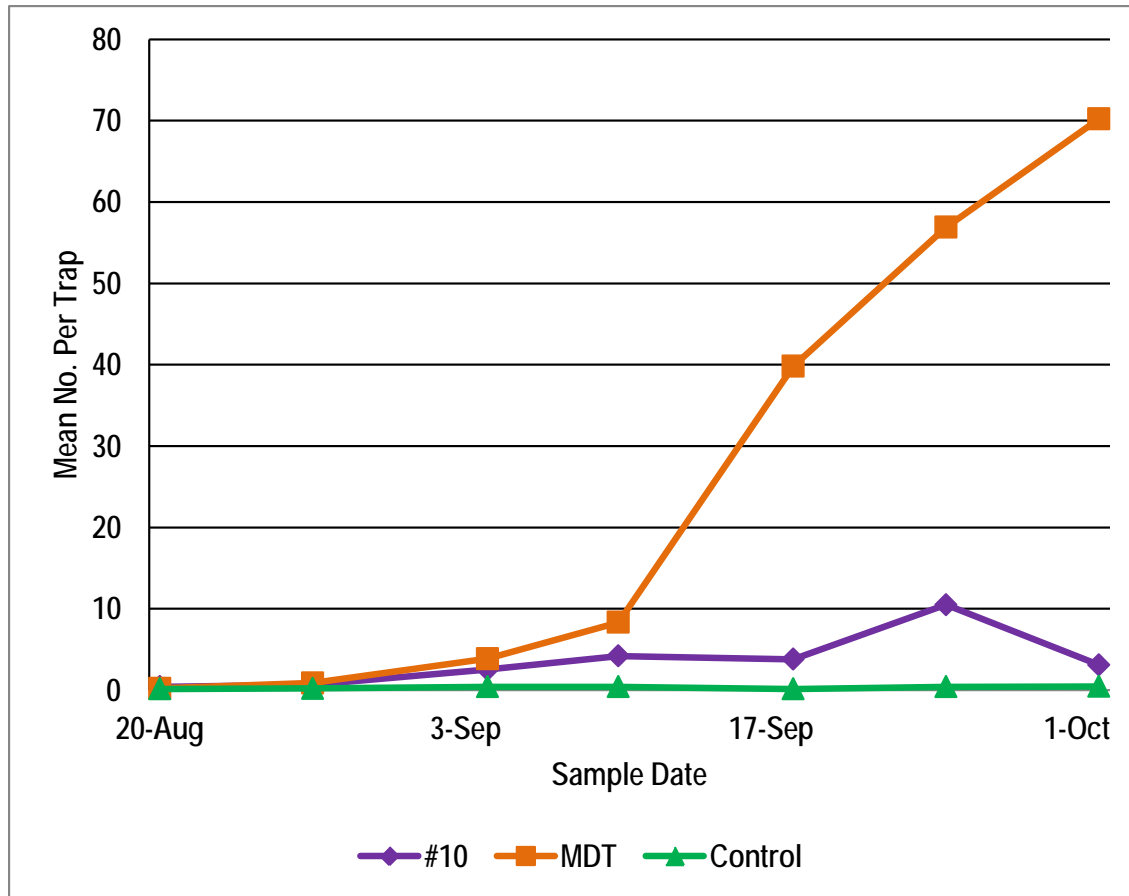
#10:Unbaited	7 : 1
MDT:Unbaited	4 : 1
#10:MDT	2 : 1

- Low numbers during much of mid-season.
- Increasing populations beginning in mid-July.



