Season-Long Patterns of Attraction of Brown Marmorated Stink Bug to Pheromone Lure in Orchard Agroecosystems

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USDA ARS

Brown Marmorated Stink Bug is a Devastating Pest of Tree Fruit

Feeding and Reproduction Throughout The Season

Lack of Monitoring Tools and Knowledge

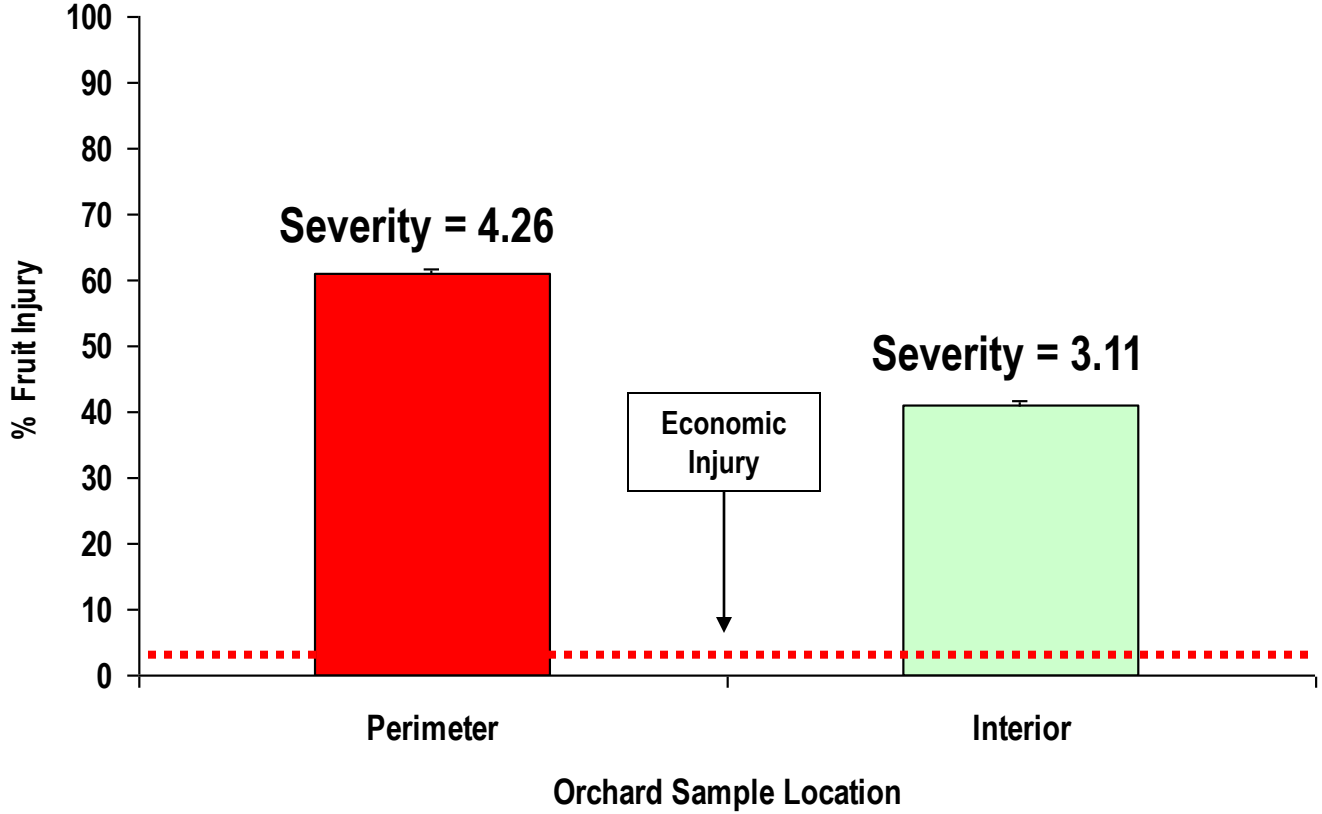
July 29, 2010

Many mid-Atlantic growers in WV, MD, PA, NJ and VA had significant losses.

Numerous growers lost over 50% of their peach crop in 2010.

Some lost their entire crop.

BMSB Feeding Injury—Rate and Severity
Regional Commercial Apple Orchards
2010 Growing Season



2010 economic loss in mid-Atlantic apples due to BMSB feeding estimated at 37 million dollars (US Apple Association)

Development of Effective Detection and Monitoring Tools

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

Key Components: 2009-2010 Studies

- Visual Stimulus
  - Large black pyramid
- Olfactory Stimulus
  - methyl (*2E,4E,6Z*)-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 (*2E, 4E, 6Z*)-decatrieonate.
- Cross attractive to brown marmorated stink bug and other pentatomids.
- Reports from Asia and U.S.

