

Pheromone-Based IPM Tactics for Managing the Brown Marmorated Stink Bug

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Many Mid-Atlantic
Growers Experienced
Catastrophic Damage
Levels of

>50%

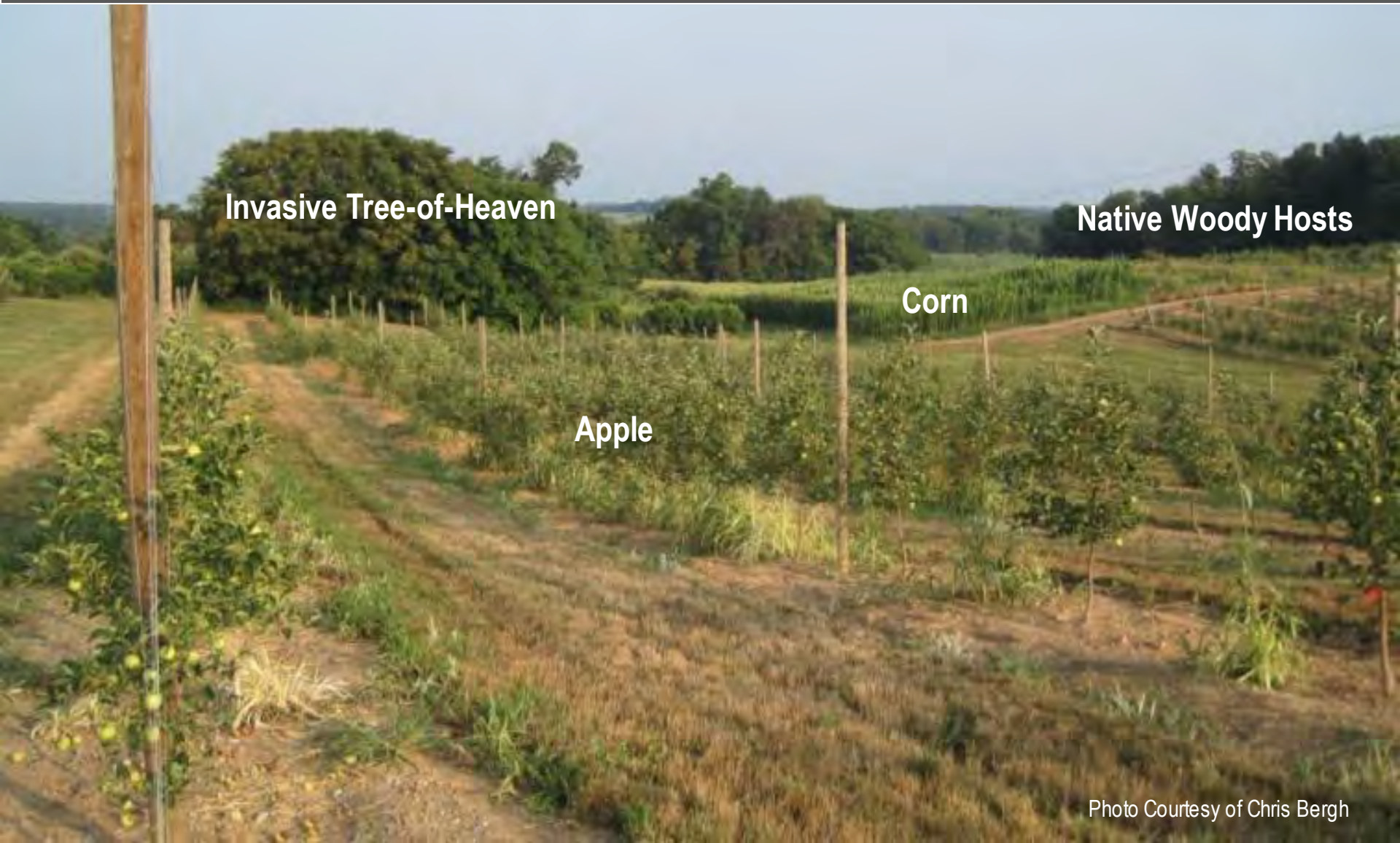
in Stone Fruit Crops in
2010

\$37 Million

In Losses For
Mid-Atlantic Apple
Growers in 2010



Landscape-Level Threat To Crops



Invasive Tree-of-Heaven

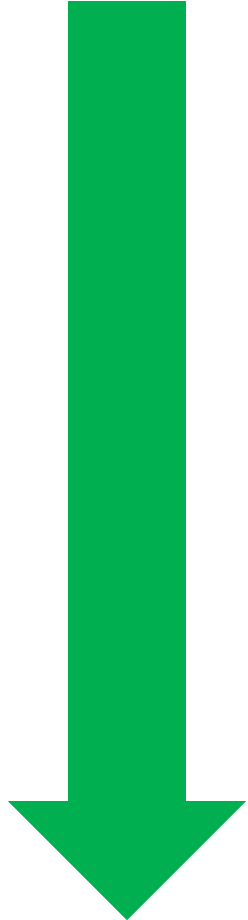
Native Woody Hosts

Corn

Apple

Key Questions



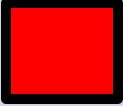