# Late-Season Summary

## Mid-August to Mid-October

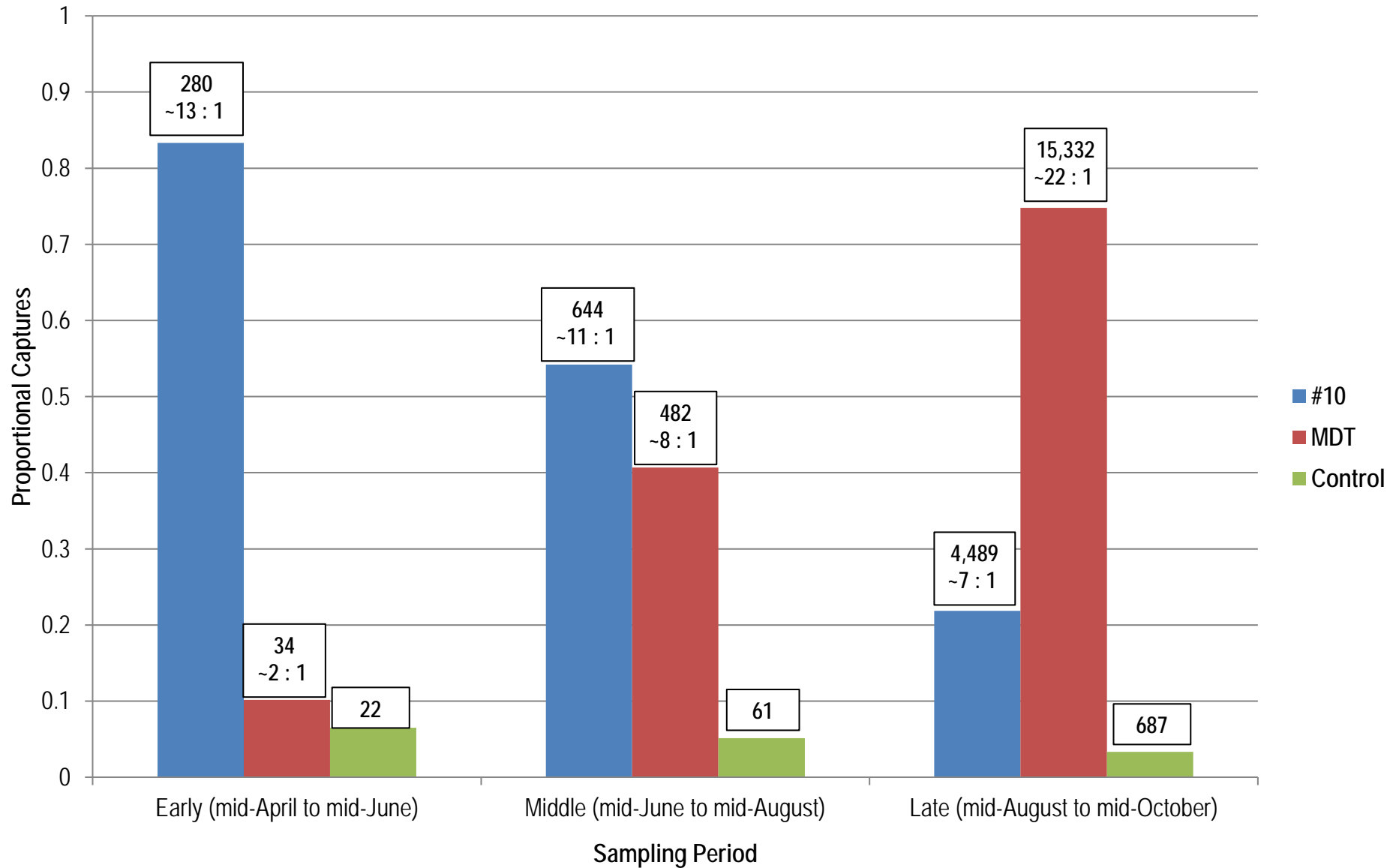


### Trap Capture Ratios

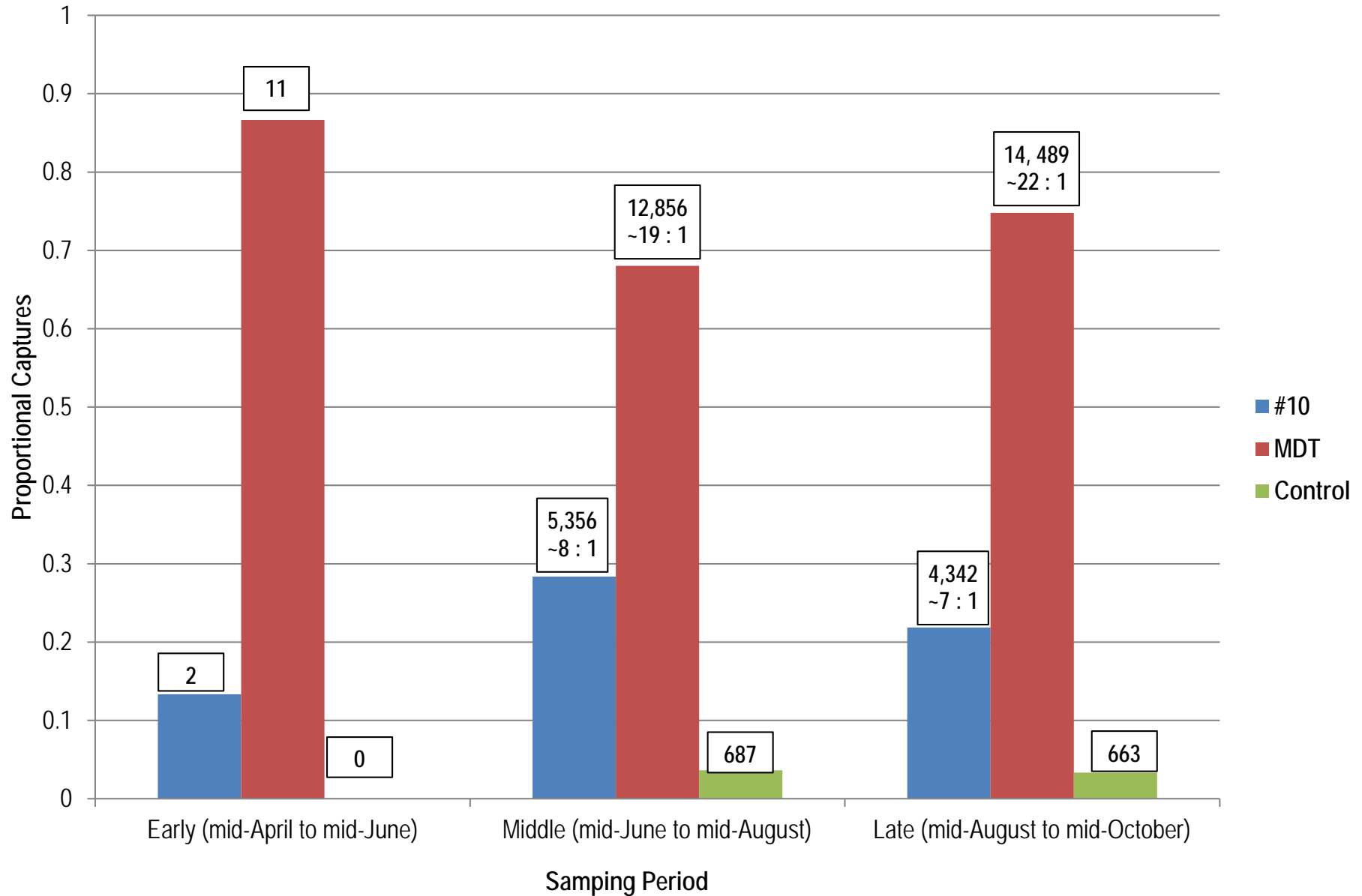
#10:Unbaited	12 : 1
MDT:Unbaited	90 : 1
MDT:#10	7 : 1