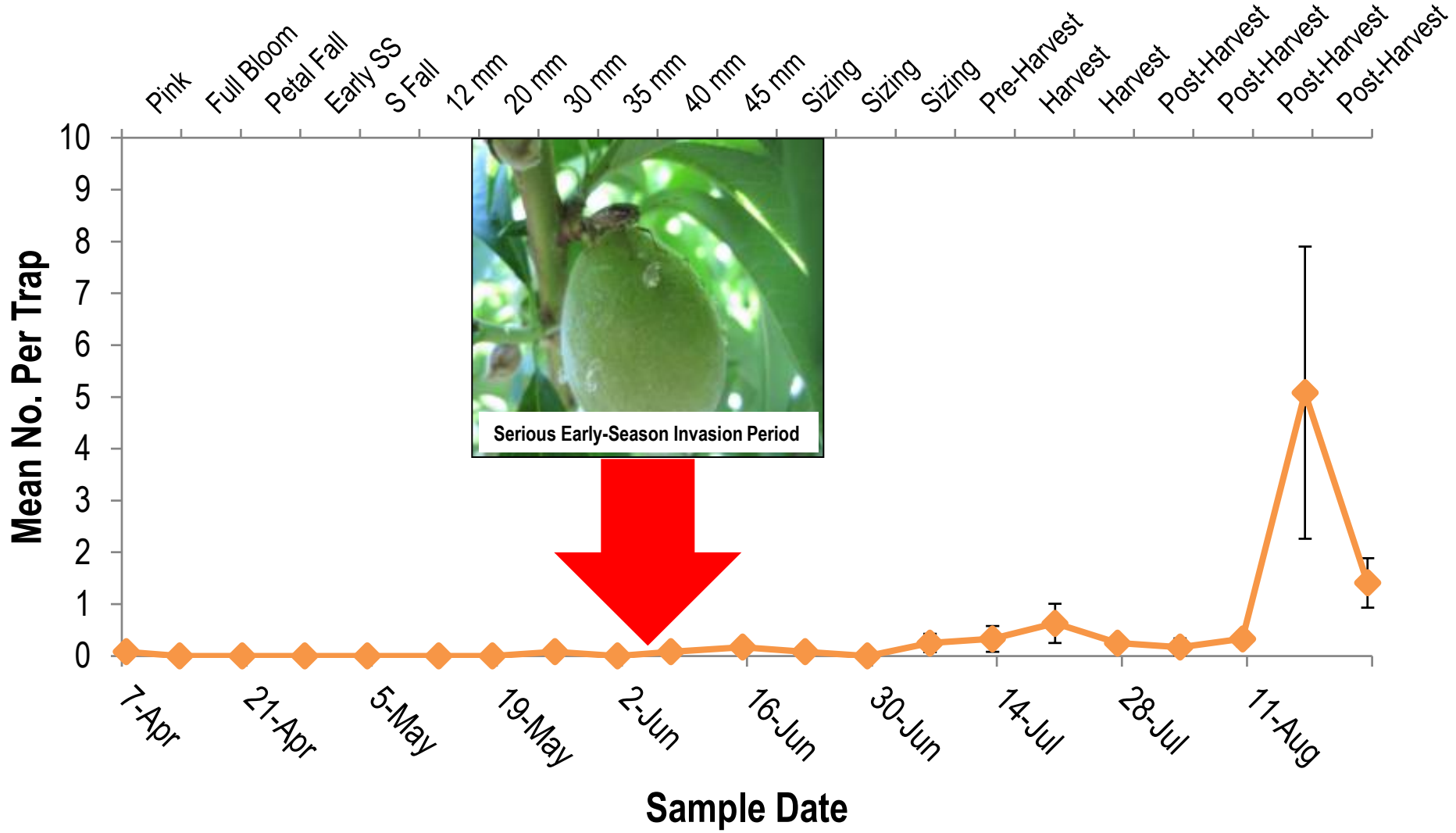
Will BMSB Respond to Methyl *(2E, 4E, 6Z)*-Decatrienoate in the early-season?

- 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 (*2E,4E,6Z*)-decatrieonate (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

