Exploring relationships between pheromone trap capture and crop injury

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Funding

USDA

Specialty Crop Research Initiative

Collaborating Institutions

ars · NC State University · Penn State · OSU · University of Maryland · University of Georgia · Washington State University · Northeastern IPM Center · Cornell University · University of Kentucky · Rutgers · The Ohio State University · UC Davis · Virginia Tech · Berkeley · University of Minnesota · 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.

5 fruit projects
2 vegetable projects

=7 projects
in 15 minutes
= 2.1 minutes per project

Leskey Laboratory: Threshold Development for Apple Orchards

Two Potential Approaches To Establishing Thresholds

Retrospective Approach: Establishing Correlations Between Trap Captures and Damage

- We found this approach to be problematic as there are many factors that affect captures and damage at harvest.
- Non-uniformity among growers in terms of timing and materials used for spray applications against BMSB and other pests, and delay in injury symptoms appearing leads to a lack of discernable relationship between trap captures and injury.

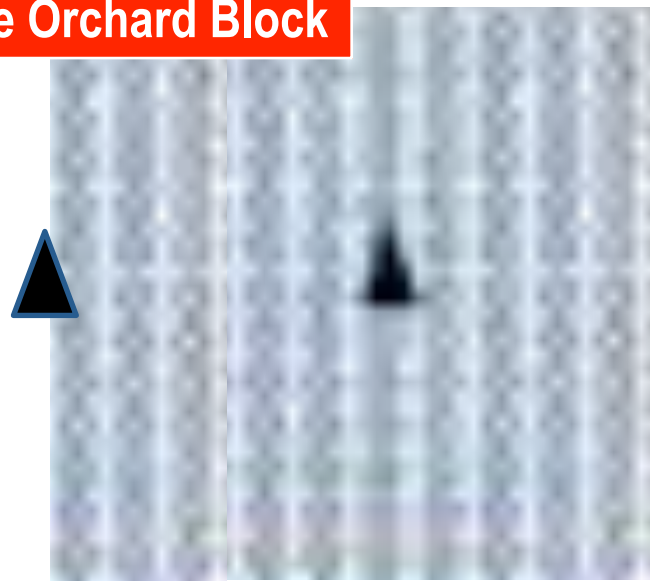
Forward-Driven Approach: Using Set Thresholds To Drive Spray Applications

- This approach establishes that the only sprays applied against BMSB will be triggered by experimental thresholds.
- This increases uniformity and enables us to determine if the number of sprays applied at a time indicated by trap captures (based on a set threshold) reduced damage at harvest.

Forward-Driven Approach: Establishing A Threshold for Apple

- Apple blocks monitored with two baited black pyramid traps baited with experimental pheromone lures. Traps checked weekly.
- When adult captures in either trap reached a set threshold, the block was treated with BMSB material (ARM). Block treated again 7-d later. Threshold was then reset.
- This approach enabled the sprays to drive the results against BMSB.

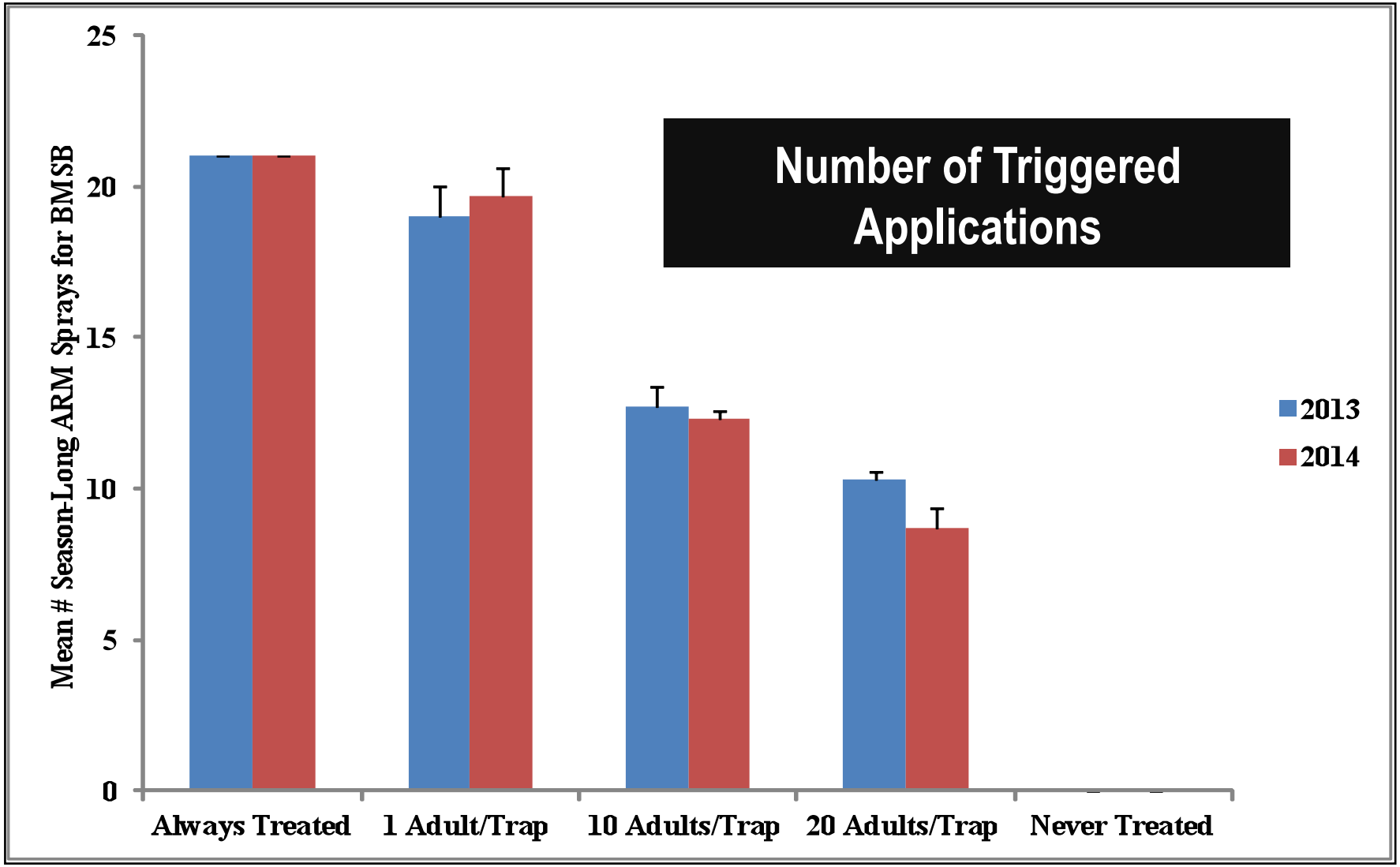
Apple Orchard Block



Experimental Treatments

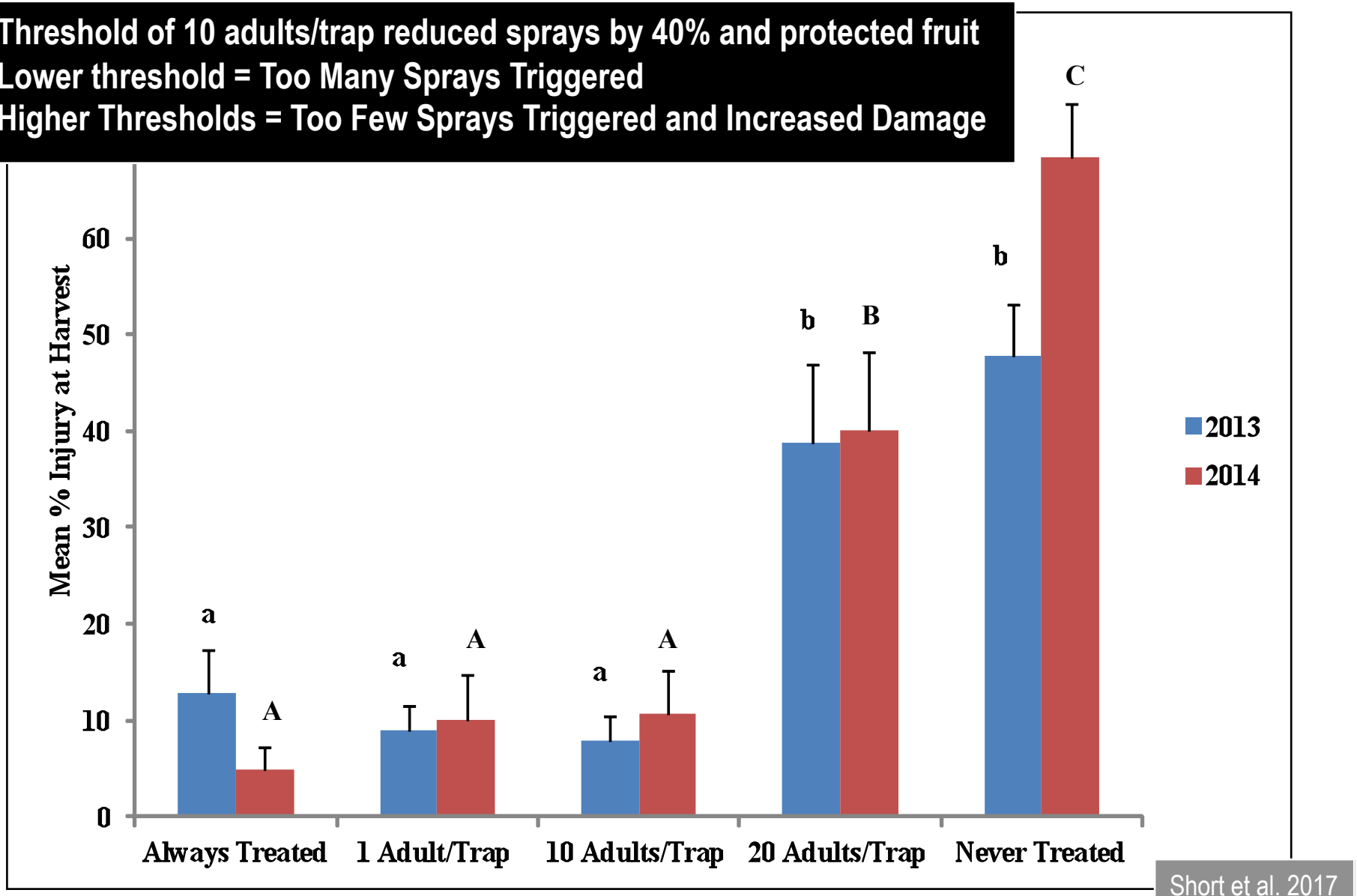
1) 1 Adult / Trap
2) 10 Adults / Trap
3) 20 Adults / Trap
4) Treated Every 7 d
5) No Spray (Control)

Season-Long Insecticide Applications Made Against BMSB Triggered By Trap Captures



A Threshold of 10 Adults/Trap Provided Best Information as to Need for and Timing of Applications Against BMSB

- Threshold of 10 adults/trap reduced sprays by 40% and protected fruit
- Lower threshold = Too Many Sprays Triggered
- Higher Thresholds = Too Few Sprays Triggered and Increased Damage

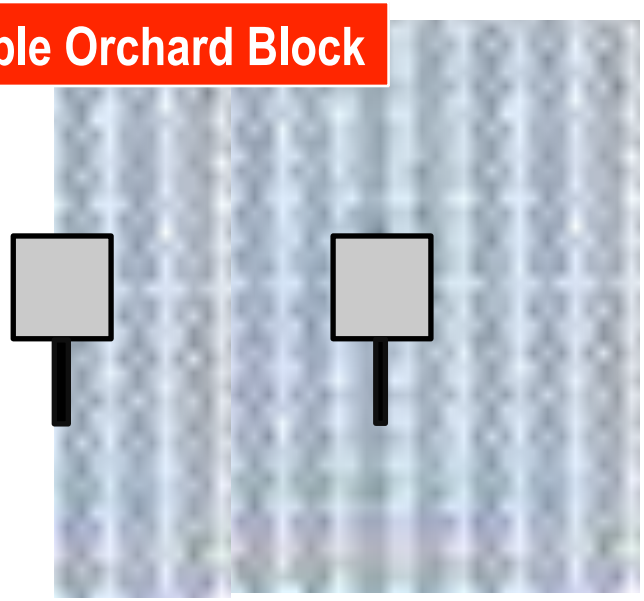


Short et al. 2017

Forward-Driven Approach: Establishing A Threshold for Apple

- Apple blocks monitored with two clear sticky panels baited with Trécé Dual Lures. Black pyramid trap standard included. Traps checked weekly.
- When adult captures in either trap reached a set threshold, the block was treated with BMSB material (ARM). Block treated again 7-d later. Threshold was then reset.
- This approach enabled the sprays to drive the results against BMSB.