- MDT very attractive and #10 attractive in late season.
- MDT outcompetes #10 in late season at tested release rates.
- Large numbers in the field.

# Seasonal Adult Captures



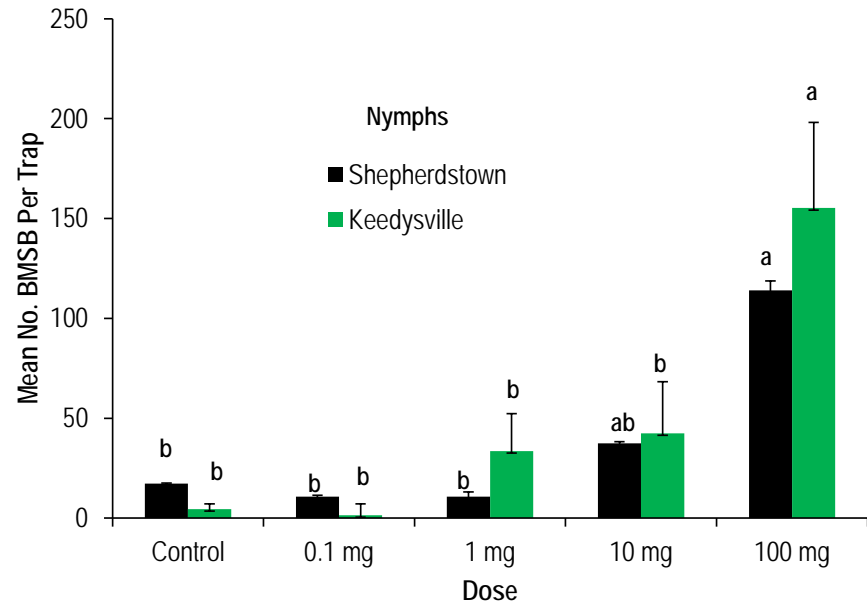
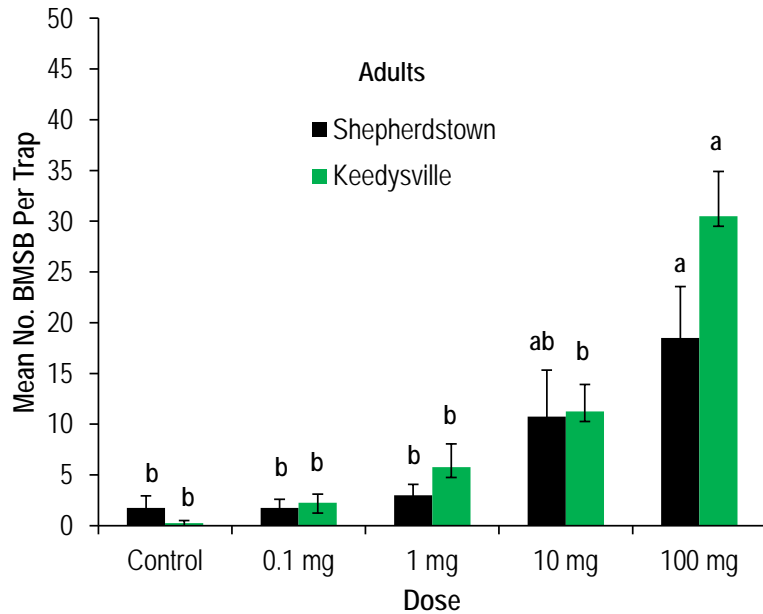
# Seasonal Nymphal Captures