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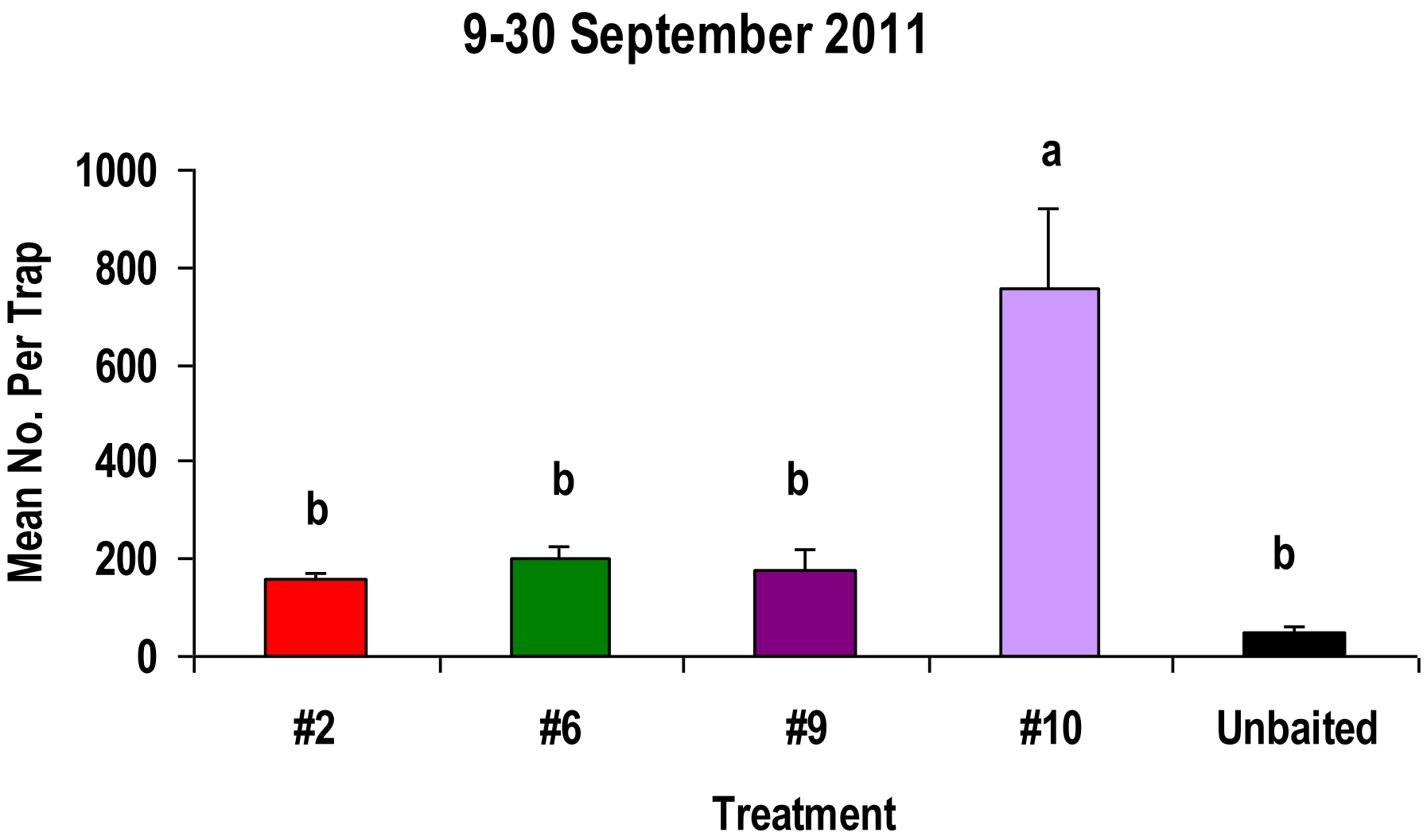
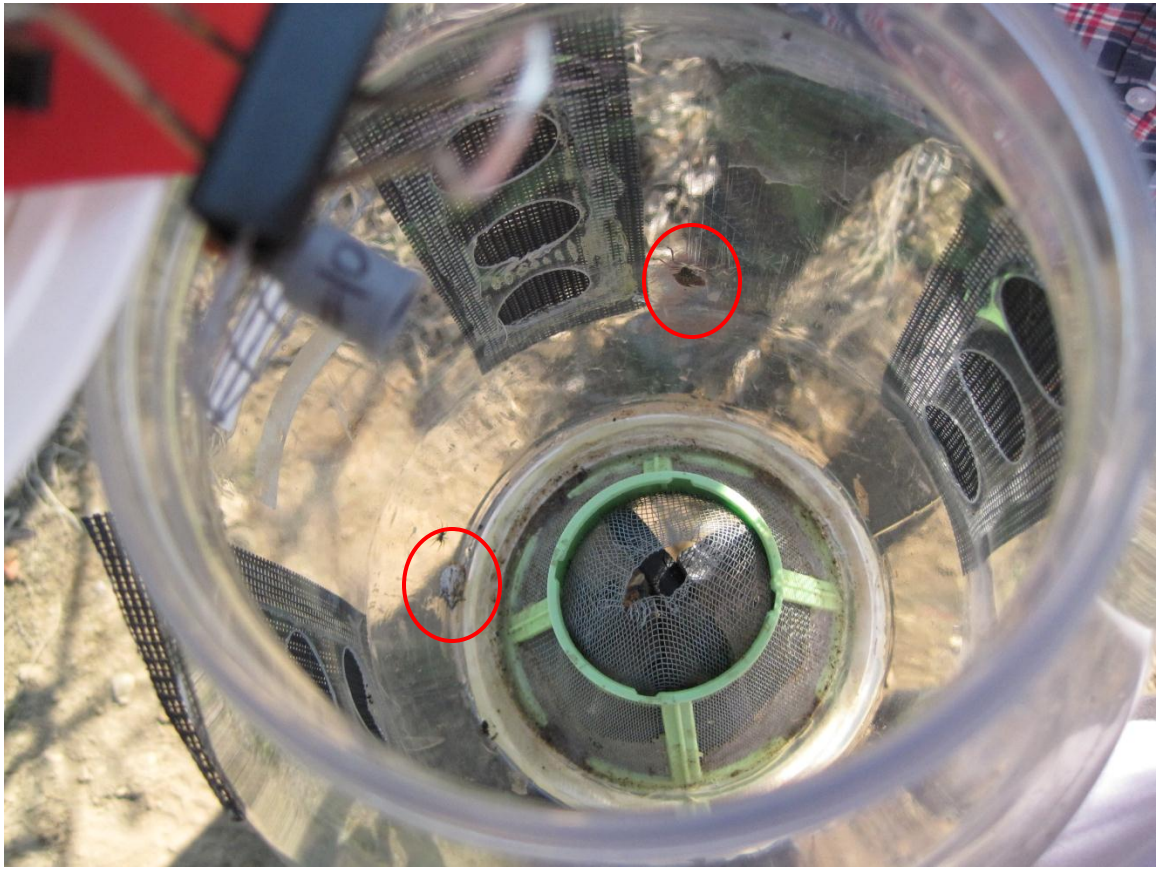