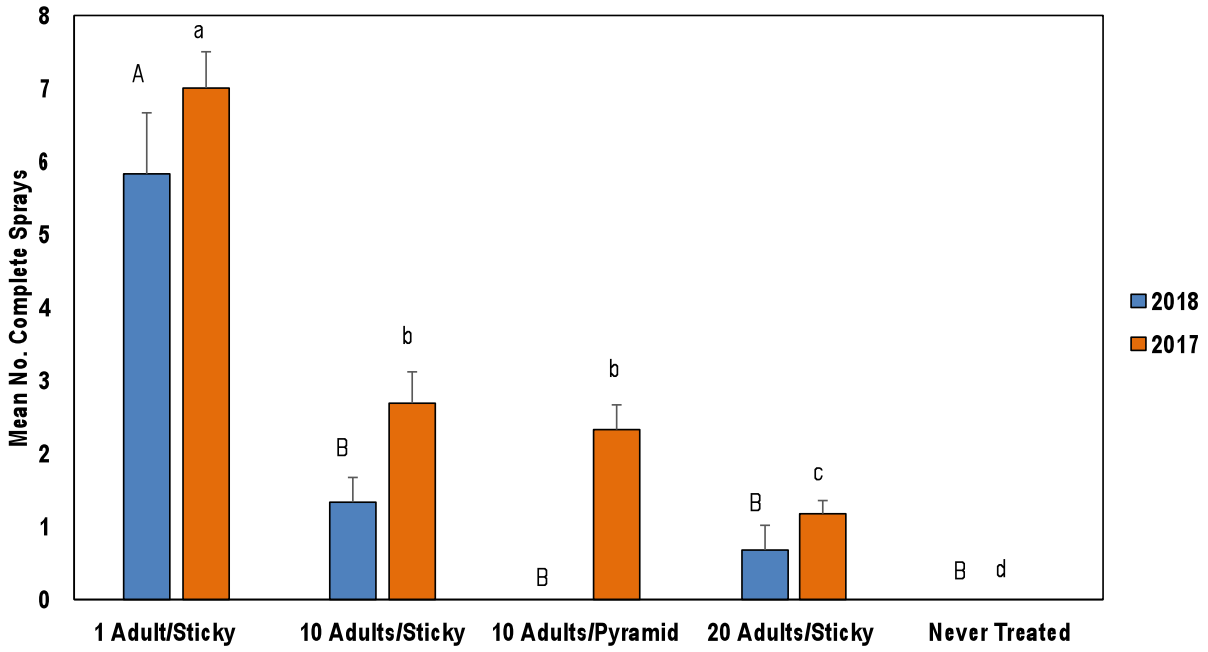
Apple Orchard Block

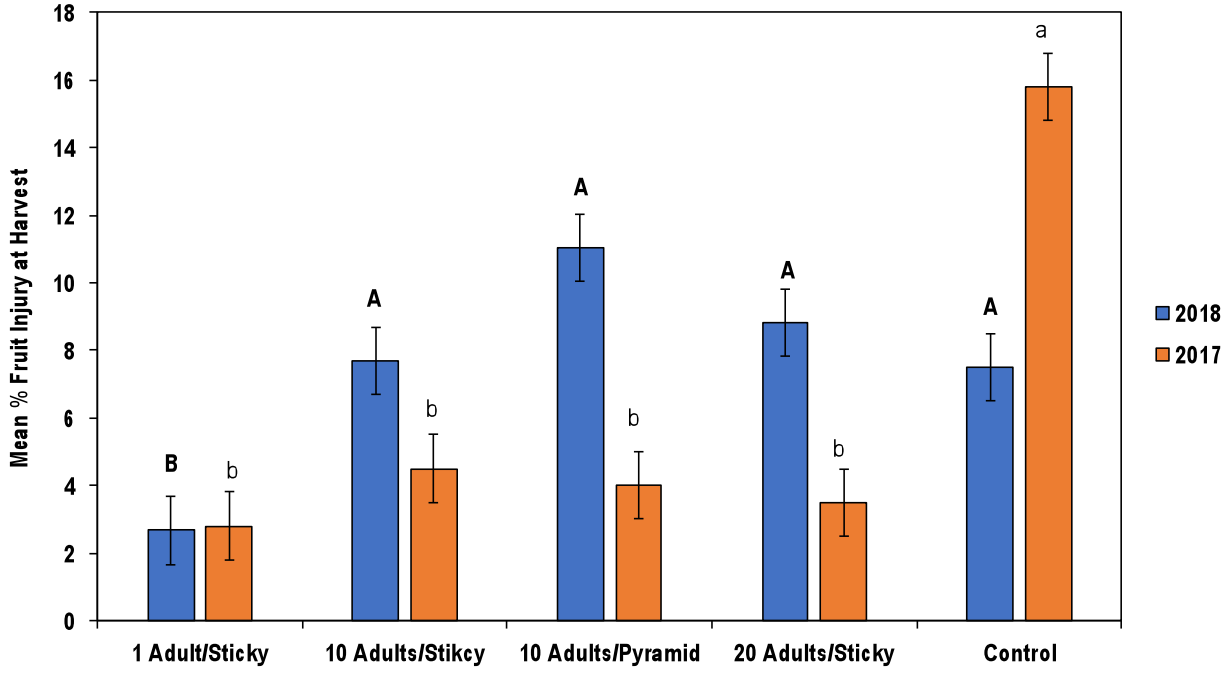


Experimental Treatments

1) 1 Adult / Trap
2) 10 Adults / Trap
3) 20 Adults / Trap
4) Treated Every 7 d
5) No Spray (Control)

- Threshold of 1 adult/sticky trap resulted in significant reductions in injury.
- Sprays appeared to be triggered at correct times using this threshold.
- We used a threshold of 4 adults/sticky trap (*as an educated guess*) in commercial orchards with good success.





2019 Plans:
Establishing A Threshold for Apple Using Sticky Traps

- The following threshold treatments will be evaluated in apple orchards using clear sticky traps baited with Trécé Dual Lures
  - 1 adults/sticky trap
  - 4 adults/sticky trap
  - Always sprayed (positive control)
  - Never sprayed (negative control)

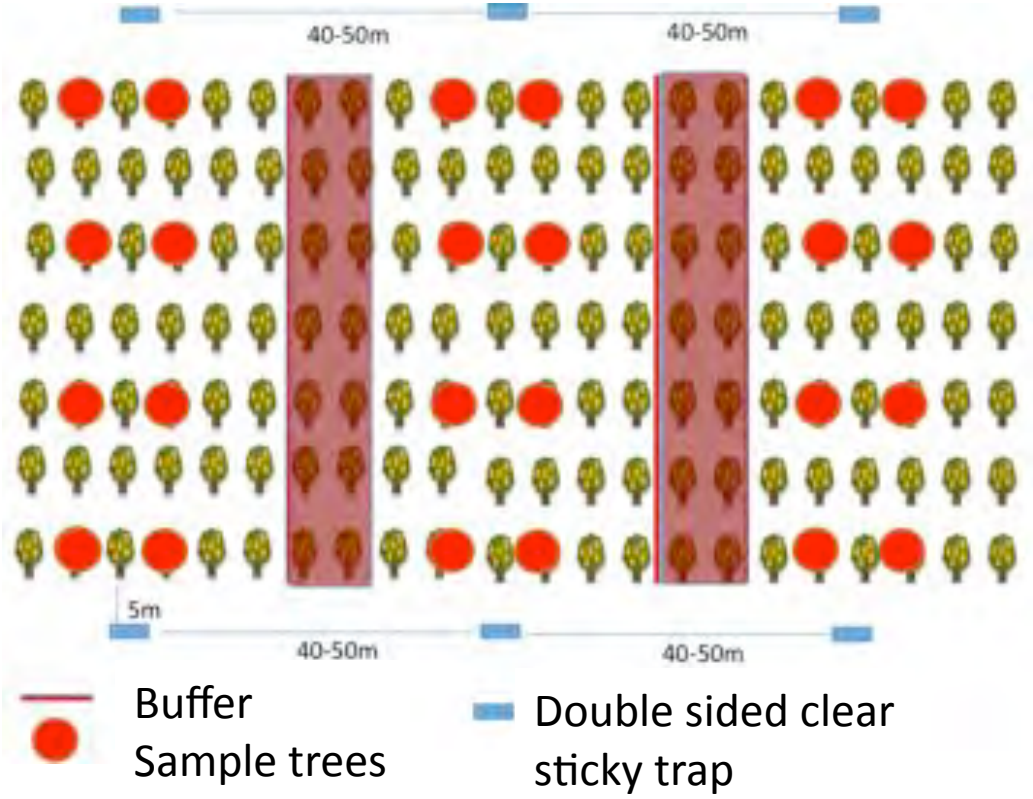
Evaluation of different lure doses for BMSB management decision in Peach

Anne Nielsen

- **Research Questions**
  - **How does reduced BMSB lure rate influence trap capture in peaches?**
  - **Could reduced lure rates provide effective threshold for making management decisions?**

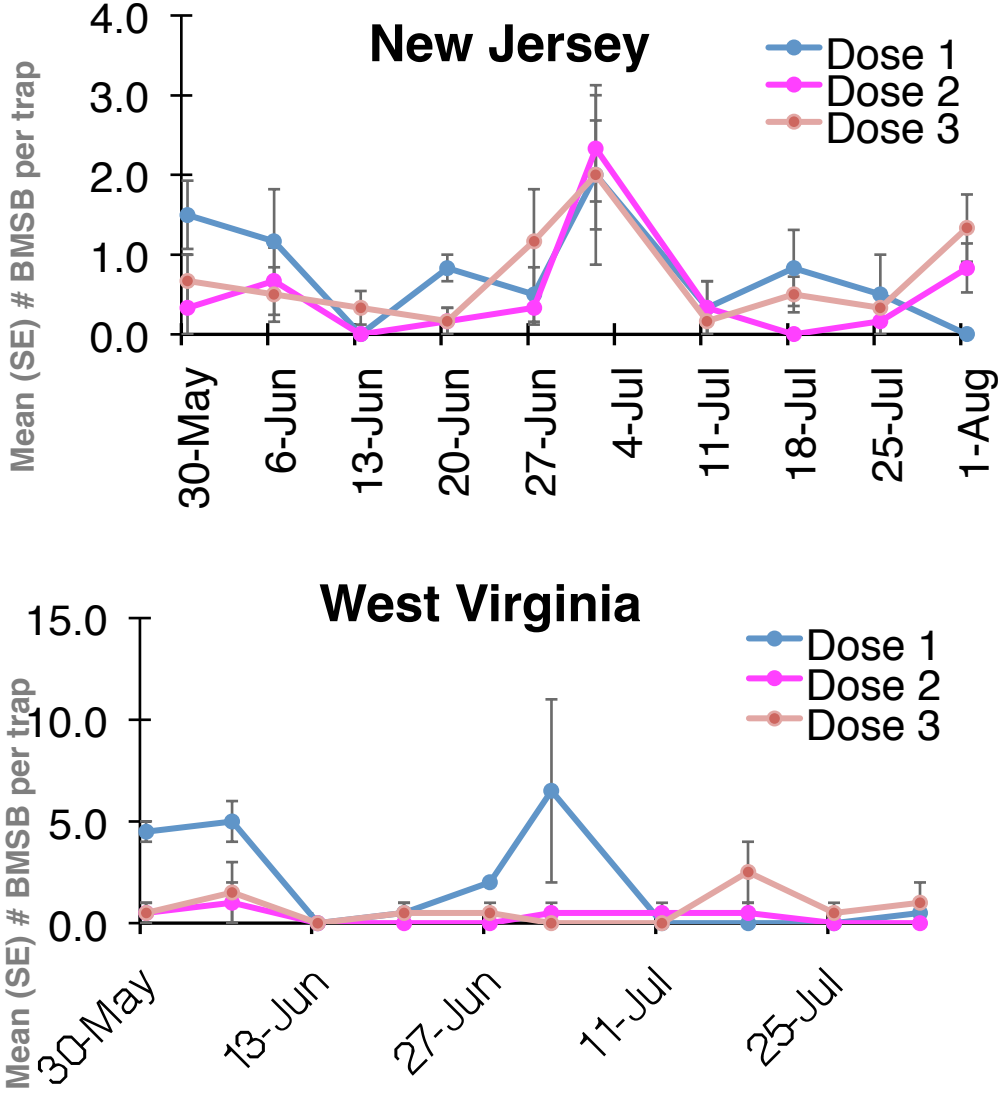
Methods

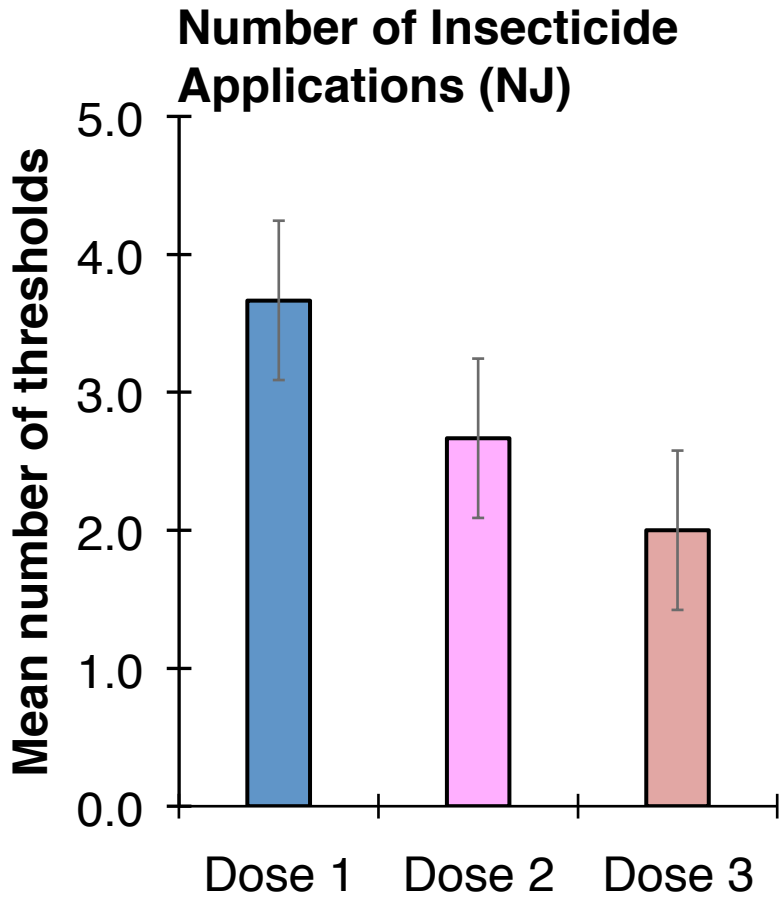
- **BMSB lure treatments**
  - **Dose 1: Trécé Dual**
  - **Dose 2: 10% murganitol + MDT**
  - **Dose 3: 25% murganitol + MDT**
- **Plot Layout**
  - **Peach blocks divided into 0.5-1 acre blocks**
  - **Two traps per block placed on highest risk edges, 5 m from the orchard edge**
  - **A preliminary threshold of 2 BMSB/trap triggered an insecticide application**