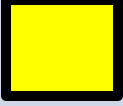
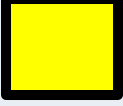
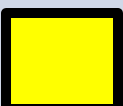
Short -Term



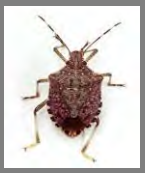
Long -Term

- What insecticides can we use to manage BMSB?
- What are some of the biological and behavioral characteristics that contribute to its pest status?
- How can we monitor BMSB and make pest management decisions?
- What other IPM tactics can we use?
- How can we integrate biological control?

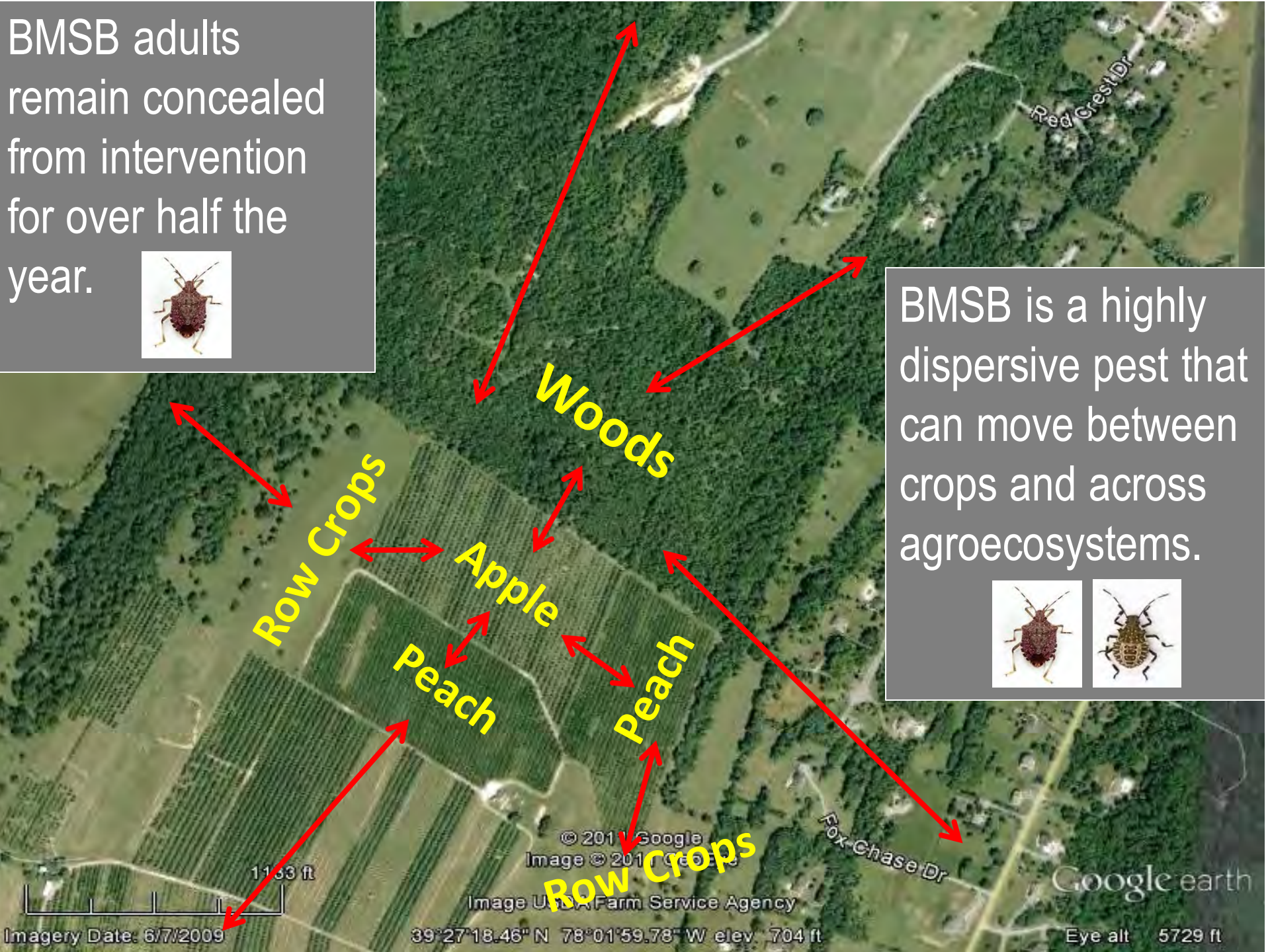
Insecticides Used Against BMSB in Tree Fruit