# Dose Response Trial

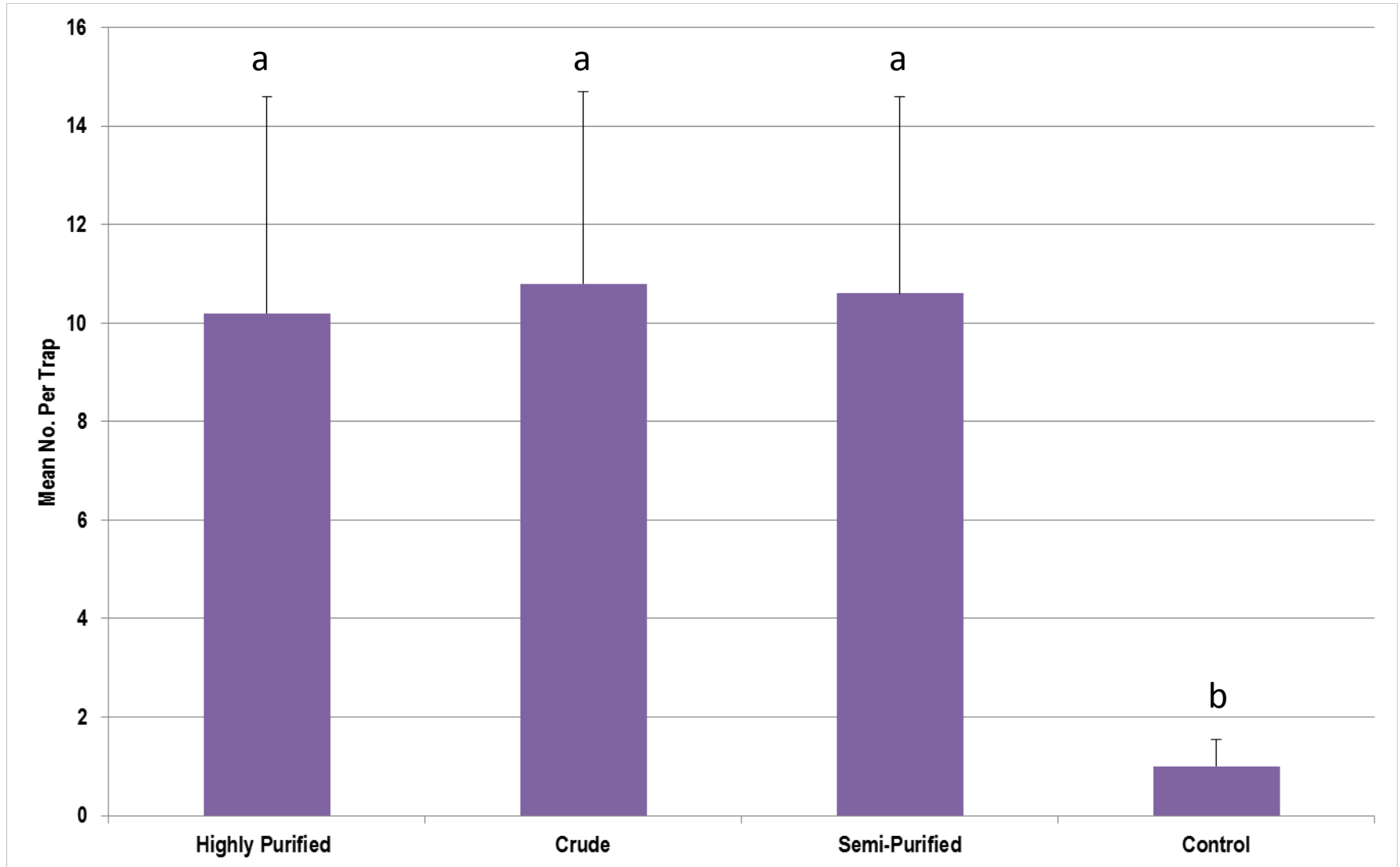
June 14-July 19, 2012

11:1 Ratio (Baited: Unbaited) for 10 mg lure  
~25:1 Ratio (Baited: Unbaited) for 100 mg lure