- **Harvest**
  - **At harvest, 25 fruit per non-baited tree on 1st, 3rd, 5th tree were collected; Injury and severity**
  - **Means BMSB for seasonal capture in traps**
  - **Injury and severity were analyzed using ANOVA and means separated using Tukey-Kramer HSD**

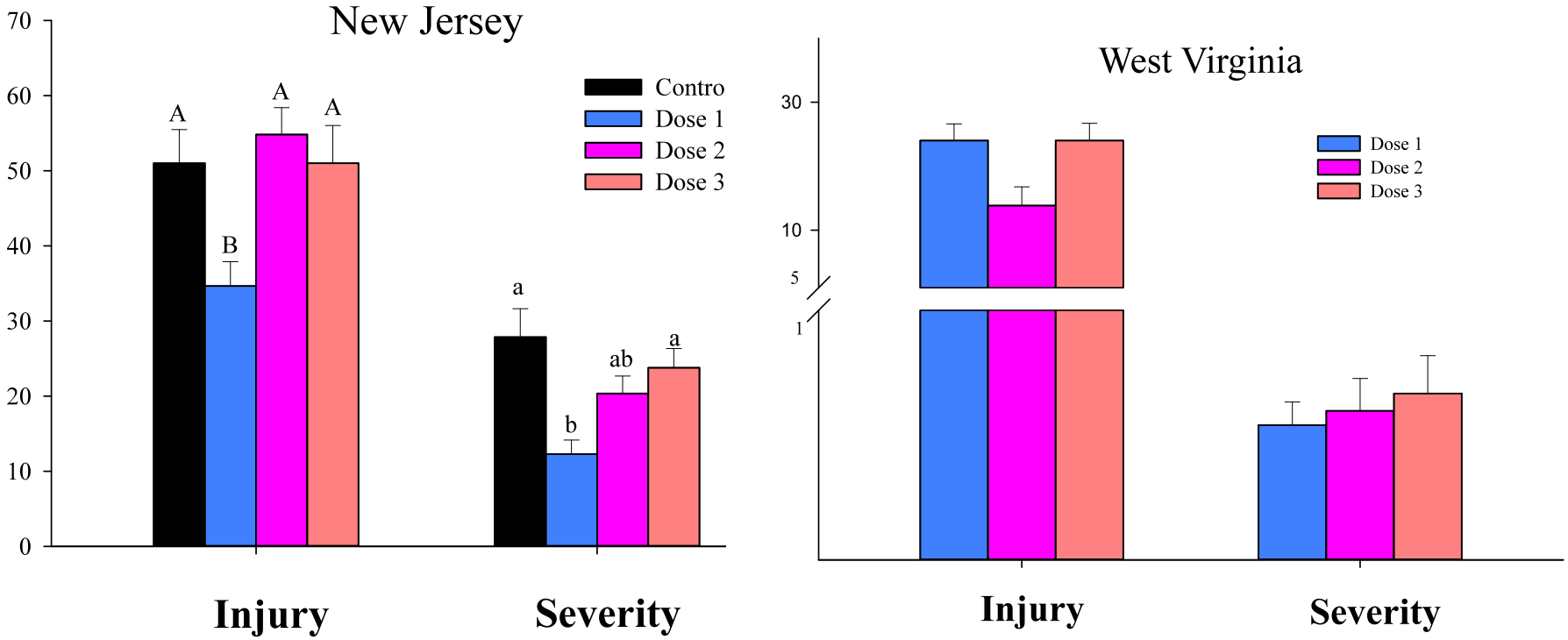
Results





Captures in baited sticky panel traps in NJ and WV peaches

Results



Mean injury and severity recorded in peaches at NJ and WV

Summary

- **The reduced rate lures tracked seasonality similarly as the Dual standard but caught significantly fewer BMSB.**
- **There were no differences between the injury recorded at the edge and interior.**
- **Only the Dual lure had significantly lower injury and severity of injury than the unsprayed control.**
- **These results indicate that either a reduced rate lure is ineffective or the threshold is not sensitive enough.**

Site-specific differences in BMSB captures and fruit injury

Whitney Hadden, Tracy Leskey, and Chris Bergh

Sub-Objective:

Examine the relationship between BMSB captures in pheromone traps at the edge of woods next to apple orchards and fruit injury at harvest?

Methods

BMSB captures

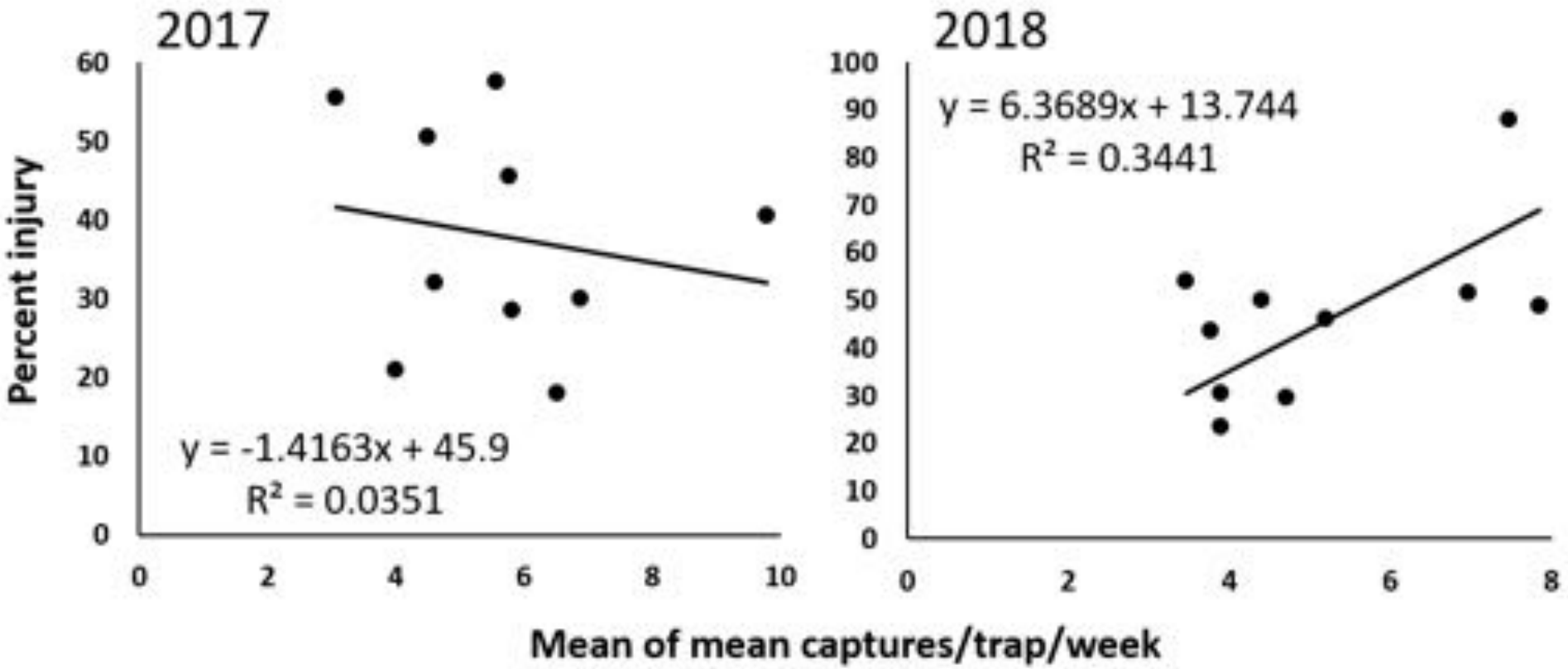
- 10 orchards
  - fruit for processing
  - Frederick Co., VA
  - ≥ 1 km apart
  - managed identically
  - managed minimally BMSB
- 3 sticky traps/site
  - baited with Trécé Dual lure
  - along woods edge
  - 50 m spacing
- Monitored weekly
  - mid-April through mid-Oct.
  - 2017 and 2018

Apple injury assessments

- At commercial harvest
- 10 trees per orchard
  - 'Imperial York'
  - border rows
  - adjacent to woods with traps
- 20 fruit per tree (200/ orchard)

- Correlations between fruit injury at harvest & BMSB captures

Apple injury vs captures



Conclusions and Future Directions

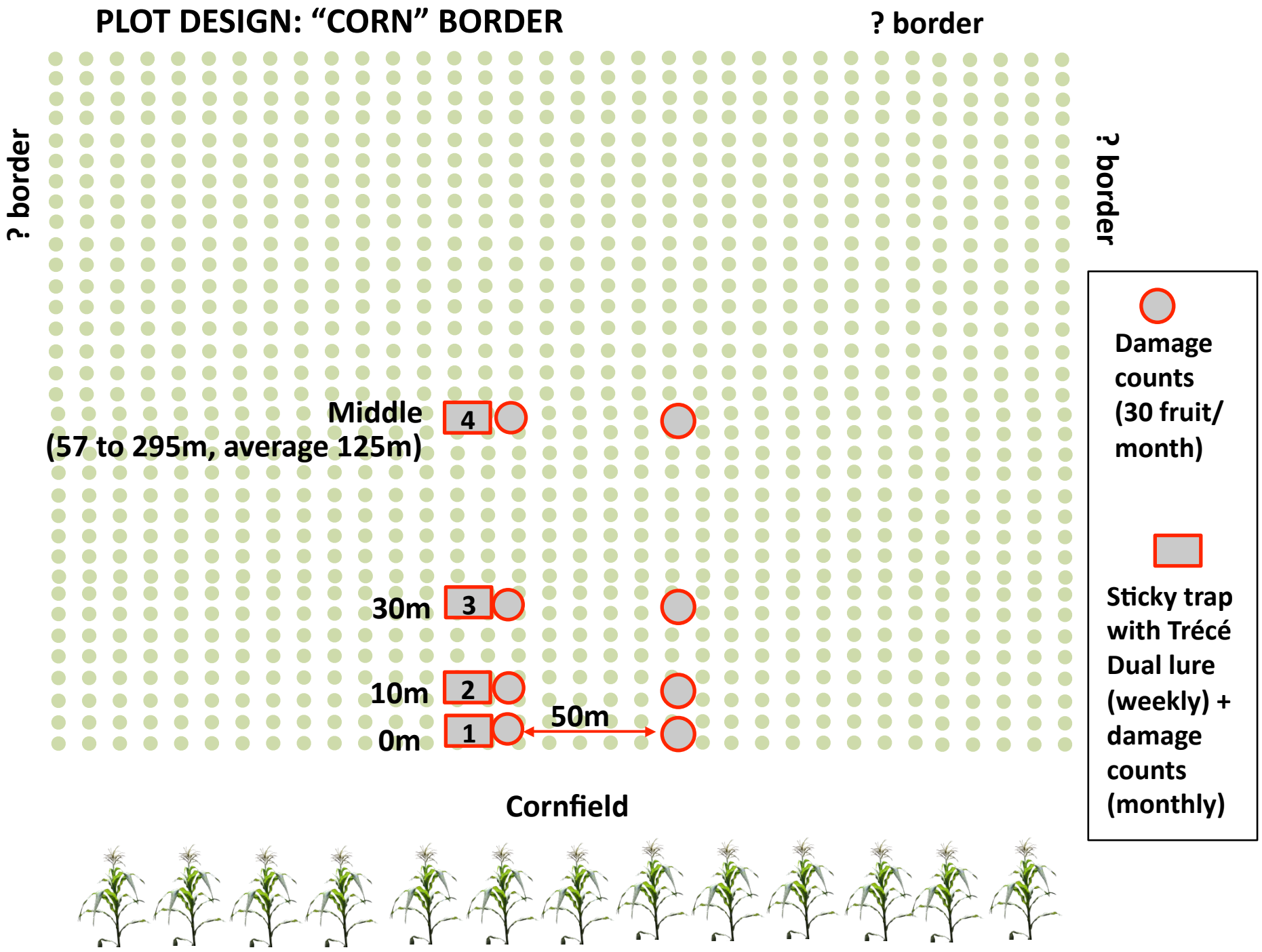
- Lack of correlation between BMSB captures and apple injury in both years
- Repeat in 2019 to determine if site ranking for BMSB captures remains similar among years
- Examine the relationship between site-specific differences in BMSB captures and the composition and size of adjacent woodlots

NORTH CAROLINA
Interpretation of Pheromone Trap Captures in NC Apples

- **Orchards dispersed in a diverse habitat**
  - **Heavily forested region**
  - **Other crops include corn, pastures/fallow land**
  - **Residential and commercial buildings common**
- **Relatively small orchards**
  - **Average orchard size is ~15 acres**
  - **Irregularly shaped**
- **Diverse orchard management schemes among orchards adjacent to one another**