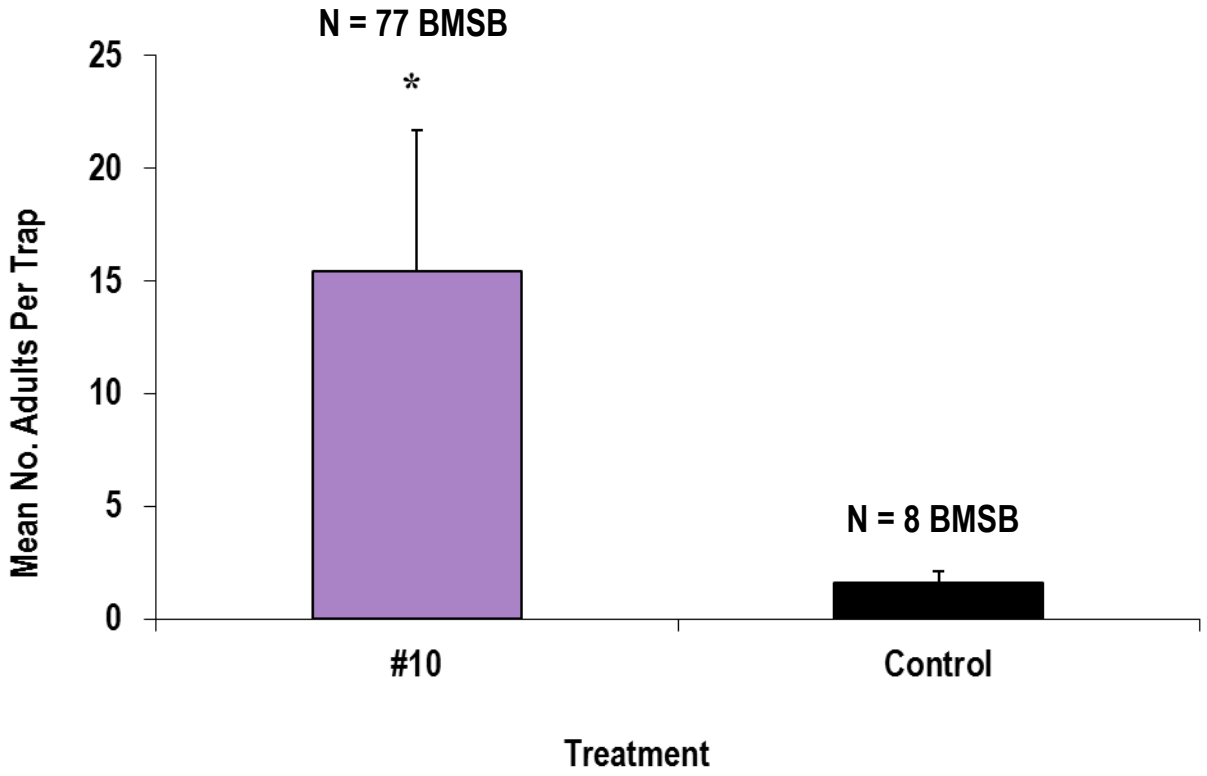
Traps baited with #10 captured ~15x more than control and ~3-4x more than other treatments.

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

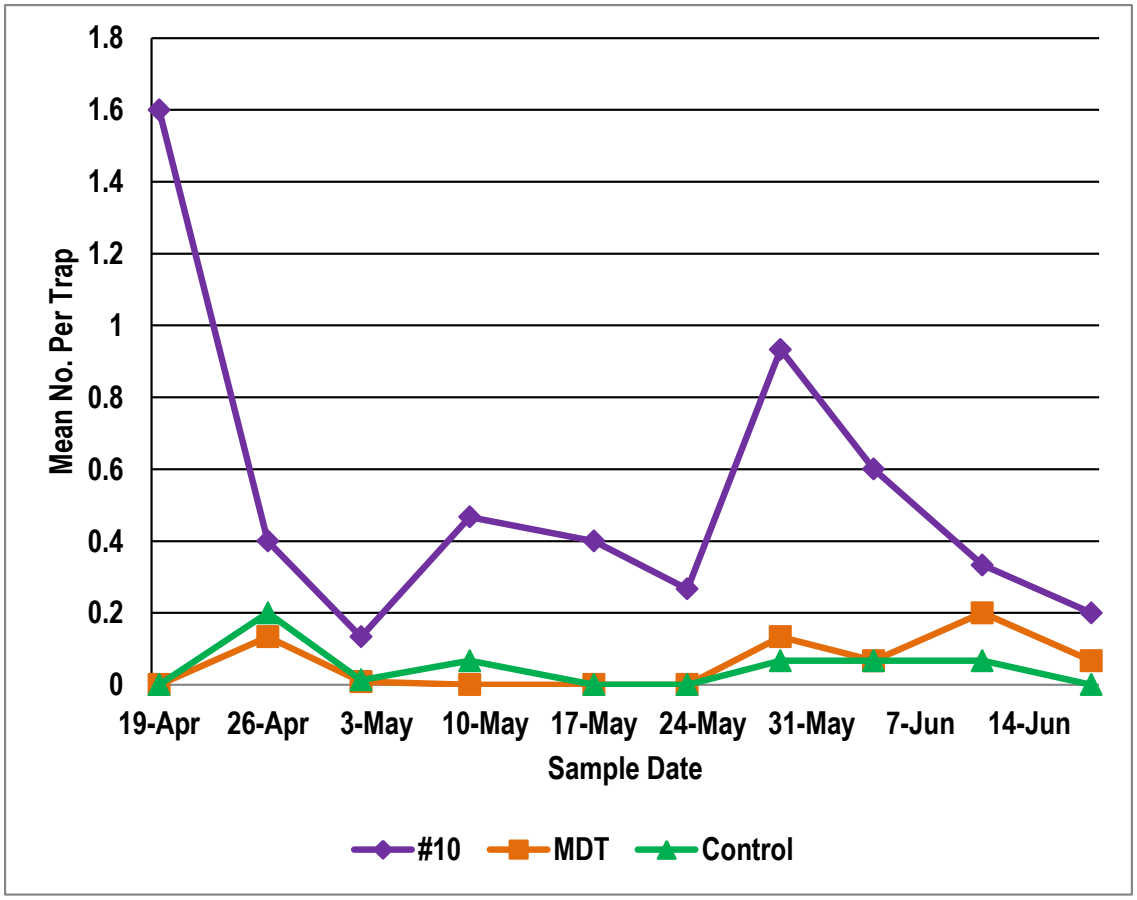
AgBio

Sterling/Rescue

General Protocol

- Black pyramid traps
- Three odor treatments
  - 1) #10
  - 2) MDT
  - 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