# Lure Affordability: Encouraging Results from Purity Trial

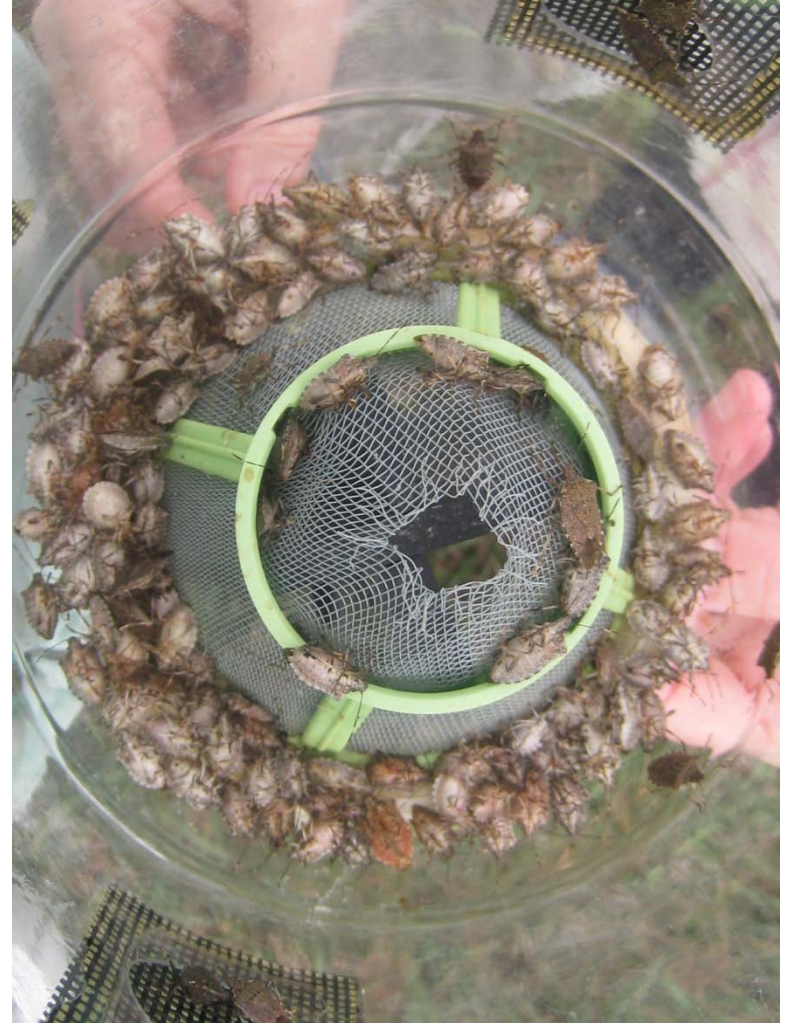


# Commercial Lure Trials

Company	Participants	Formulation #1	Formulation #2	#10	Control
ISCA	USDA, WVU, OSU, Cornell, UMD, Rutgers	15 (splat)	53 (septa)	105	26
Scentry	USDA, Rutgers	5	N/A	23	3
Alpha Scents	USDA, PSU	111 (membrane)	83 (septa)	256	33
Hercon	USDA, WVU, OSU	23	N/A	76	13
Sterling	USDA, PSU, Rutgers	76	N/A	121	43
Trece	USDA, OSU, Cornell	68	N/A	93	43

# Conclusions

- Aggregation pheromone of BMSB has been identified.
- This stimulus provides reliable, season-long detection of BMSB.
- Likely will need a higher loading of material.
- Crude material can be used to formulate lures, reducing overall costs.
- MDT is very sensitive stimulus in the late-season.