Experimental Design

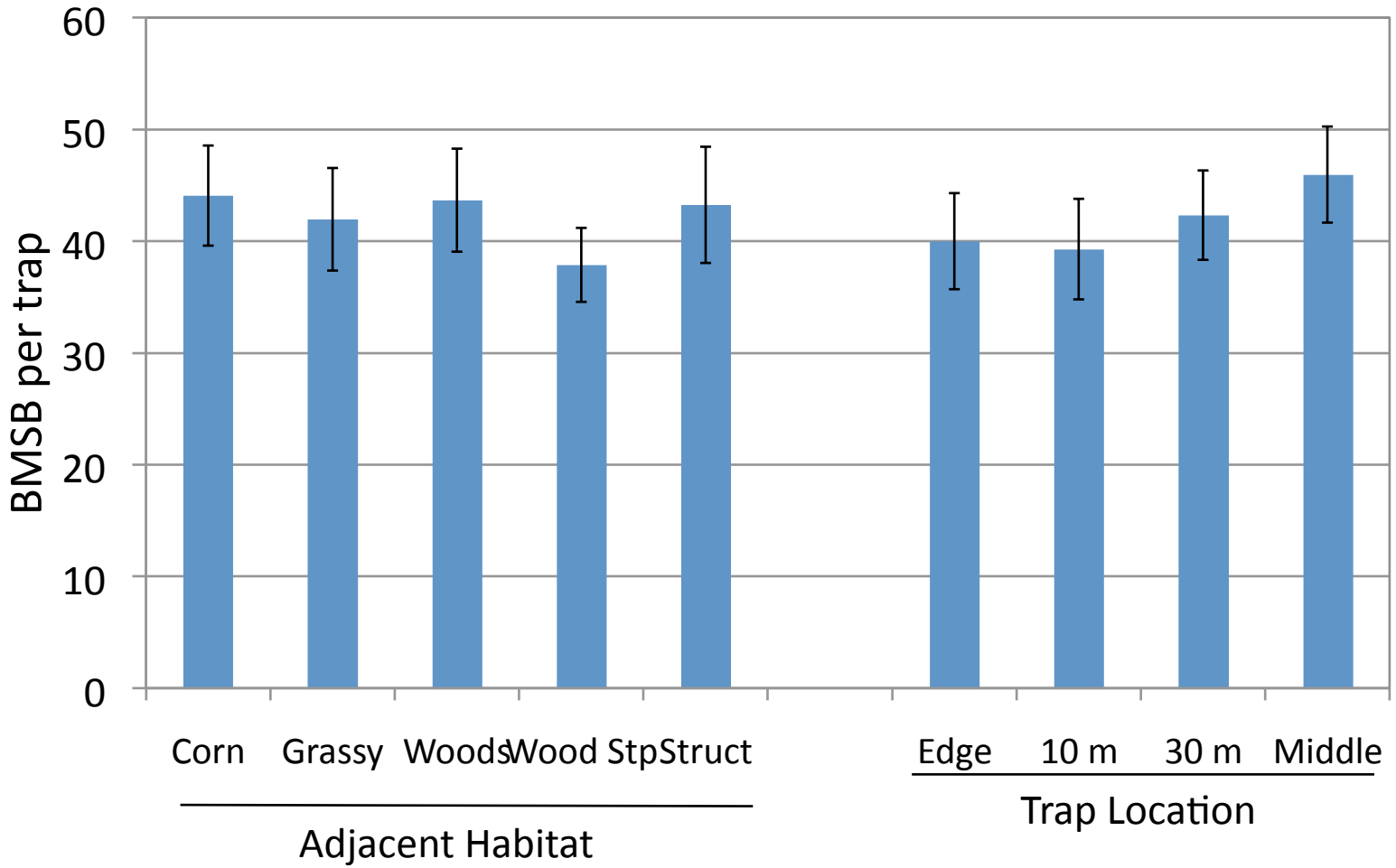
- BMSB Traps and Damage Assessments in 27 orchards
  - Traps monitored weekly
  - Damage monthly
- Traps and damage assessed along a transect into orchard along one border per orchard
  - Woods
  - Wooded strip
  - Open field (pasture)
  - Structure
  - Corn field


PLOT DESIGN: "CORN" BORDER
? border
? border
? border
Middle
(57 to 295m, average 125m)
4
30m
3
10m
2
0m
1
50m
Cornfield
Damage counts (30 fruit/ month)
Sticky trap with Trécé Dual lure (weekly) + damage counts (monthly)

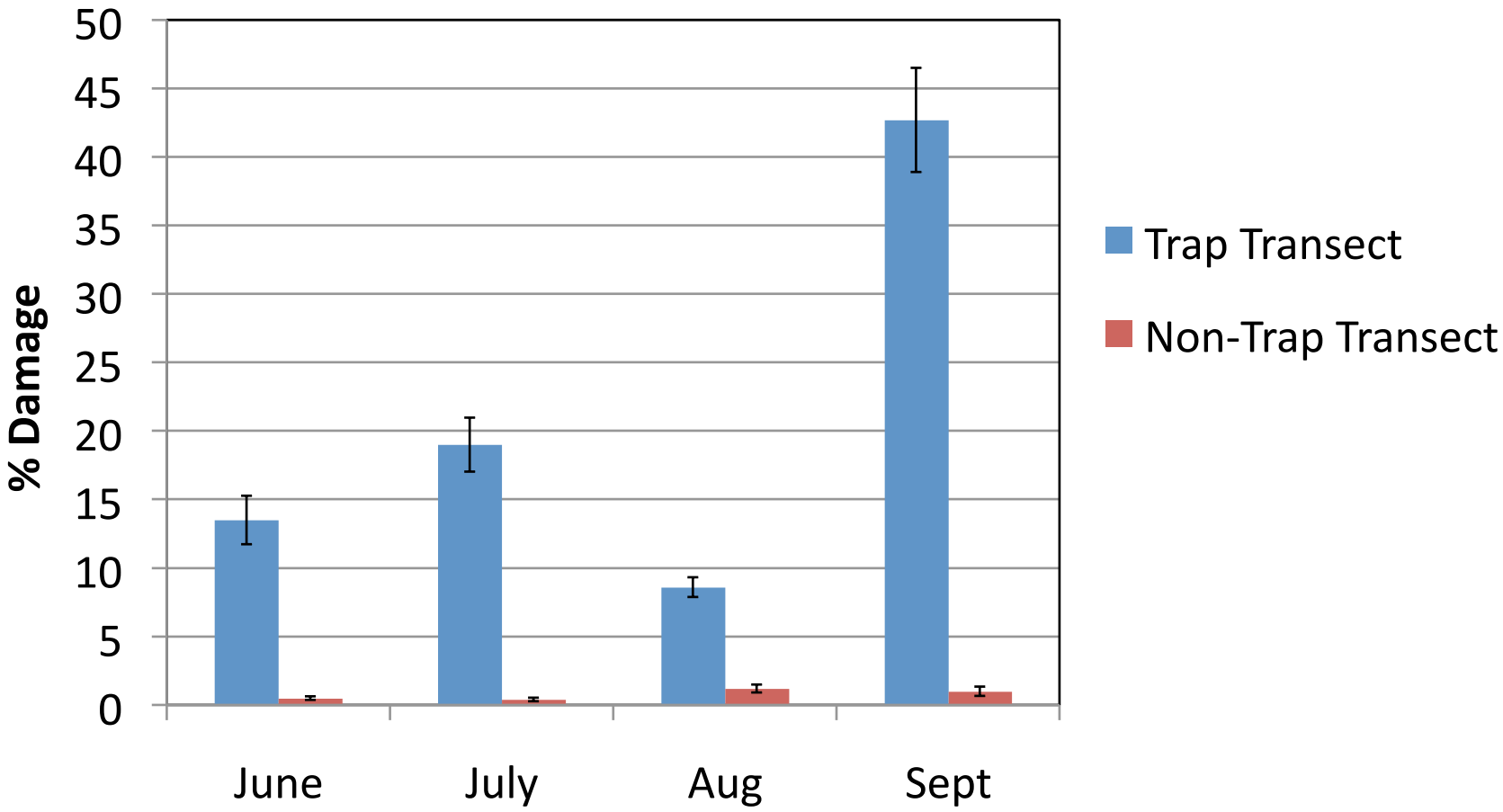
Season Total BMSB Trap Captures

ANOVA:

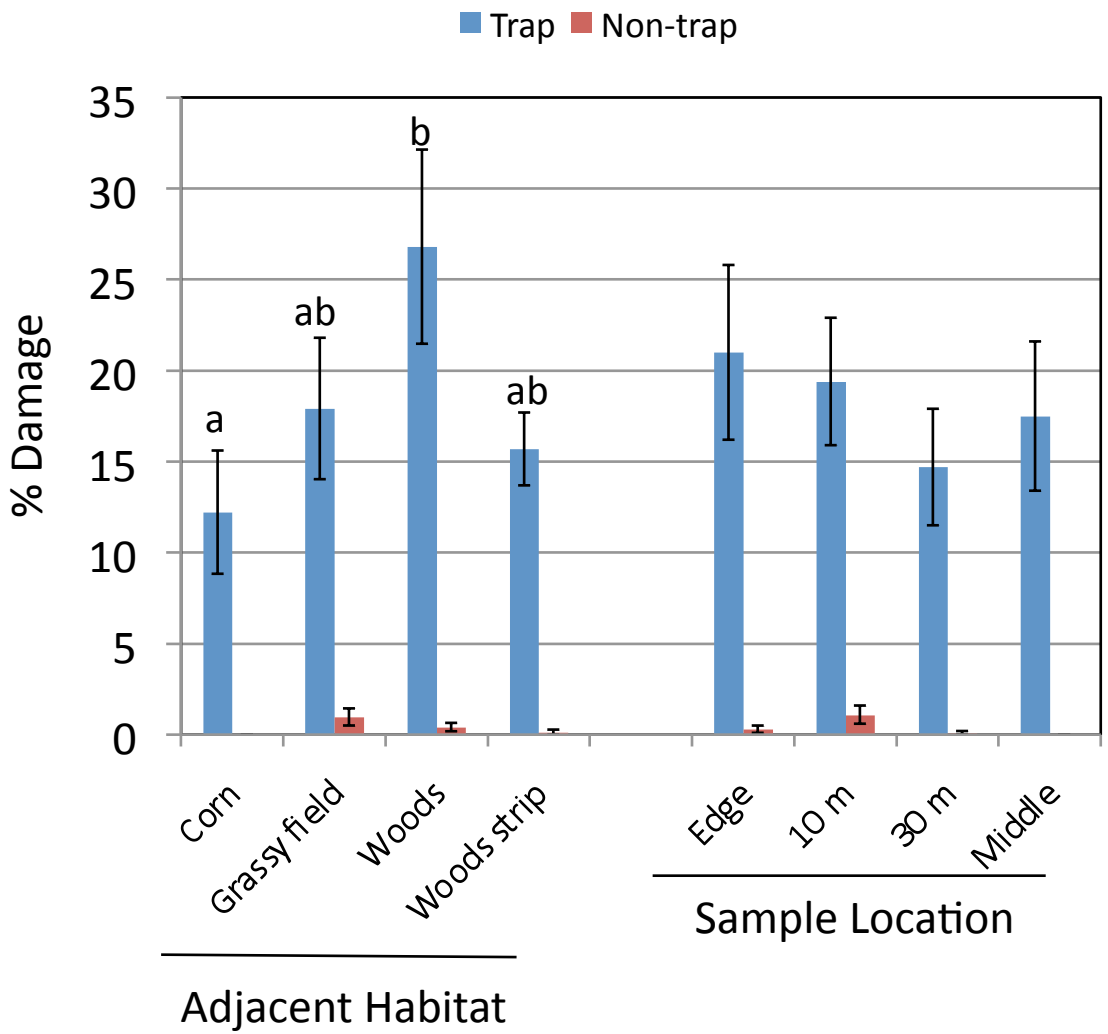
Factor	df	F	P
Habitat	4	0.42	0.73
Distance	3	0.47	0.70
Habitat x Distance	12	0.84	0.58



Impact of Pheromone Trap on Damage



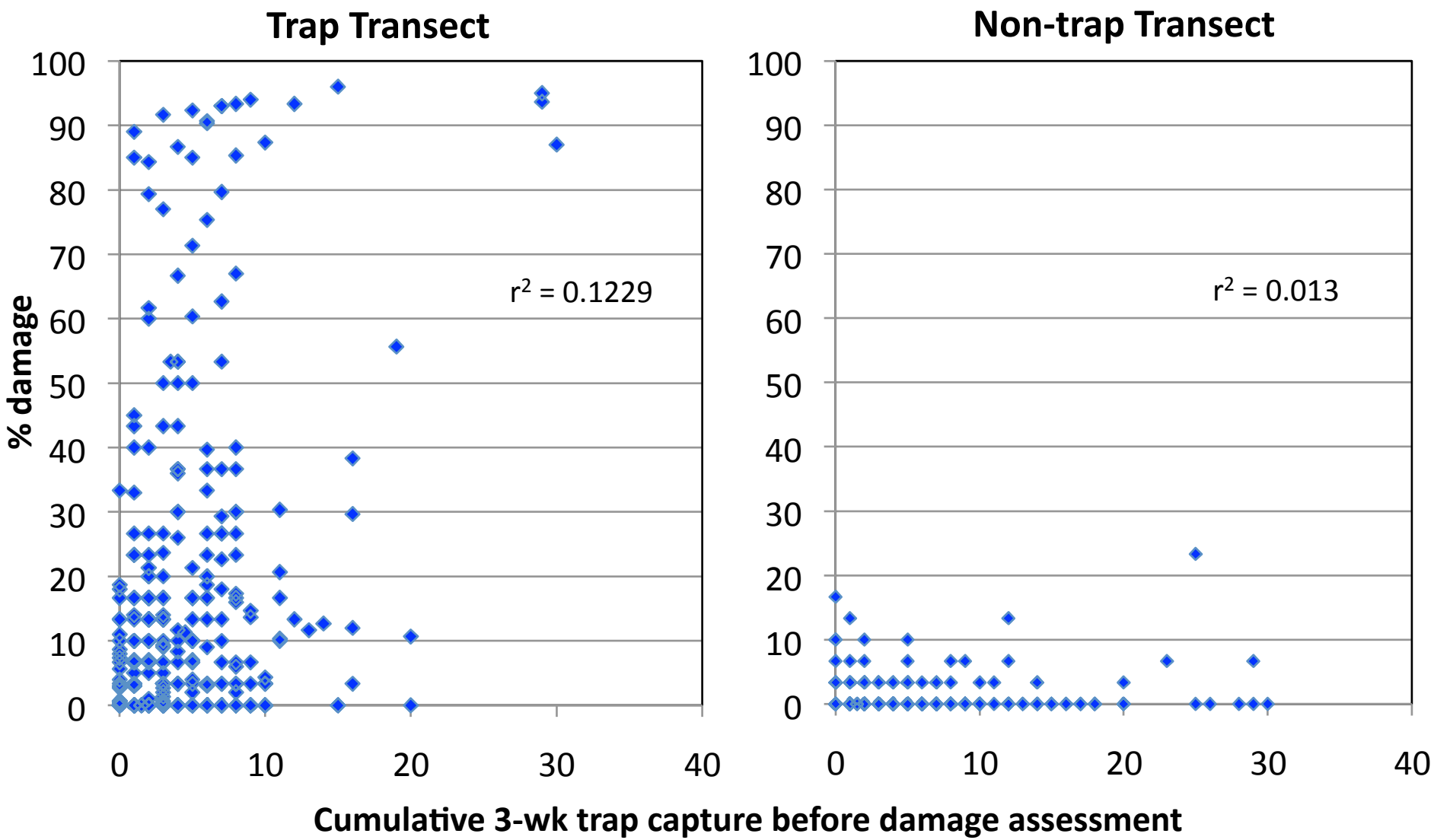
BMSB Damage on Fruit - July



ANOVA results:

Factor	df	F	P
Habitat	3	2.86	0.04*
Trap	1	147.2	<0.001*
Distance	3	0.70	0.55
Habitat x Trap	3	2.03	0.09
Habitat x Distance	9	0.44	0.91
Trap x Distance	3	0.24	0.87
Habitat x Trap x Distance	9	0.39	0.94

Pheromone Trap Capture vs Damage



Conclusions

- Neither adjacent habitat nor spatial location within orchard affected pheromone trap capture
  - Small orchards may mask effects of BMSB dispersal distance
- Damage was strongly associated with location of pheromone traps
  - Bodes well for attract and kill technology
- Damage was affected by adjacent habitat
  - Adjacent sinks (corn) led to lower damage
  - Bodes well for habitat manipulation strategies
- Poor relationship between trap capture and damage
  - Complicated by 1-3 wk interval for damage development

BMSB trap thresholds 2018

Nik Wiman, Heather Andrews, David Anthony Mugica, Erica Rudolph, Tatum Keyes, Nathaniel Edmonds

Oregon State University

BMSB in Hazelnuts

- **Hazelnut is reproductive host**
  - **Nuts and vegetative feeding**
- **Lots of refuge – big canopies**

Hedstrom et al. 2014.