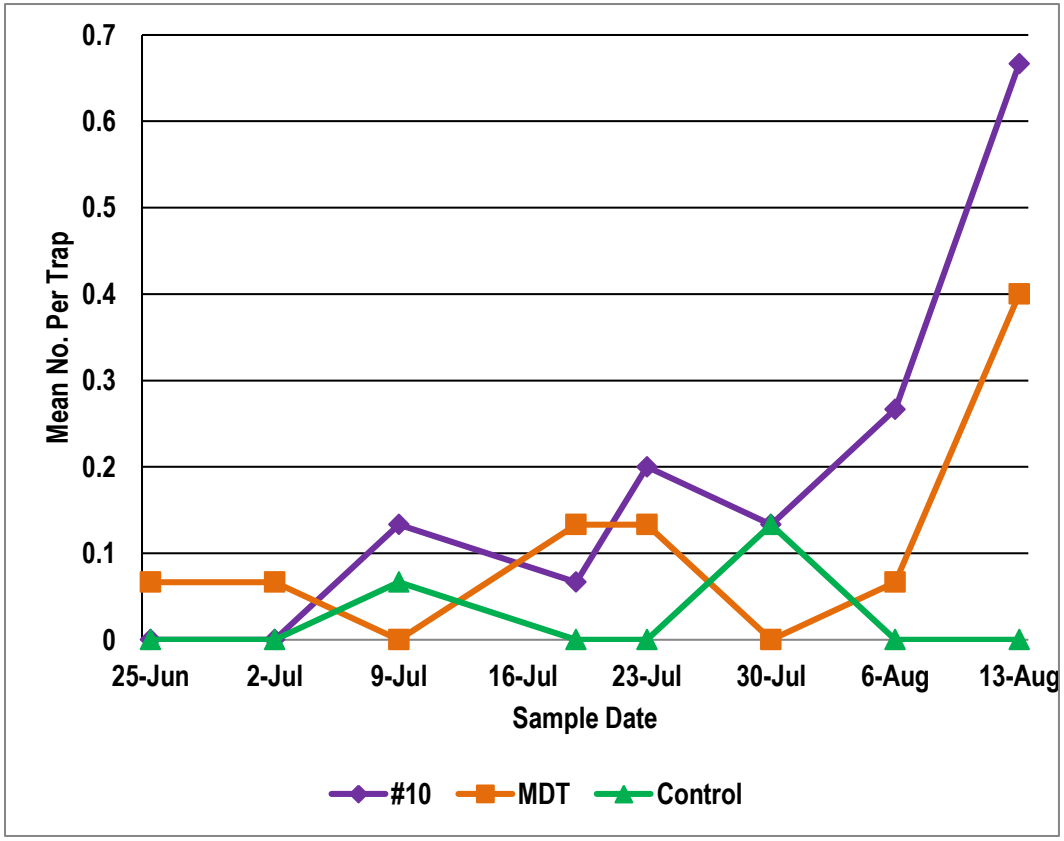


Trap Capture Ratios

#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

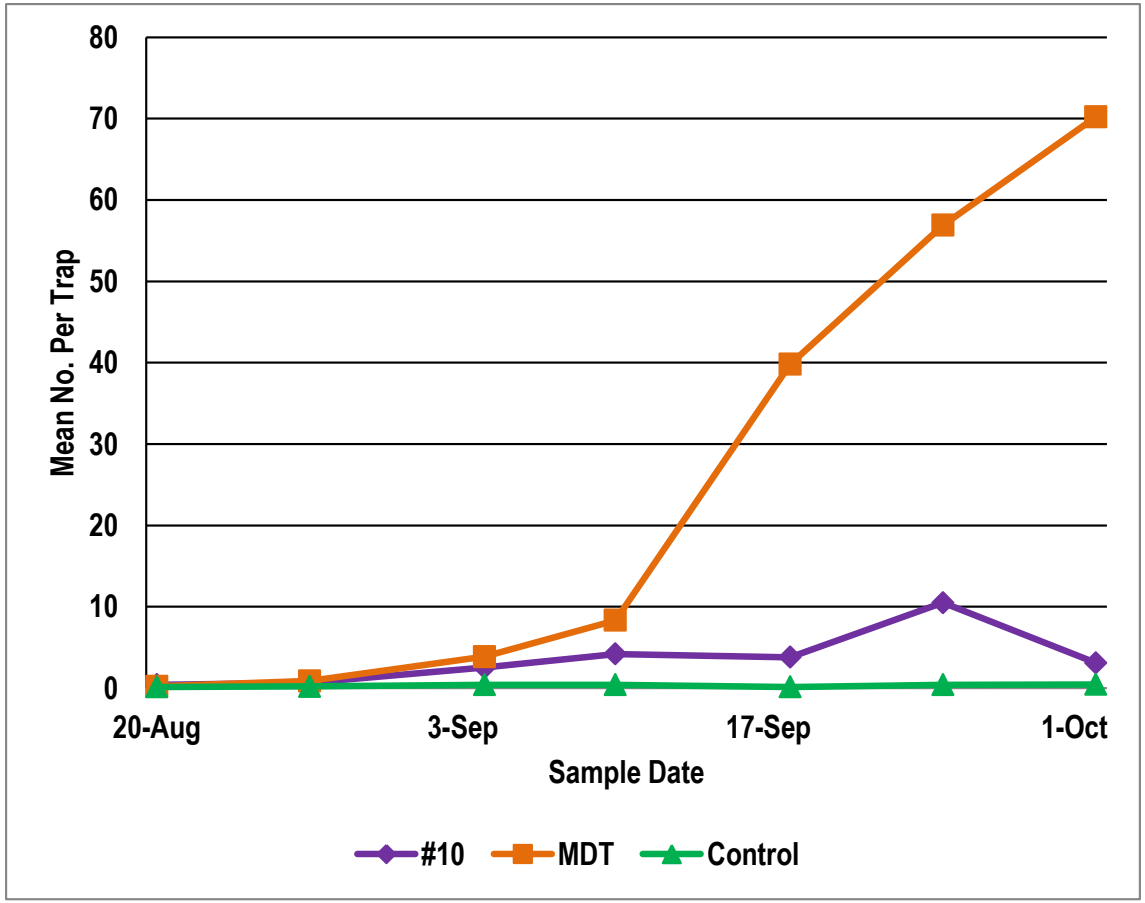


Trap Capture Ratios

#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.