Insecticide	Lethality	Residual Activity (3d)	Beneficials
Methomyl (Lannate)	HIGH	LOW - MODERATE	
Bifenthrin (Brigade)	HIGH	LOW	
Fenpropathrin (Danitol)	HIGH	LOW	
Lambda-Cyhalothrin (Warrior)	MODERATE	LOW	
Clothianidin (Belay)	MODERATE	MODERATE	
Dinotefuran (Scorpion, Venom)	HIGH	LOW	
Thiamethoxam (Actara)	MODERATE	LOW - MODERATE	

BMSB adults remain concealed from intervention for over half the year.

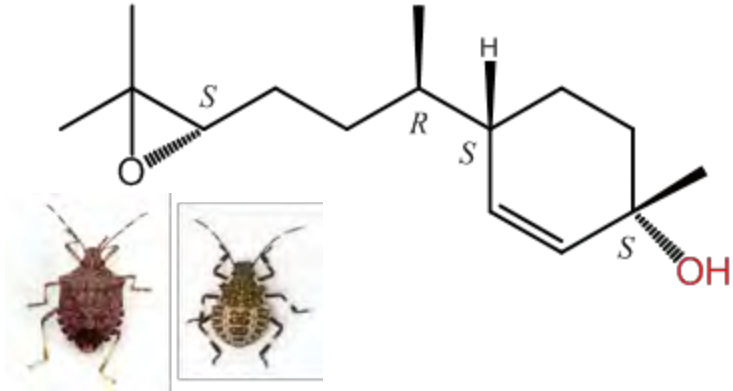


BMSB is a highly dispersive pest that can move between crops and across agroecosystems.

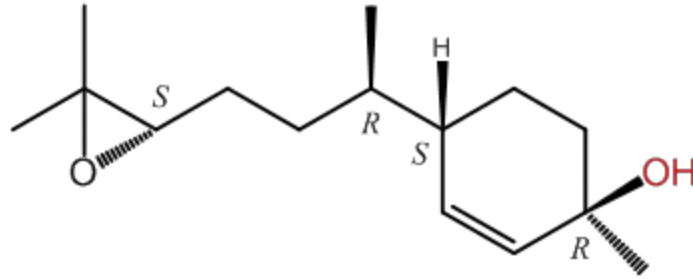


Two-Component BMSB Aggregation Pheromone and Synergist

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

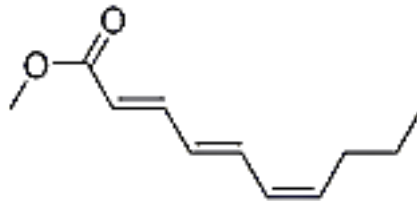


Minor component of BMSB aggregation pheromone
(3*R*,6*S*,7*R*,10*S*)-10,11-epoxy-1-bisabolen-3-ol