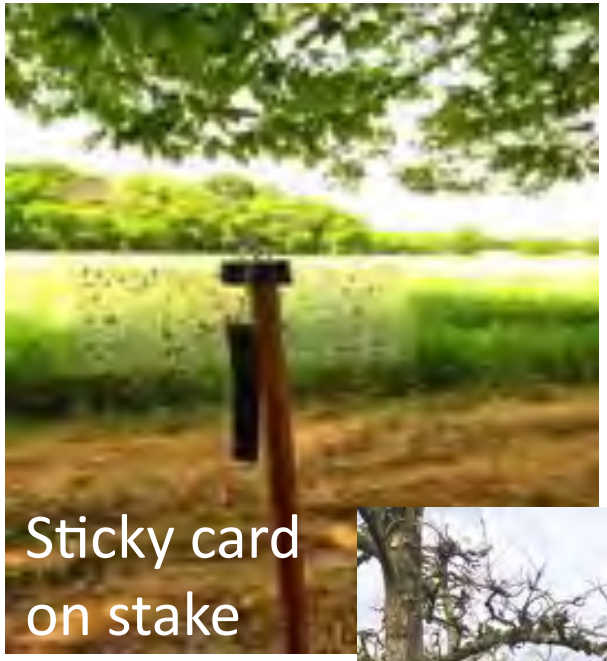
Figure 2. Primary damage symptoms associated with kernel feeding by BMSB on hazelnut kernels: a. healthy kernel (in shell); b. blank nut (empty shell); c. shriveled kernel; d. corking damage.

Trap thresholds for hazelnut

- **Can we use trap captures as a decision aid for spray timing?**
  - **Protect the crop**
  - **Save money on pesticide/labor**
  - **Conserve natural enemies**
    - **Samurai wasp**
  - **Avoid secondary pest problems**

N. Wiman, OSU Dept. Horticulture

Traps used in threshold study – weekly monitoring 2016-2018 seasons


Sticky card on stake

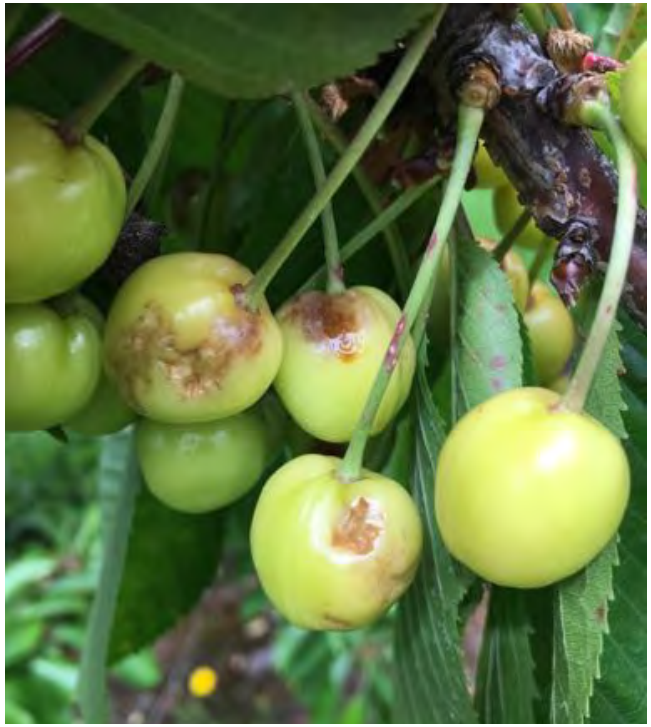

Pyramid trap

- 3 lures for each type
  - Alpha Scents combo
  - Trecé
  - USDA: Septa + MDT
- Damage counts every 2 weeks
  - Interior
  - Border