Season-Long Trap Captures

Adult Captures 

Period	Time	Reps	#10	MDT	Control
Early Season	Mid-April to Mid-June	79	208	26	18
Mid Season	Mid-June to Mid-August	81	568	443	59
Late Season	Mid-August to Mid-October	81	3793	14420	421

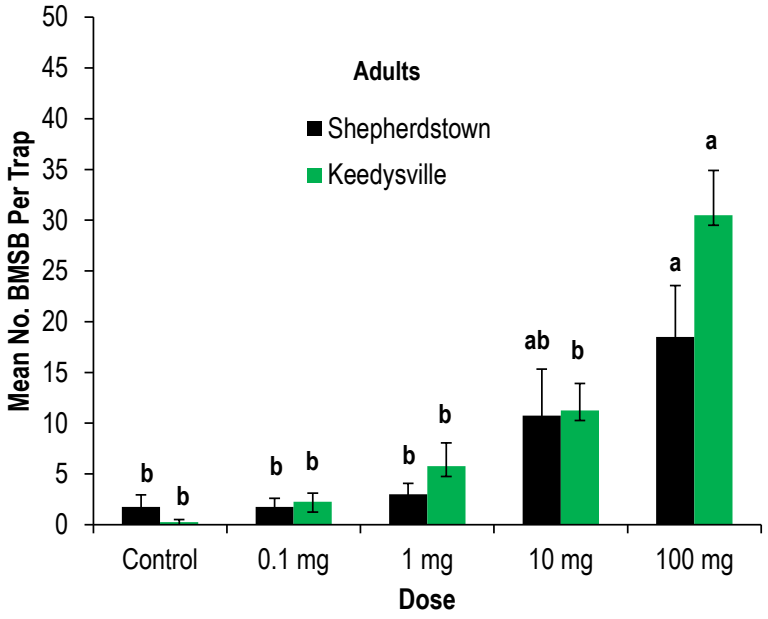
Nymphal Captures 

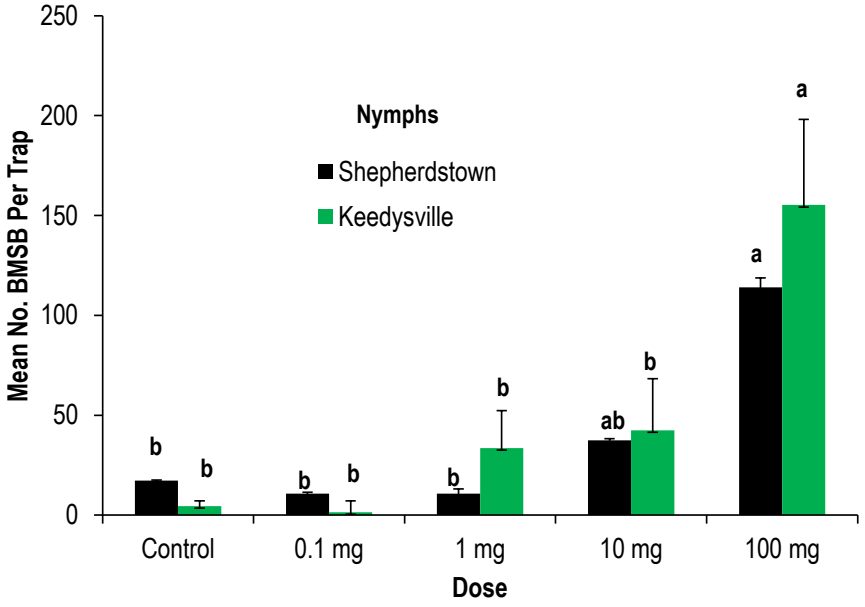
Period	Time	Reps	#10	MDT	Control
Early Season	Mid-April to Mid-June	79	2	11	6
Mid Season	Mid-June to Mid-August	81	4845	11990	666
Late Season	Mid-August to Mid-October	81	2714	10633	638