+

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



=

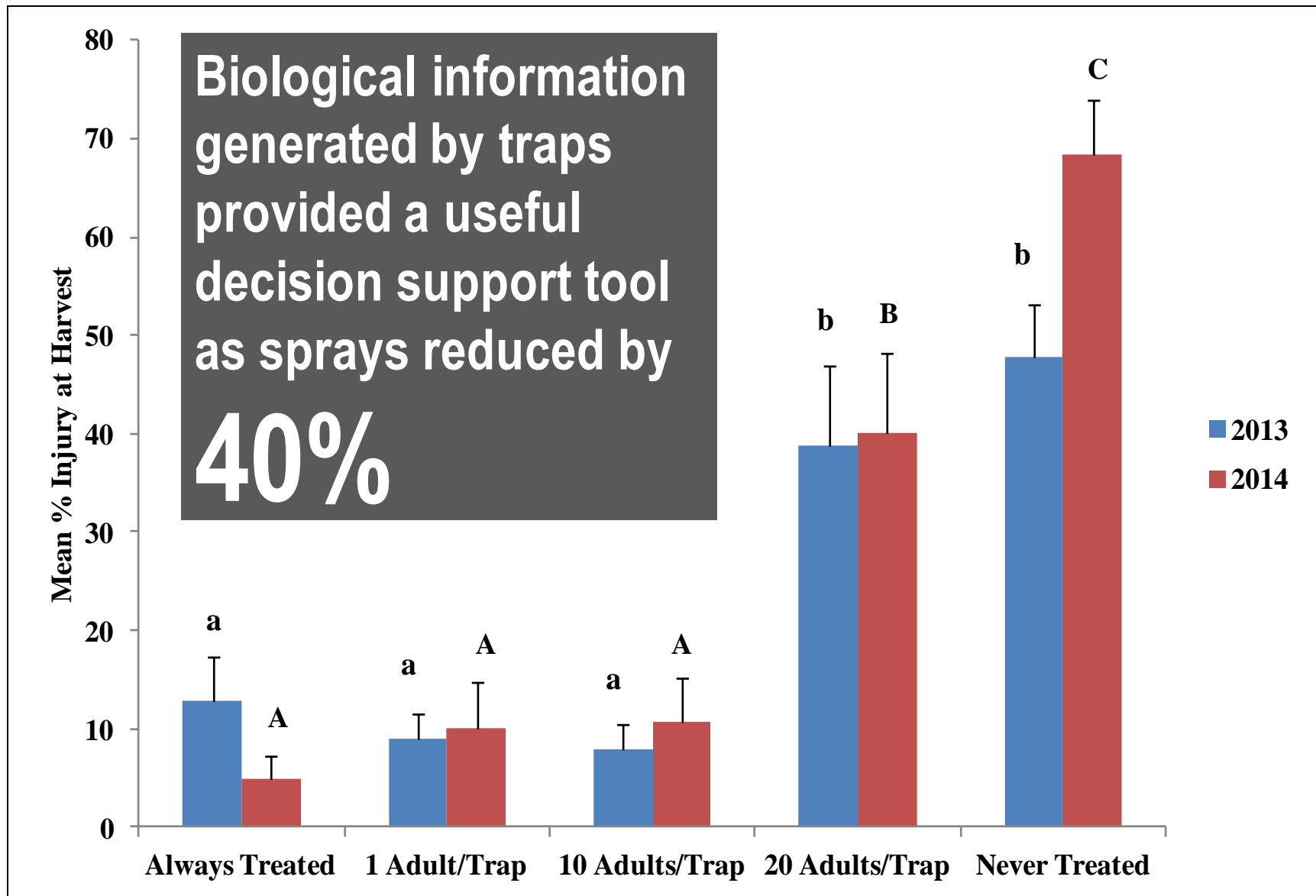
Synergism

Standard Monitoring Traps



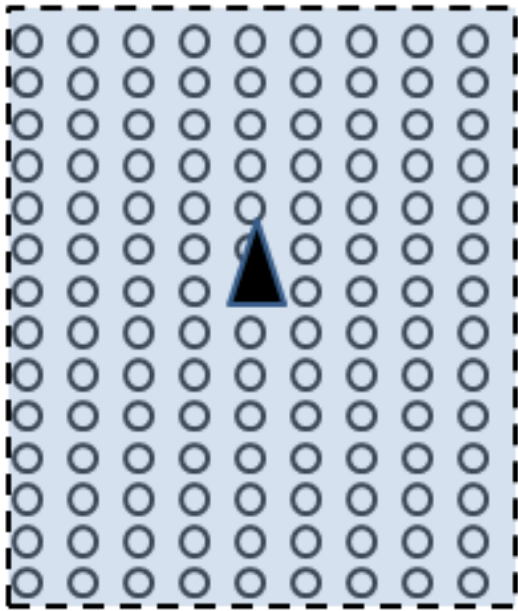
- **Visual Stimulus**
 - Large black pyramid (trunk-mimicking stimulus)
- **Olfactory Stimulus**
 - PHER + MDT
- **Capture Mechanism**
 - Tapered pyramid attached to inverted funnel jar with DDVP strip
- **Deployment Strategy**
 - Traps placed in peripheral row or border area

Traps Can Be Used as Decision Support Tools