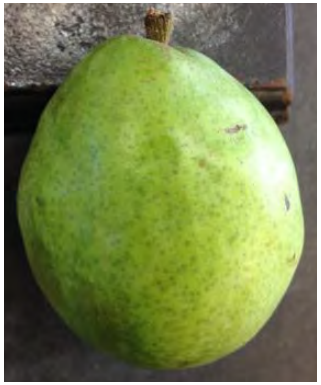
Damage threshold studies

Damage assessment ~ 100 fruit harvested every 2 weeks from border and center

Sweet cherry: HARVESTED 1st

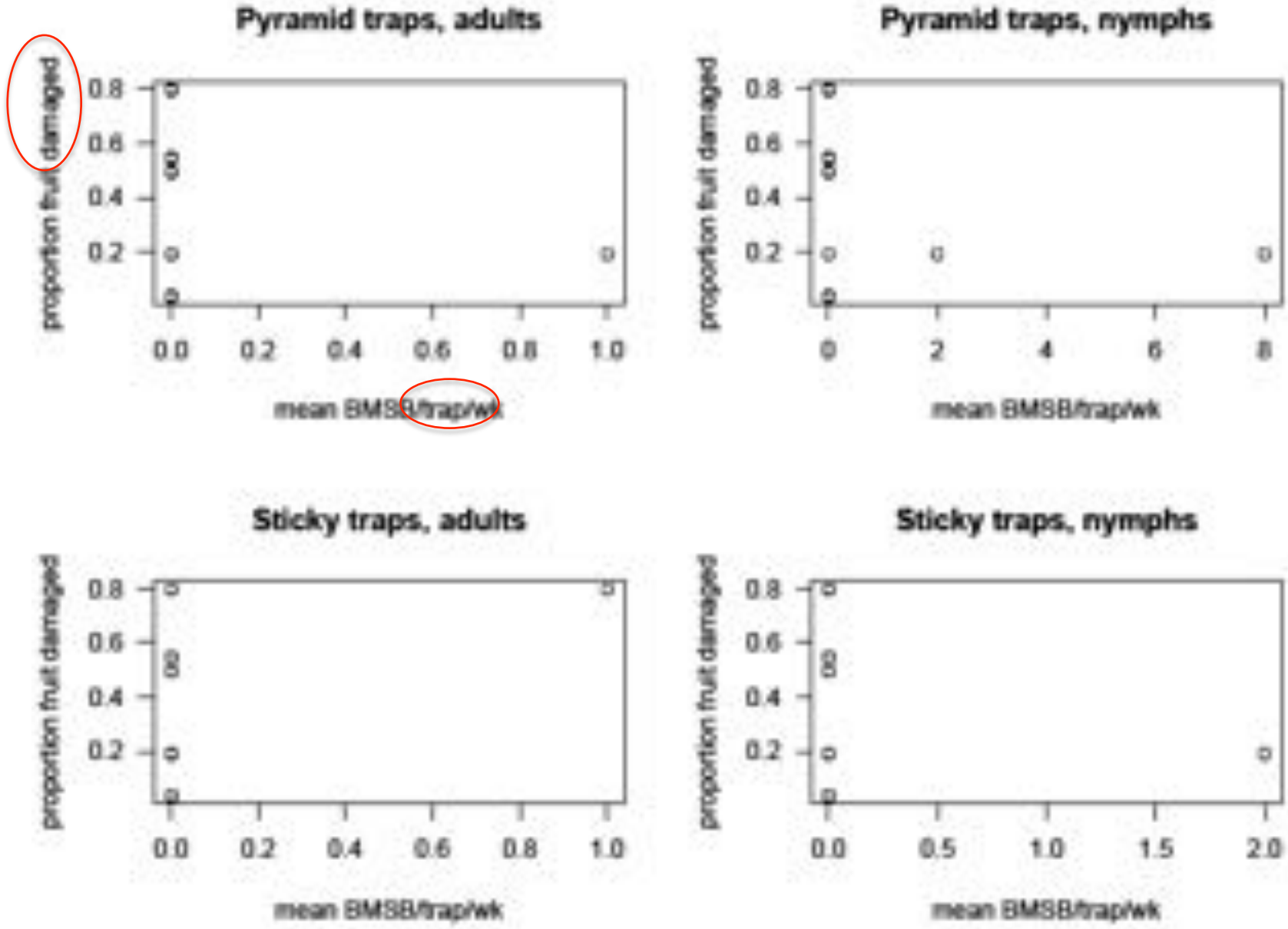


Pears: HARVESTED 2nd

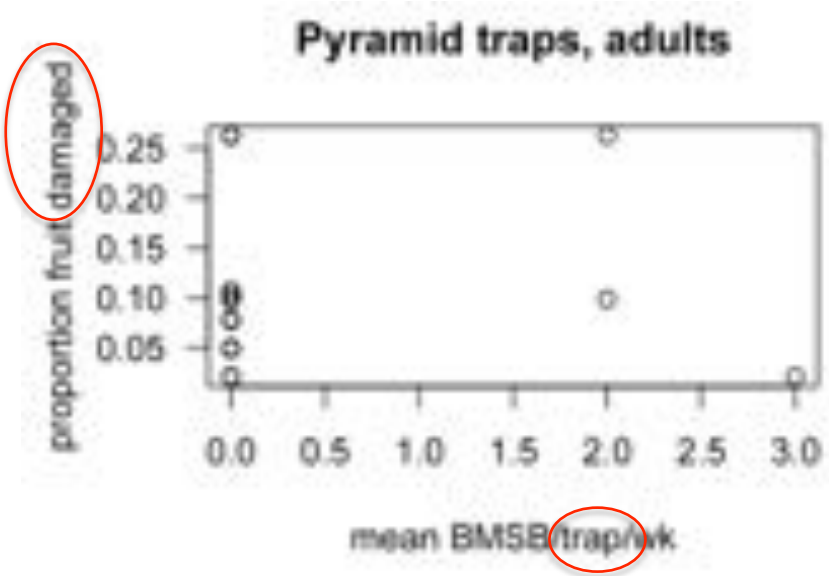


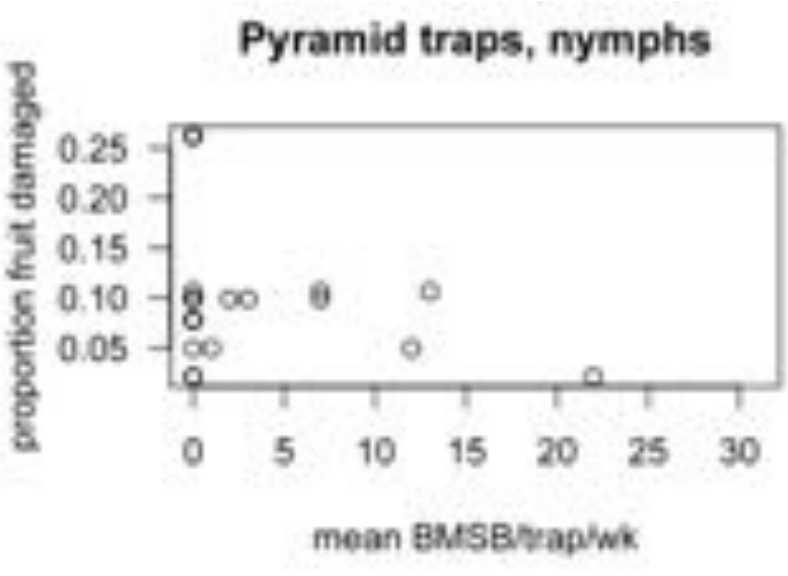
Hazelnuts: HARVESTED 3rd

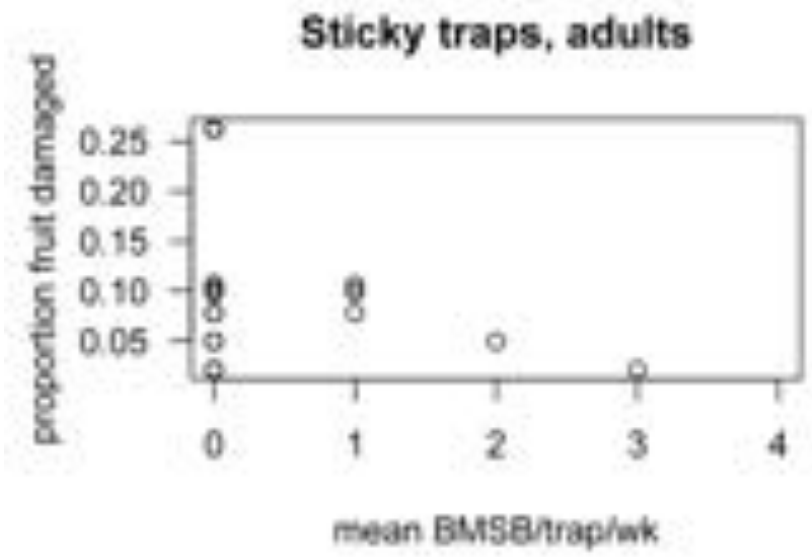
Captures vs. damage: Cherry 2018

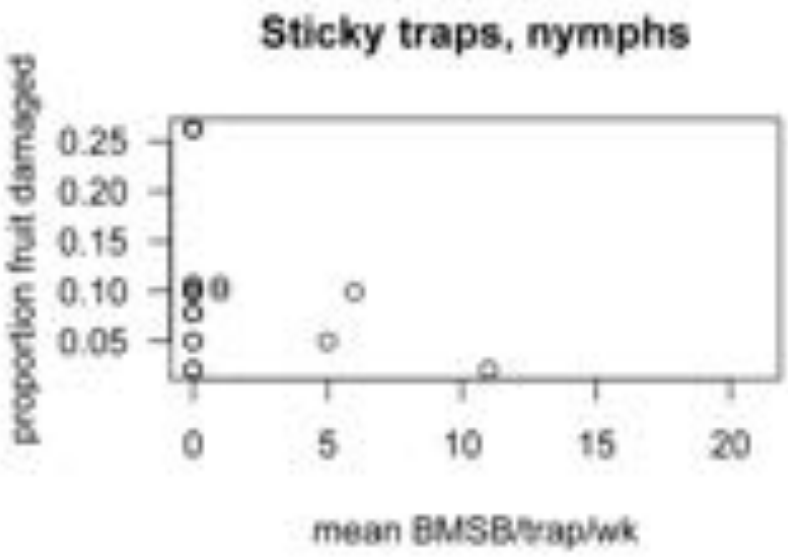


Captures vs damage: Pear 2018

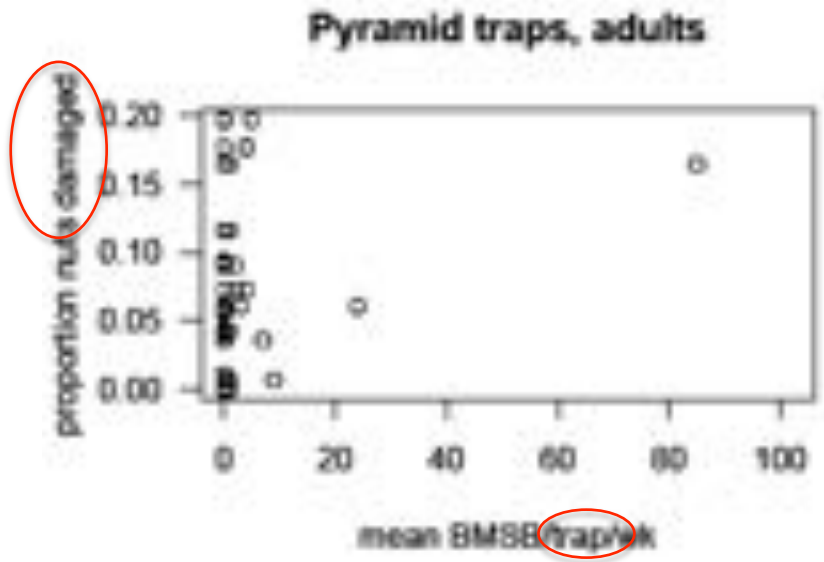


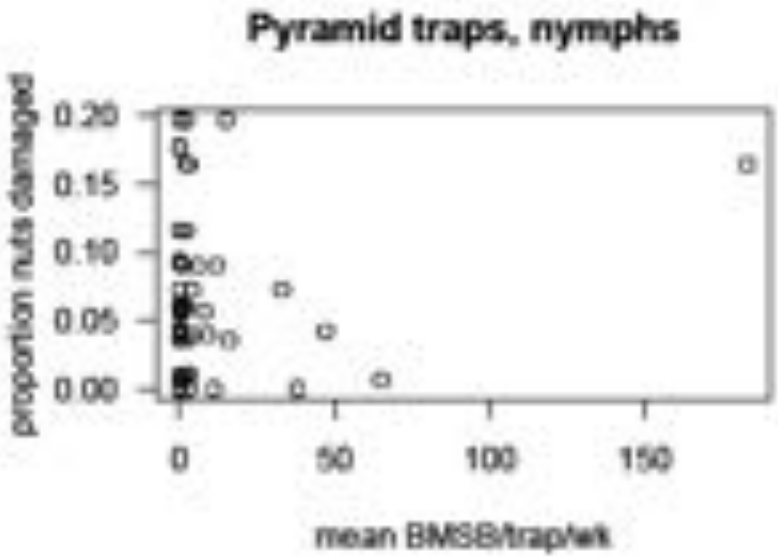


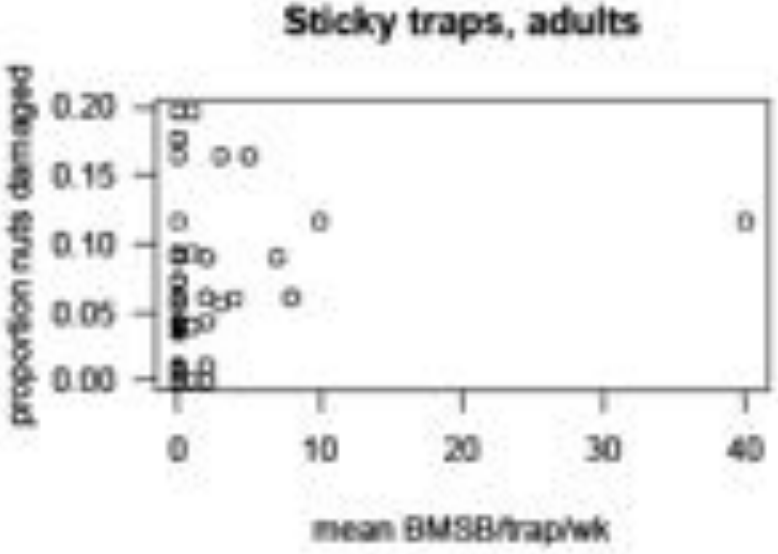


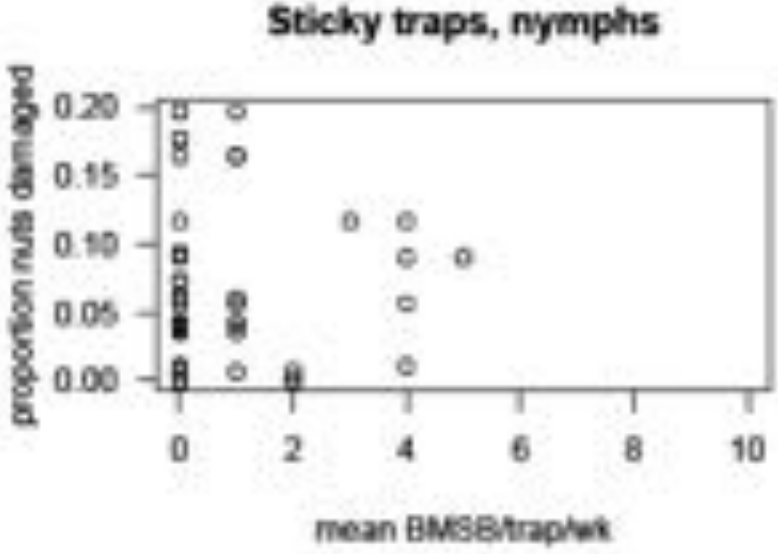


Captures vs damage: Hazelnut 2018



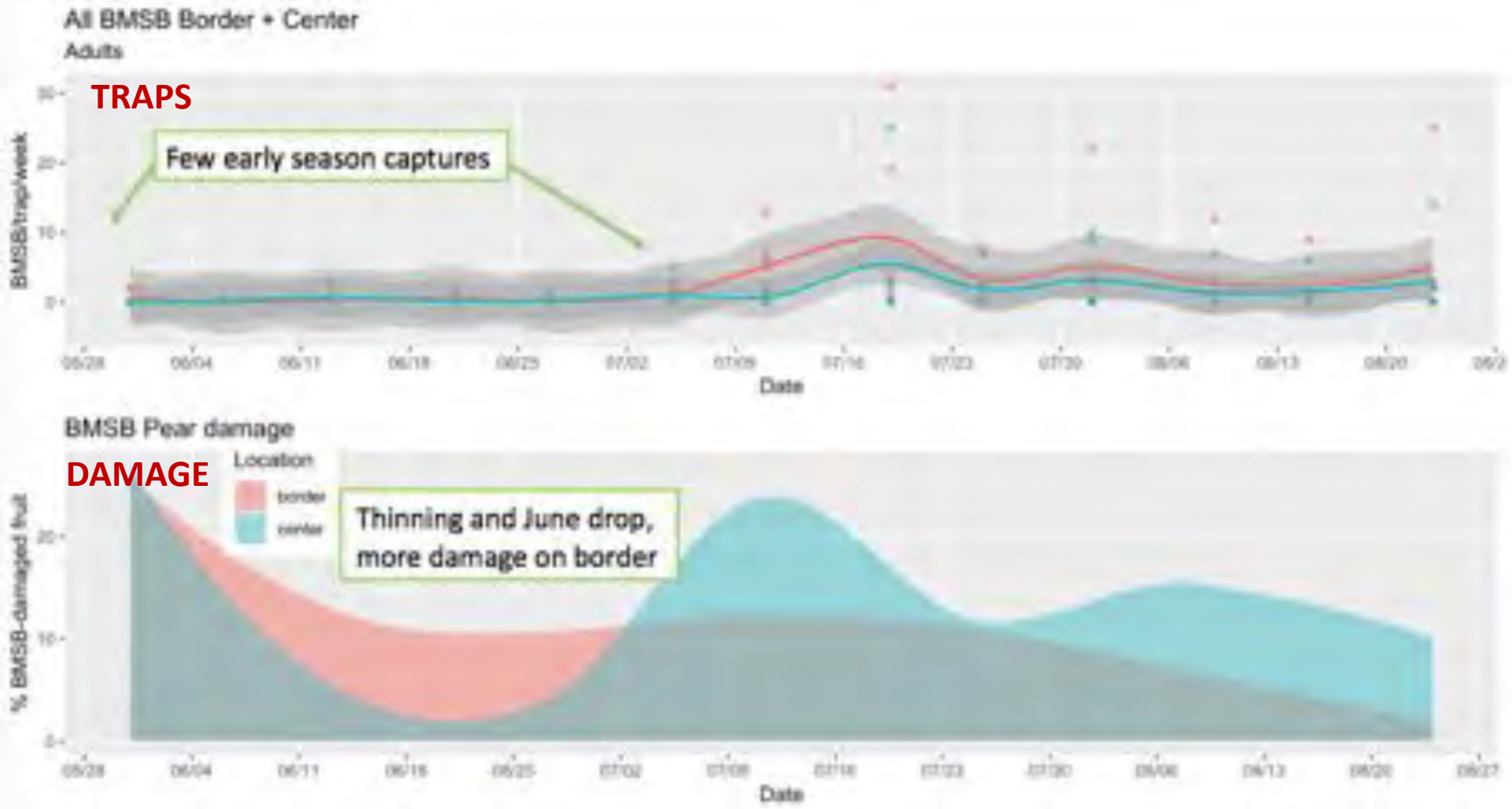




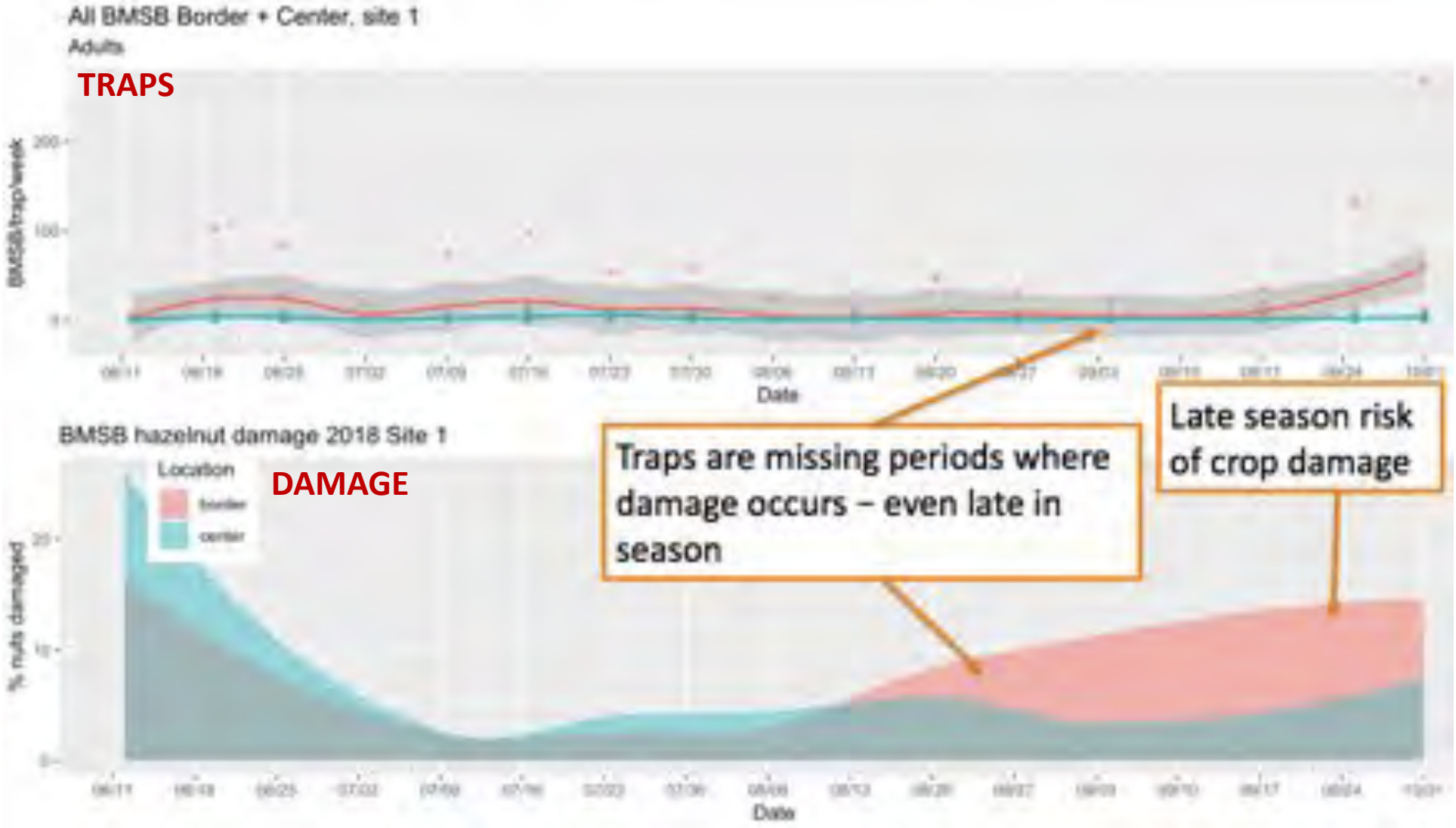


Cherry 2018: traps vs damage

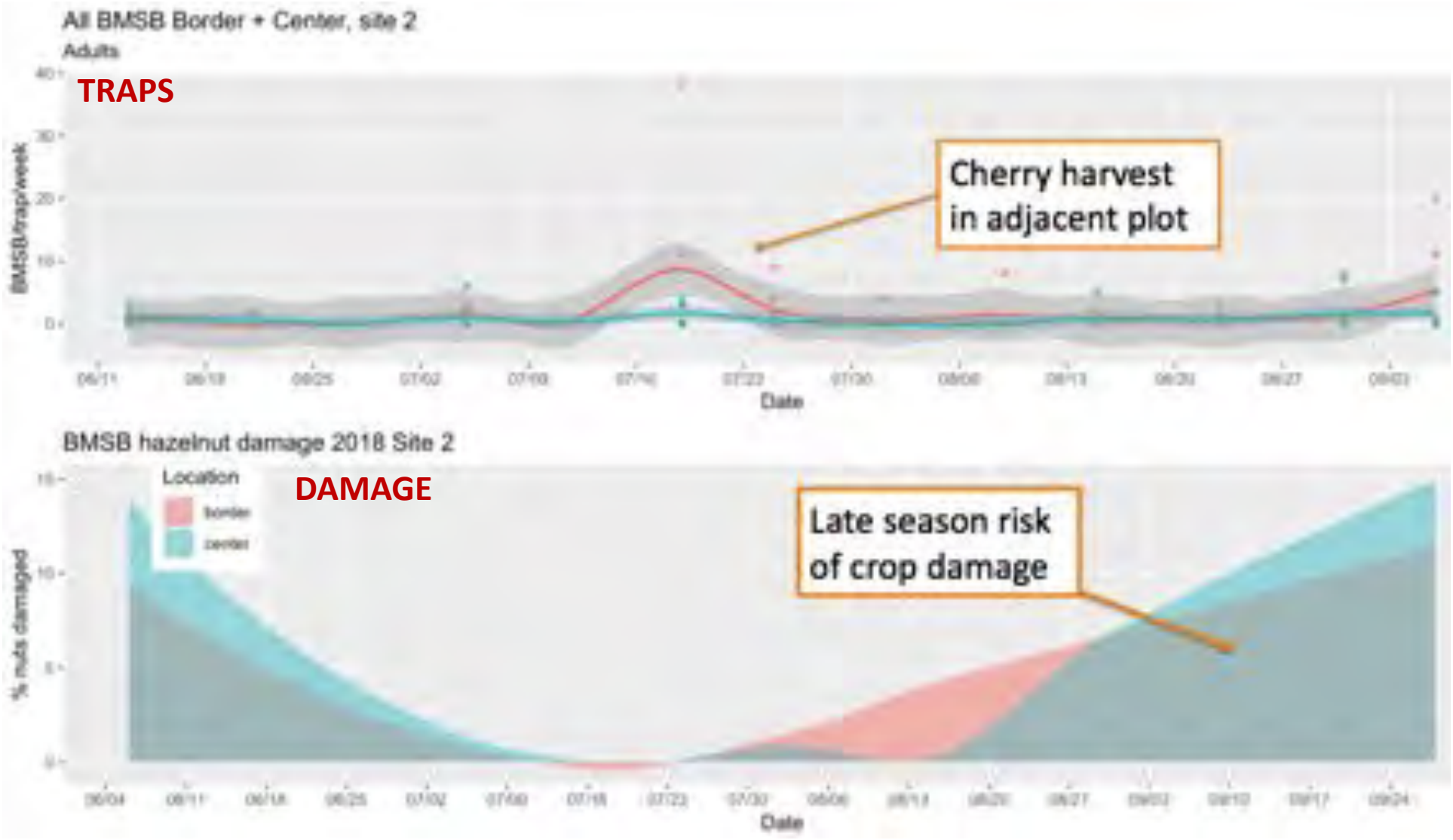
Pear: traps vs damage



Hazelnut, site 1: traps vs damage



Hazelnut, site 2: traps vs damage



Summary of results

- **Current standard trap technology is not sensitive enough for setting early orchard crop DAMAGE**
  - **Traps less useful in early crops such as cherry**
- **The BMSB being captured may not be the ones causing damage − poor correlation between damage and captures**
  - **Need to Improve early attraction**
- **Growers may be better off spraying based on presence/absence at this point**
- **Border management approach on a case-by-case basis**

Take home message - BMSB