Dose Response Trial

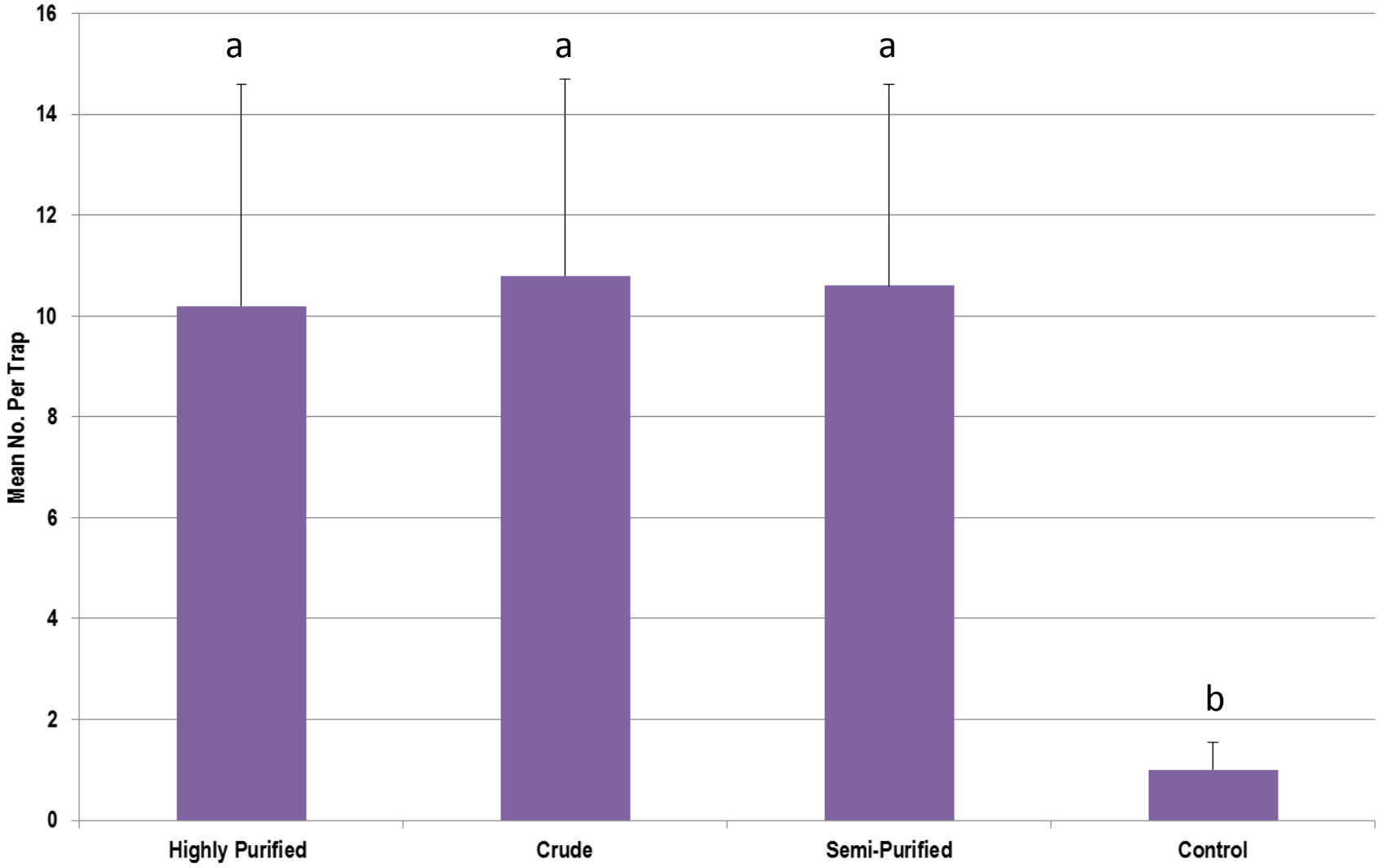
June 14-July 19, 2012

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





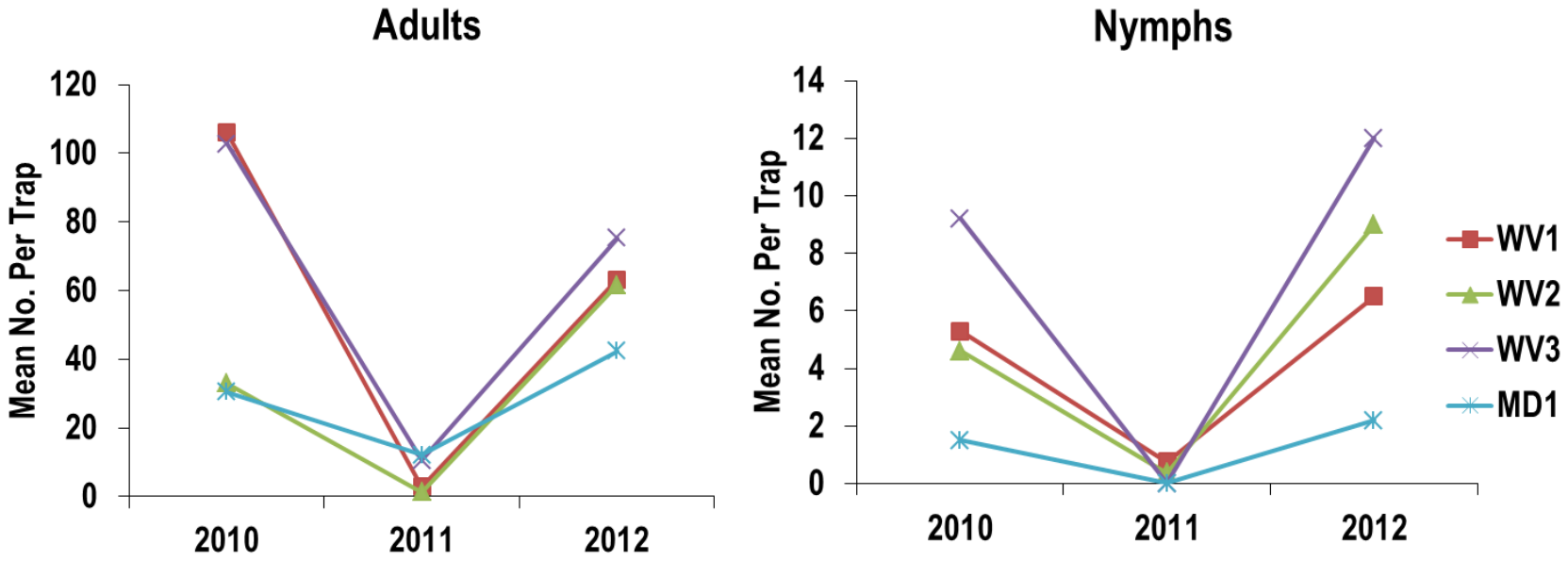
Lure Affordability: Encouraging Results from Purity Trial



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.