# Visual Cues

*Identifying Optimal Wavelengths and Intensities of Light*





# Experimental Light Traps

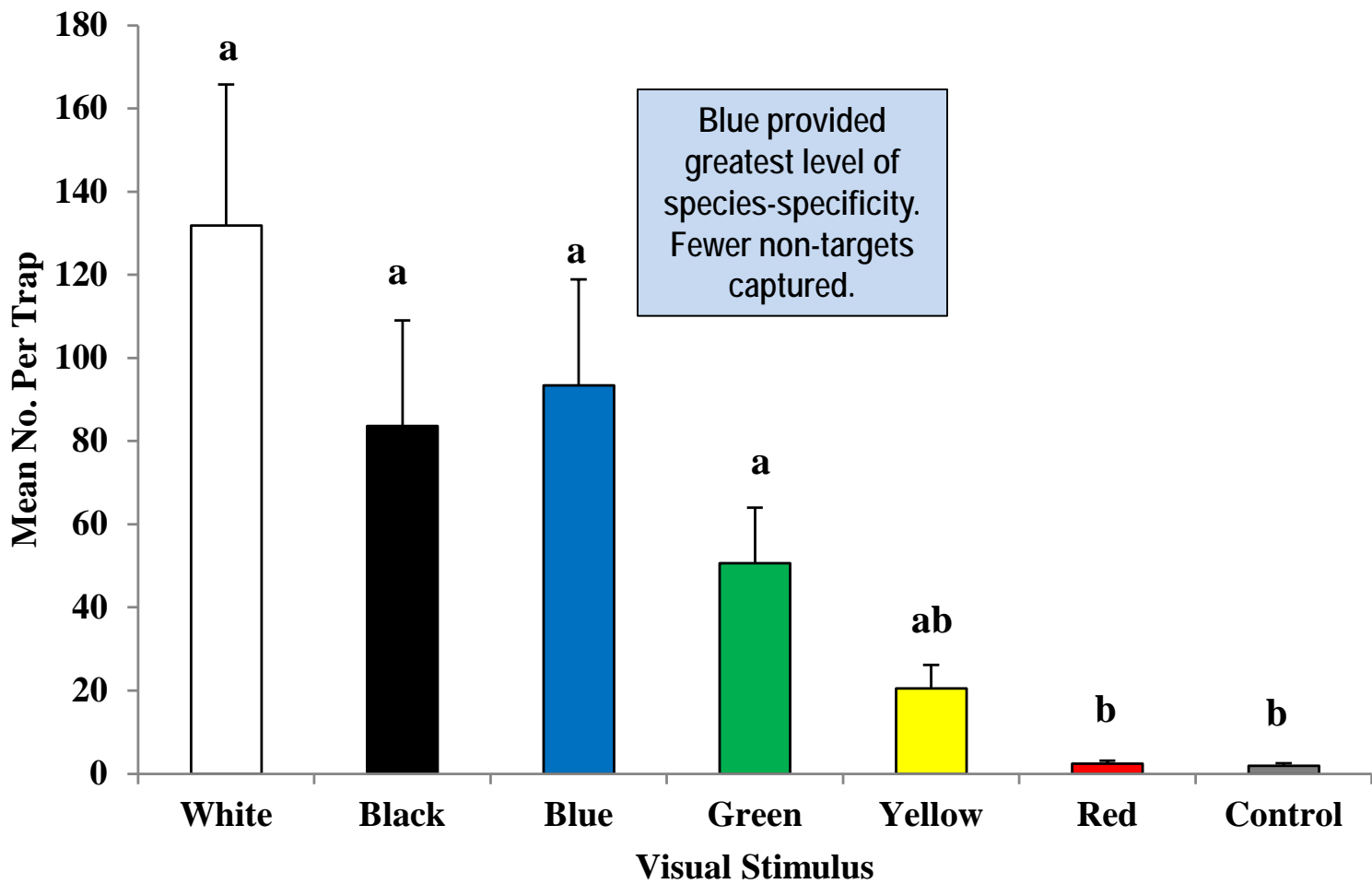




# Night View



# A Total of 21 Traps Baited With Light-Based Stimuli Captured 13,457 Adult BMSB in ~6 Weeks During Late Summer





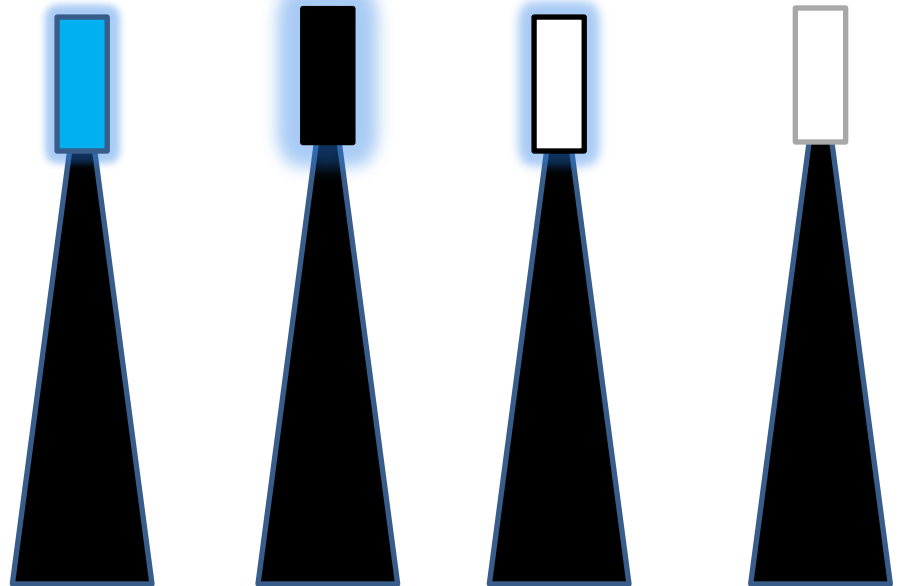
# Traps Provisioned With Blue 25W Compact Fluorescent Bulbs Attractive and Species-Specific





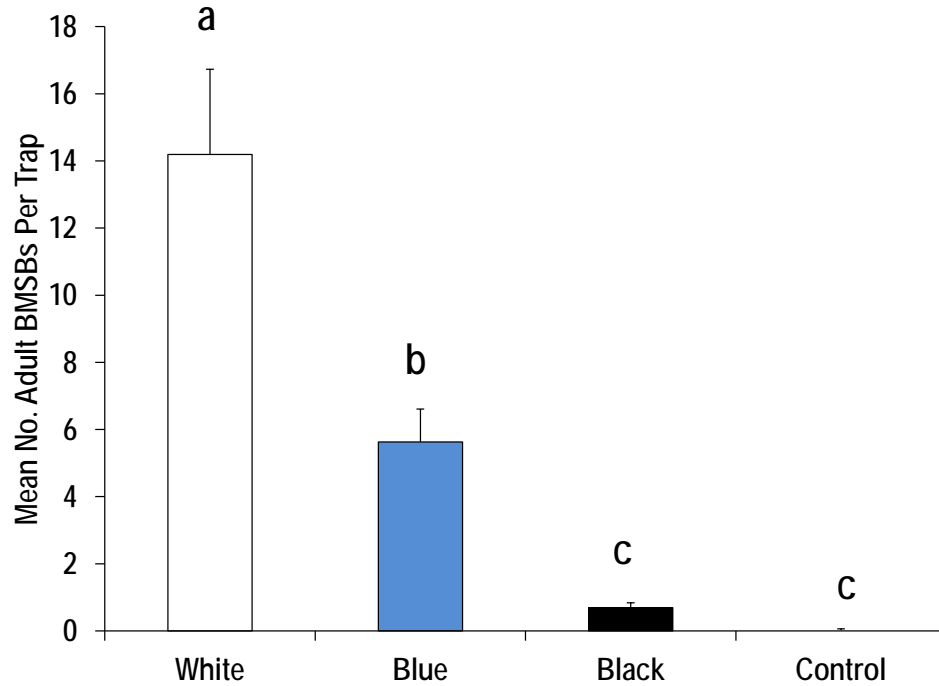
# Season-Long Trial 2012

- Do we capture BMSB reliably with the most attractive stimuli?
- Species-specificity of most attractive visual stimuli?