- **If you place traps, put them on border away from crop**
- **Do not interpret trap captures as indicative of damage – (or lack thereof)**
- **Traps can give you presence/absence**
- **Scouting is better indicator of damage – observe feeding on nuts or fruit**
- **Watch late season buildup**

Using pheromone-baited sticky card trap catch to guide BMSB control decisions in peppers

Tom Kuhar, Hayley Bush, and Adam Alford

Department of Entomology, Virginia Tech

VIRGINIA TECH™

Using pheromone-baited sticky card trap catch to guide BMSB control decisions in peppers

VIRGINIA TECH

- 6 pepper fields (Latin Square randomized small plots)
- over 2 years in VA
- Sticky card baited with BMSB Dual Lure monitored weekly

Four Treatments

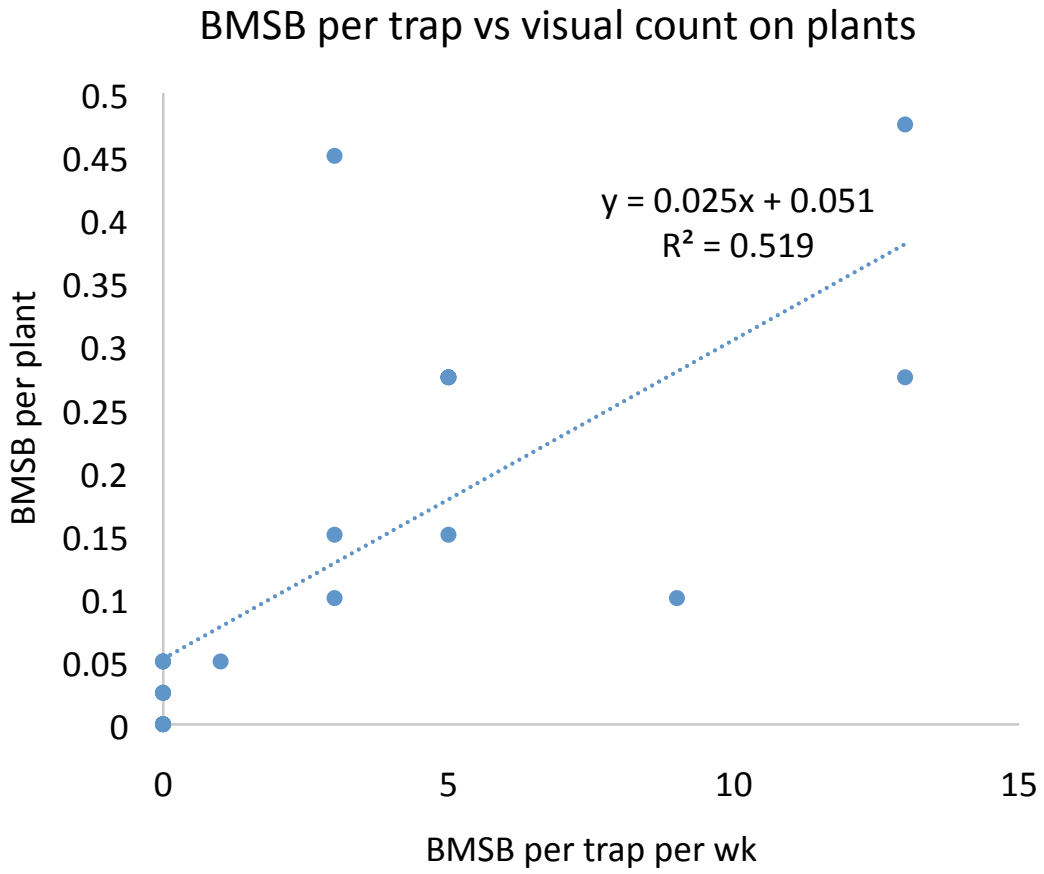
- Untreated control
- Thresh. 10 BMSB/trap/wk
- Thresh. 5 BMSB/trap/wk
- Weekly sprays of bifenthrin

- Assessed BMSB densities weekly
- Pepper damage at 2-3 harvests

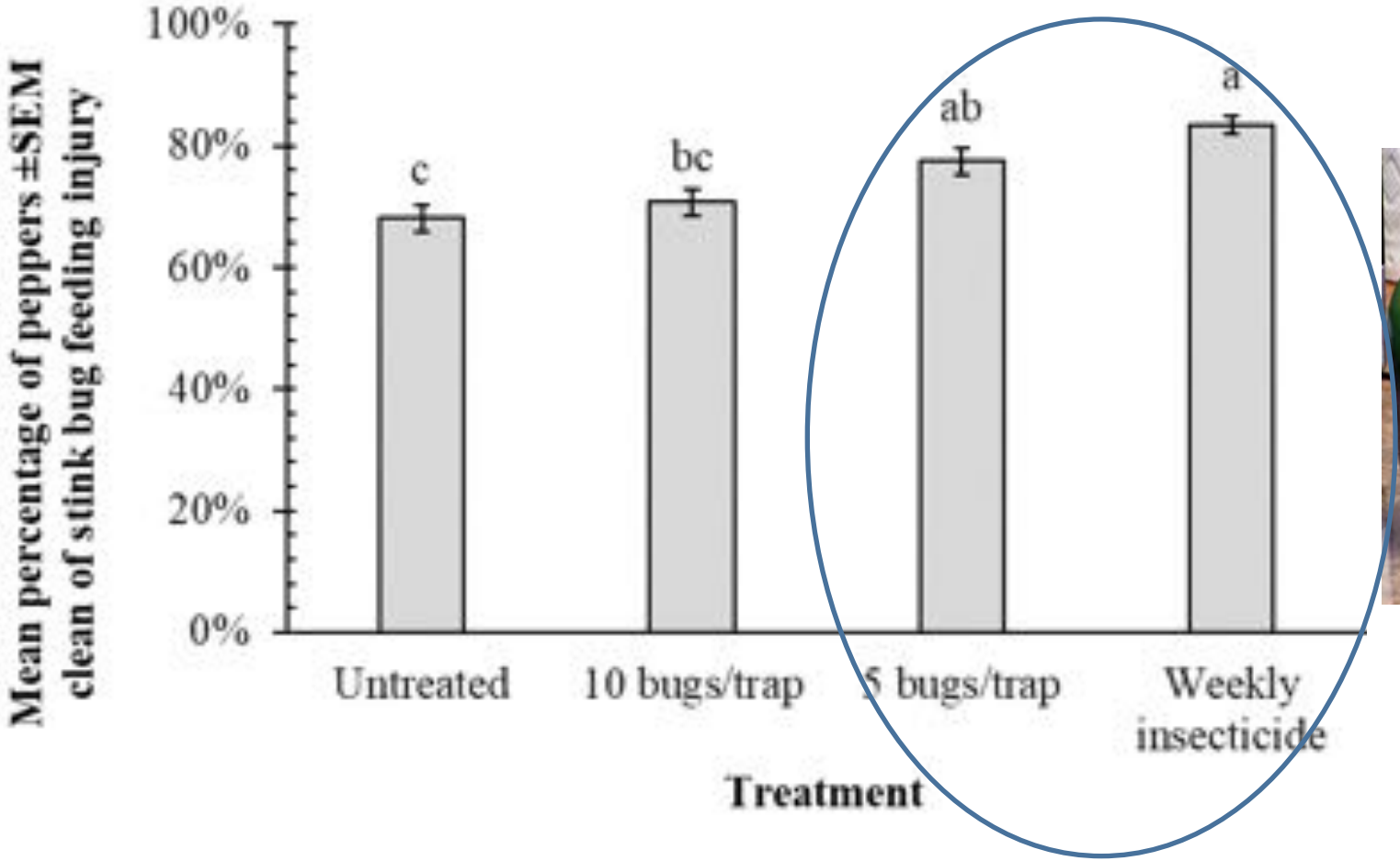
Using pheromone-baited sticky card trap catch to guide BMSB control decisions in peppers

VIRGINIA TECH

- **Based on 6 fields over 2 years, there was a significant relationship between BMSB trap catch and visual counts on pepper plants**



Percentage of harvested peppers clean of stink bug injury (data pooled from 6 fields)



Data were analyzed for significance among treatments using nonparametric Kruskal-Wallis ($\alpha = 0.05$) and means were separated using Steel-Dwass all pairs.