Peak Late-Season Captures using MDT in Commercial Apple Orchards Indicative of Early-Season Populations The Following Year



Year	Adults	Nymphs
2010	68.1 ± 21.0a	5.2 ± 1.6ab
2011	6.7 ± 2.7b	0.3 ± 0.2b
2012	60.6 ± 6.8a	7.4 ± 2.0a

Visual Cues

Identifying Optimal Wavelengths and Intensities of Light

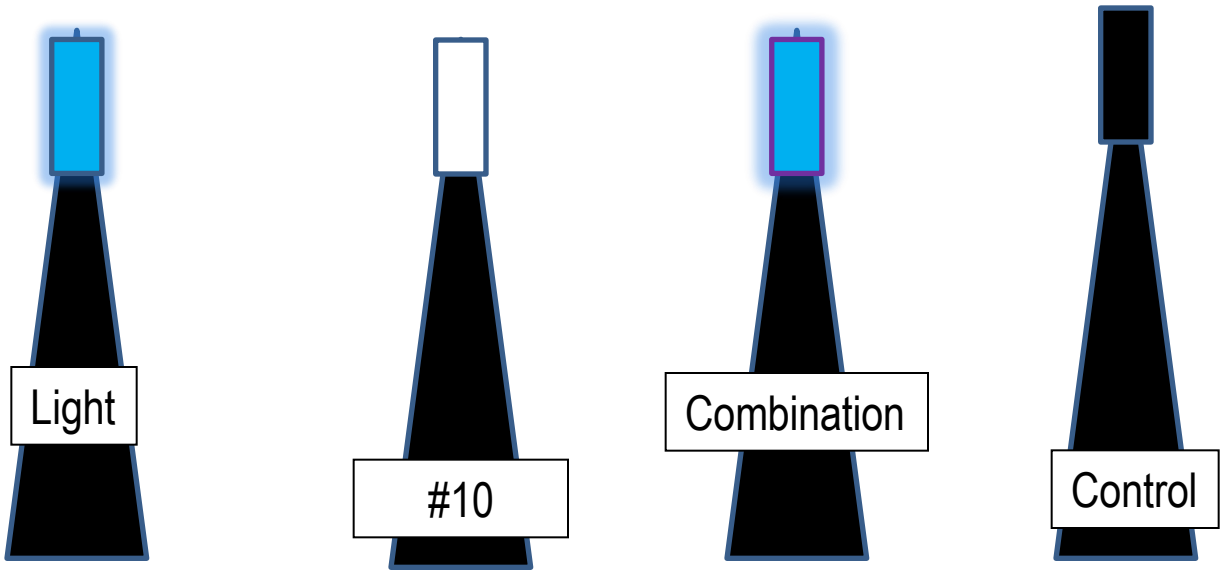
Experimental Light Traps

Night View

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

Season-Long Evaluation of Combination Stimuli

Preliminary Results 2012

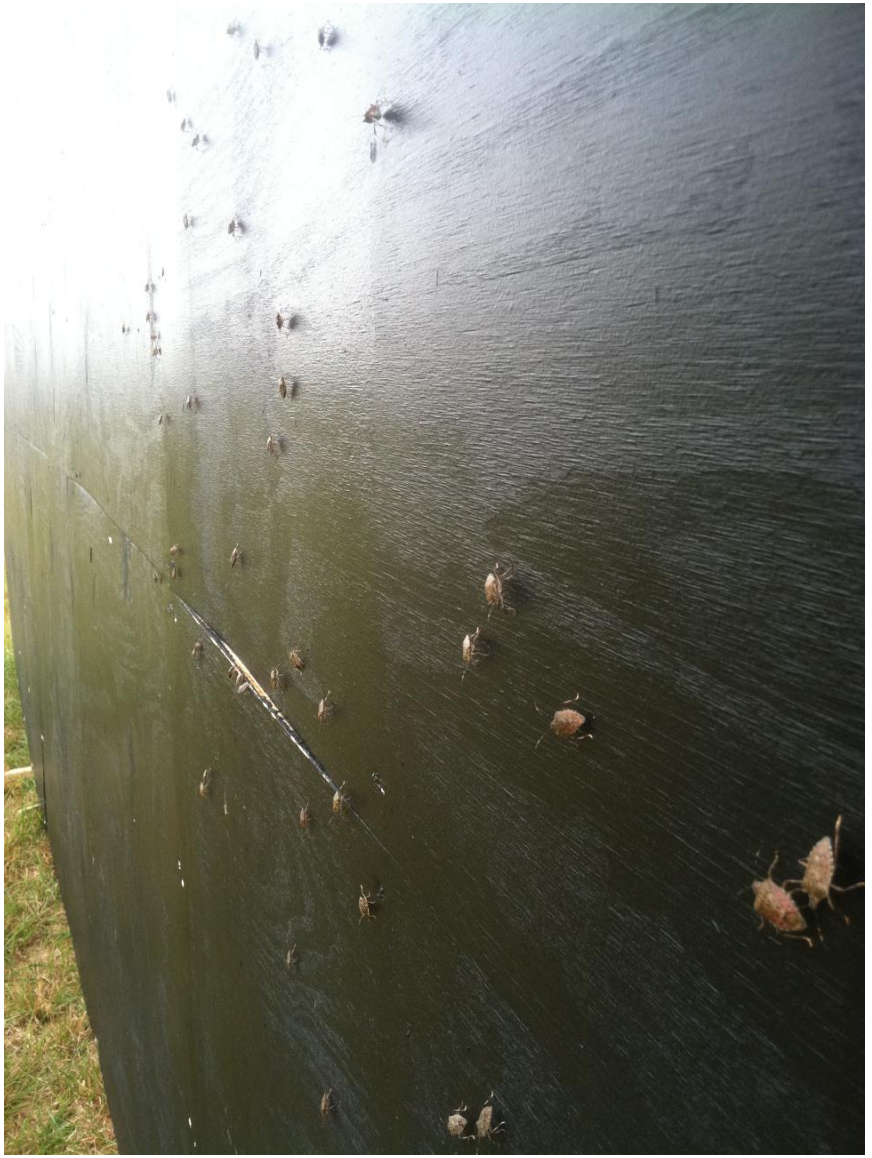


Line of Sight To Trap	Light	#10	Combination	Control
178 m^2	7.5 ± 1.6b (448)	4.1±0.8bc (246)	15.0 ± 3.4a (898)	0.3 ± 0.1c (20)
10 m^2	0.8 ± 0.2bc (47)	2.2 ± 0.5a (133)	1.7± 0.5ab (103)	0.1 ± 0.1c (6)

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

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- BMSB SCRI Team and Working Group

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

StopBMSB.org