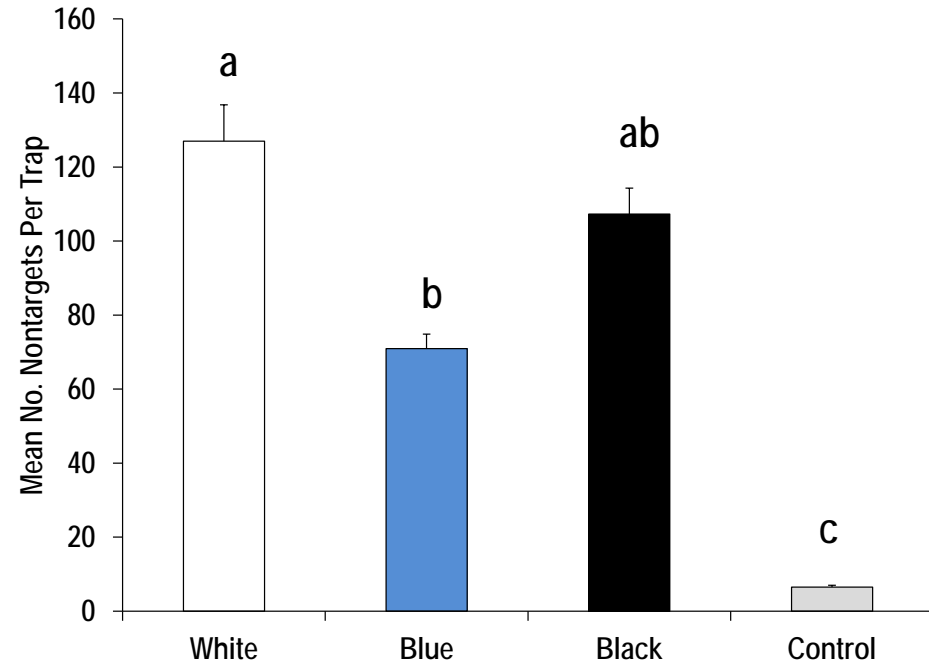


# Mean Weekly Captures

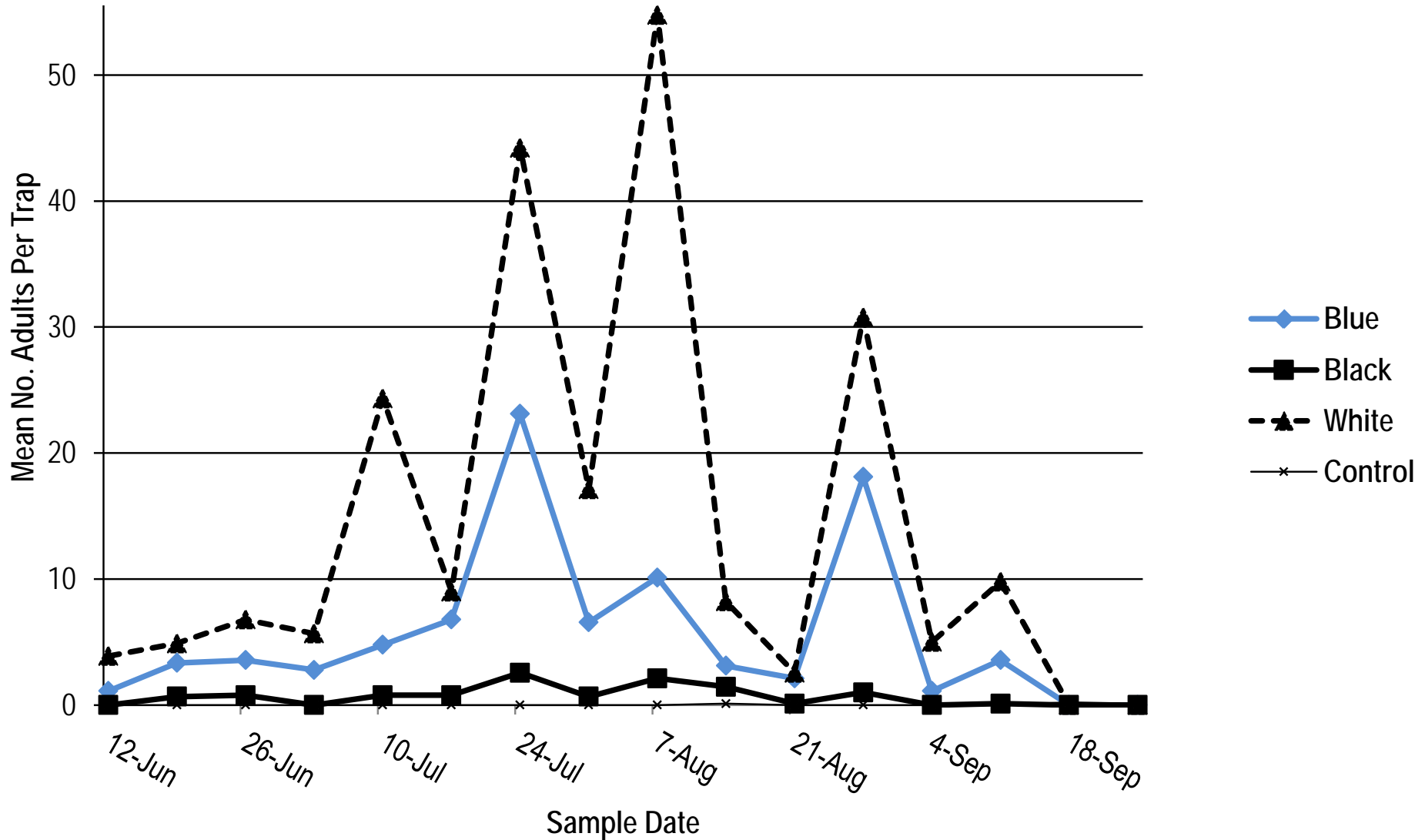
## BMSB Captures



## Nontarget Captures



# Season-Long Captures of BMSB



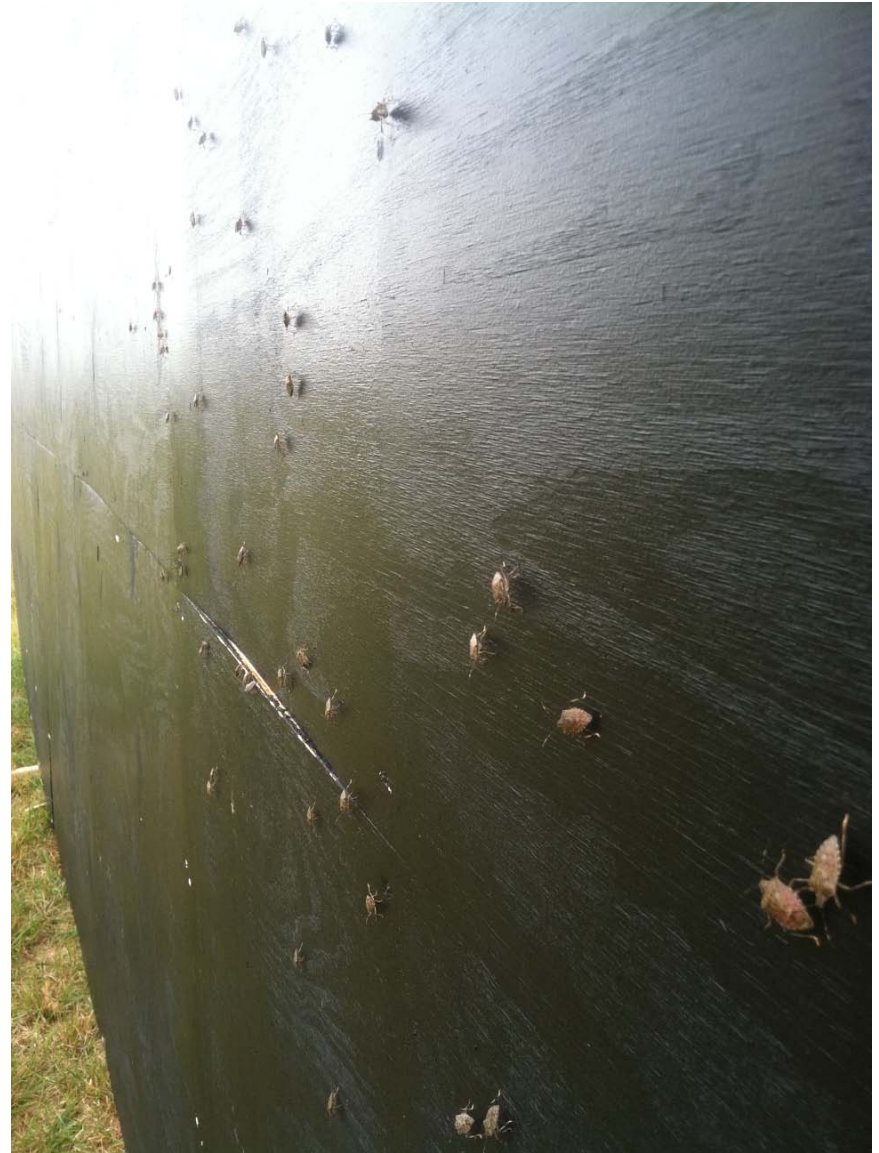
# Conclusions

- Traps provisioned with a white light source captured significantly more BMSBs and significantly more non-targets.
- Traps provisioned with blue light sources captured fewer BMSBs, but also fewer nontargets.
- Although captures of BMSB were lower in traps provisioned with black light sources, patterns of capture are significantly correlated among all light-based stimuli.
- Capture patterns essentially identical among white, blue and black light sources.



# Next Steps

- Establish physiological and behavioral state of responders to different stimuli.
- Combining attractive visual and olfactory stimuli.
  - Improve monitoring tools.
  - Develop attract and kill strategies.





# Acknowledgements

To learn more about this project and find links to BMSB information, visit



- USDA-ARS, USDA NIFA SCRI # 2011-51181-30937, and USDA-APHIS
- BMSB SCRI Team and Working Group



Doo-Hyung Lee

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