Using pheromone-baited sticky card trap catch to guide BMSB control decisions in peppers

VIRGINIA TECH

- **Following a trap catch threshold of 5 or 10 BMSB/trap significantly reduced the number of bifenthrin spray applications compared with standard weekly sprays.**

# of insecticide applications per crop

Treatment	Garrett Farms 2017	Kentland A 2017	Kentland B 2017	Garrett Farms 2018	Kentland A 2018	Homefield Farm 2018	Average
Untreated control	0	0	0	0	0	0	0
Thresh. 10 BMSB/trap/ wk	2	0	0	0	0	1	0.5
Thresh. 5 BMSB/trap/ wk	4	1	1	0	1	4	1.8
Weekly sprays	8	8	8	6	8	9	7.8

Stink bug injury in sequential sweet corn plantings

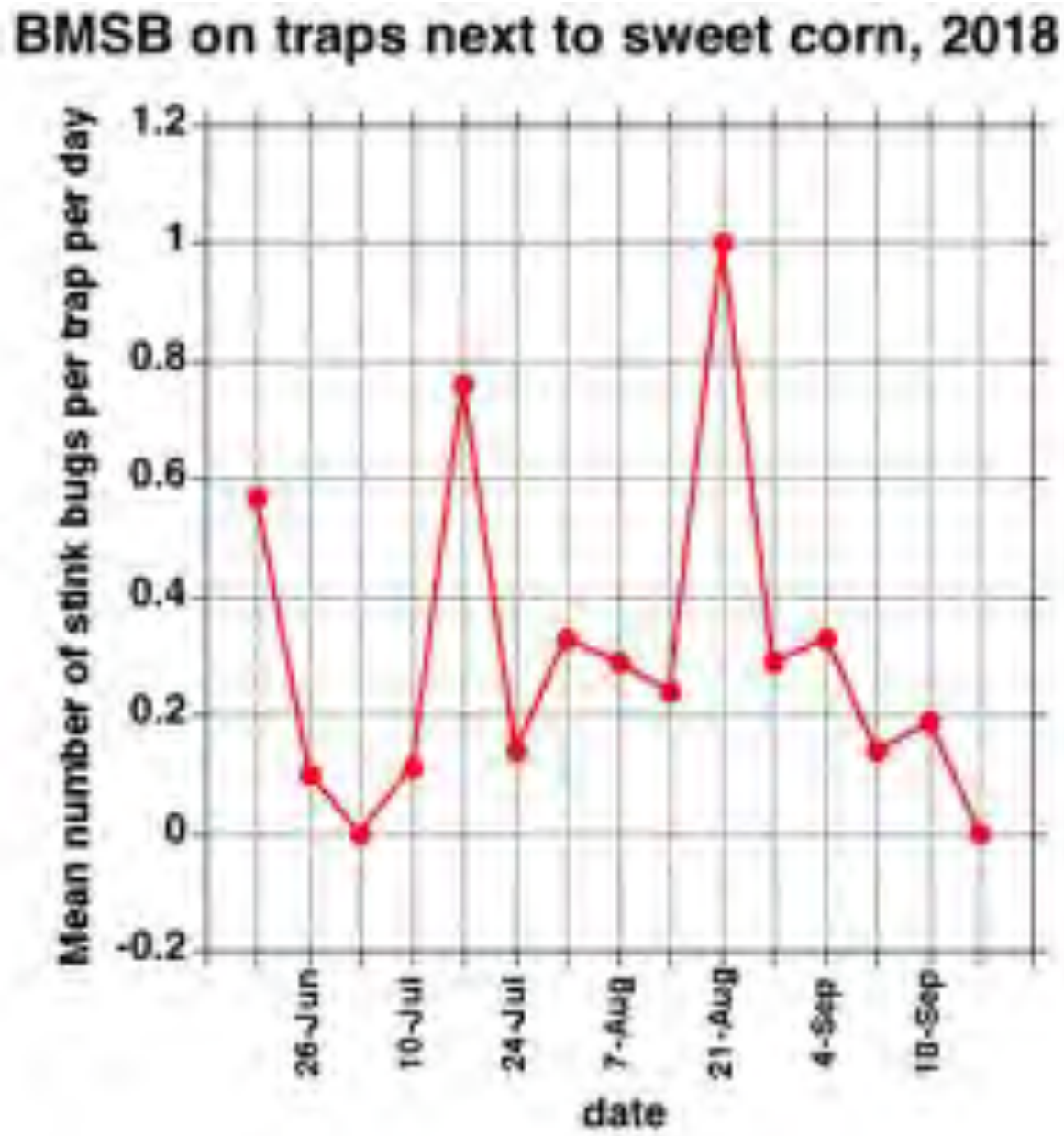
Sweet corn field trial, 2018

- 5 sequential planting dates
- 3 blocked replicates
- 8 rows per planting per block
- 1 sticky trap next to each block
- No insecticides sprayed
- Scout plants for stink bugs weekly
- Measure injury to kernels at harvest

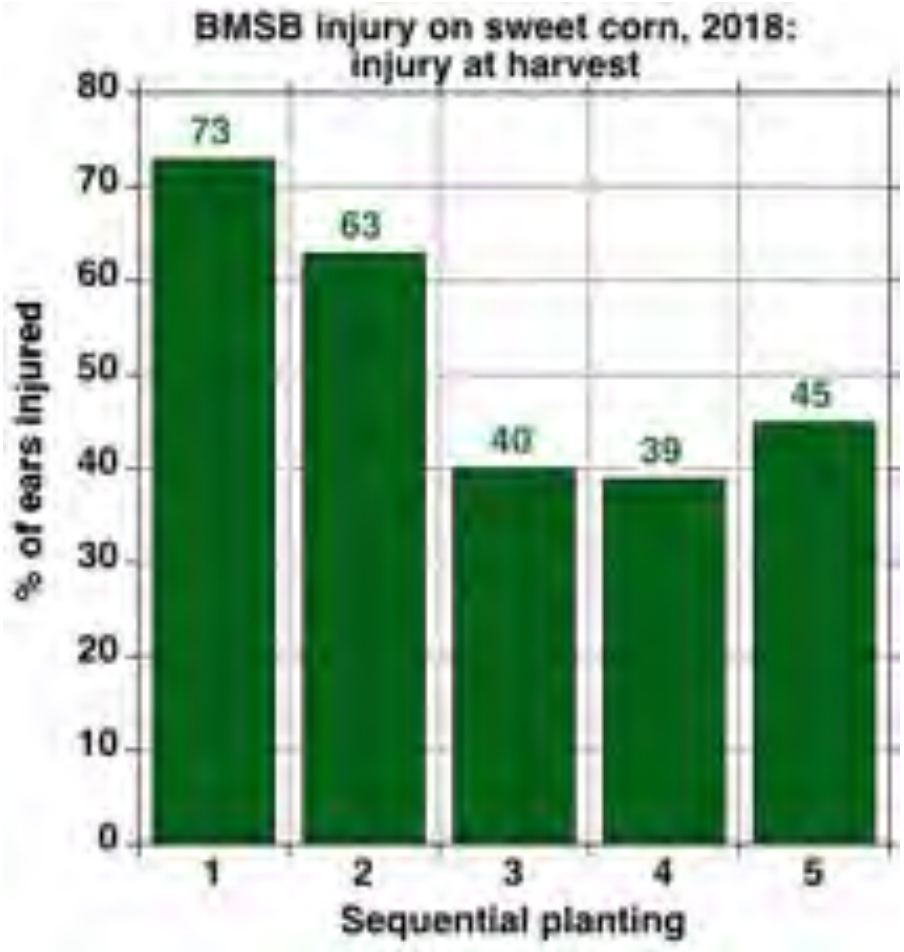
Results

- Data analysis underway
- Detection of bugs by scouting
  - Few before silking stage
  - Strong spillover effect near trap
    - Mostly 5 plants on each side of trap
    - Mostly in edge row
- Detection of damage at harvest
  - Injury in all 5 sequential plantings
  - Injury in all 8 rows
  - More injury in outer 2 rows

Results


BMSB on traps next to sweet corn, 2018
Mean number of stink bugs per trap per day
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
26-Jun
10-Jul
24-Jul
7-Aug
21-Aug
4-Sep
18-Sep
date

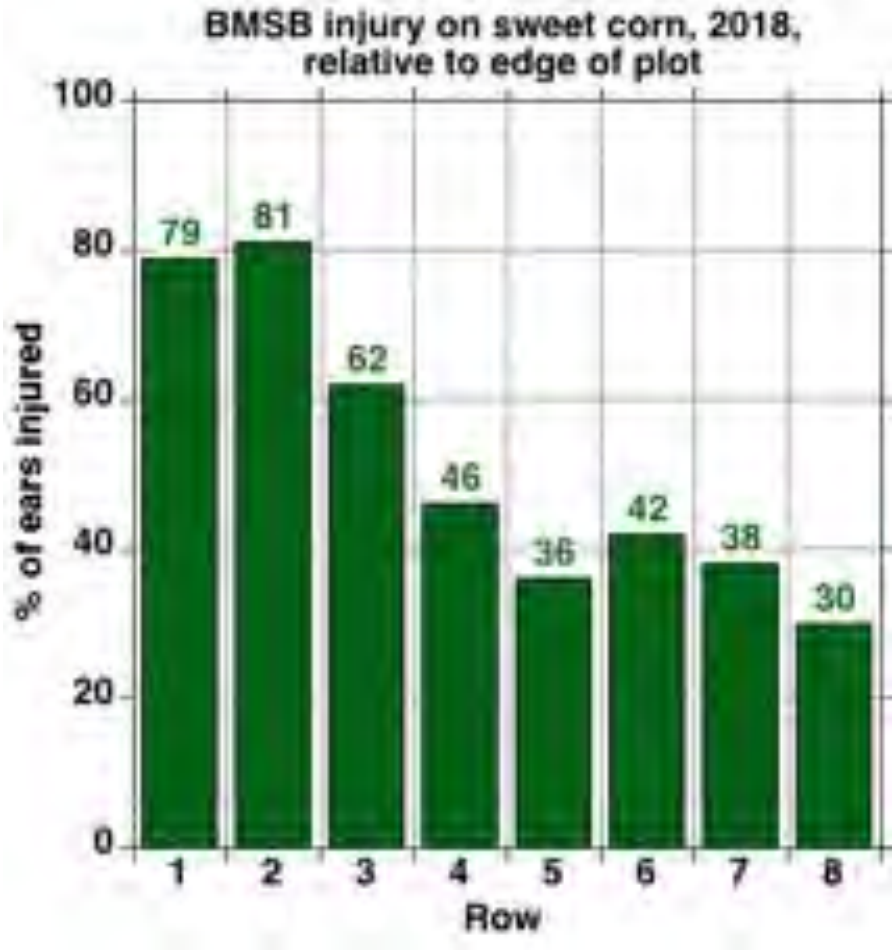
Results

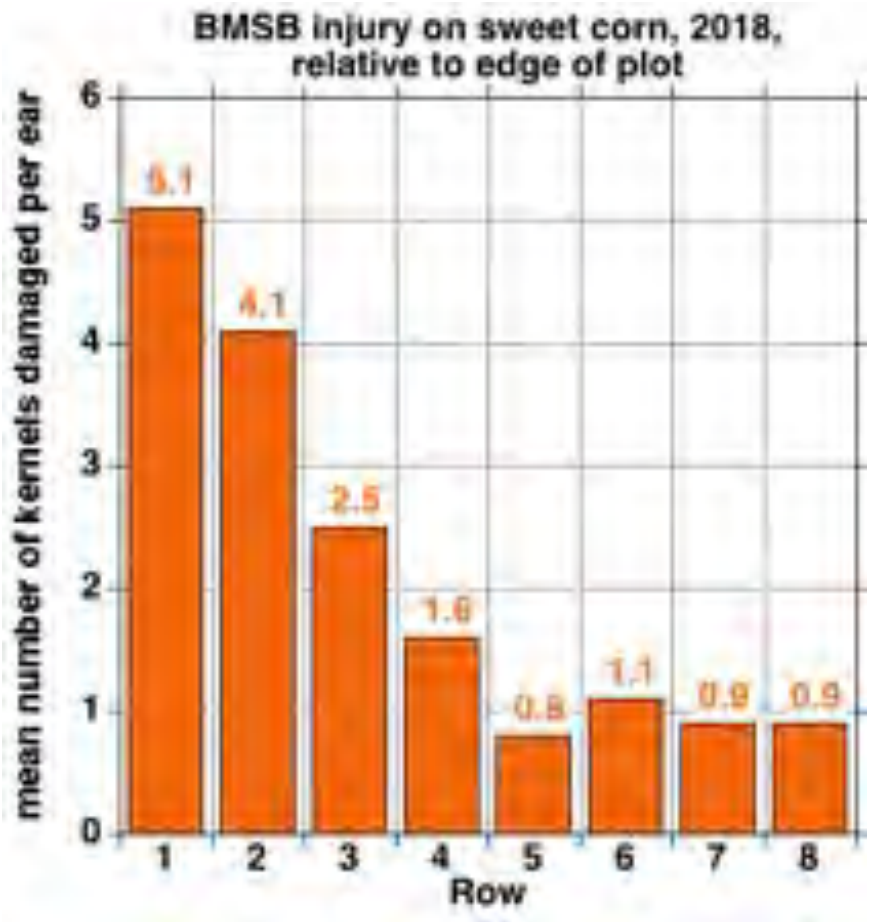


Extra early | Early | Main | Late | Extra late

Results

Edge effect: Mean of all 5 plantings combined





Plan for sweet corn, 2019

- **Trial #1: similar trial but compare plots with adjacent trap & plots without trap**
- **Trial #2: single planting date, with 4 insecticide timing options, vs no spray**
  - **Use traps as presence/absence**
  - **Timing dependent on crop growth stage**