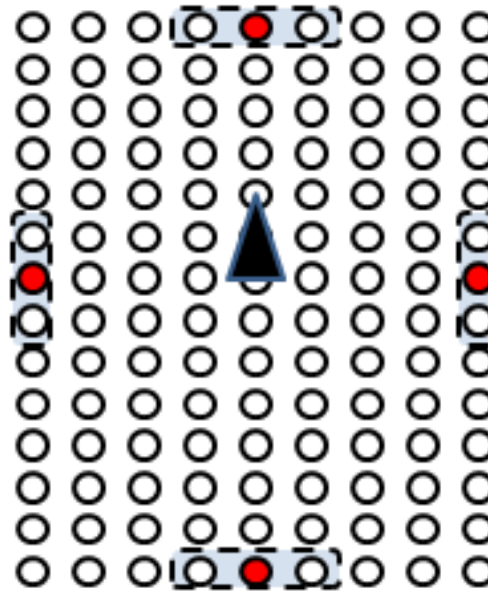
Pheromone-Based IPM Tools

Trap-Based Treatment Block



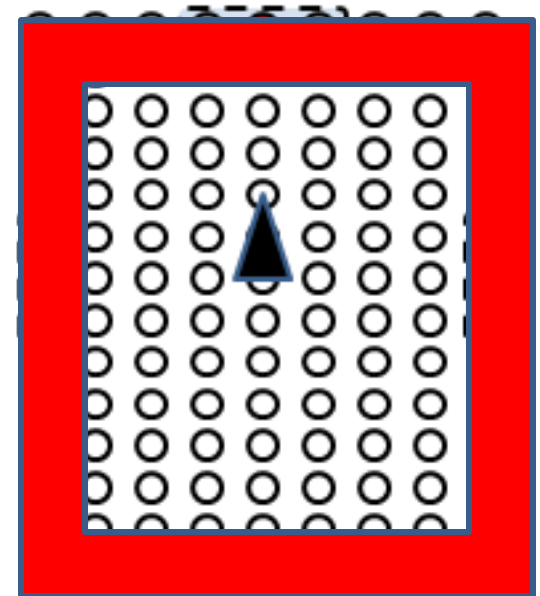
Treat entire block when threshold hit either as two ARMs sprays one week apart.

Attract-and-Kill Block



Treat only baited border row trees spaced 50 m apart with an insecticide at 7-d intervals.

Border Row Spray Block

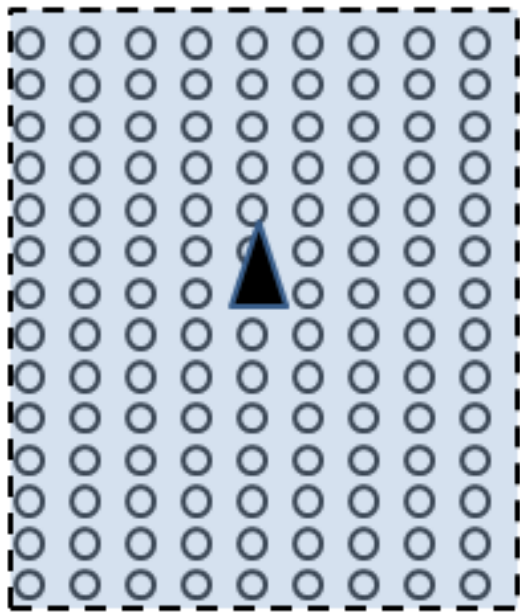


Treat only the perimeter of orchard at 7-d intervals.

Development of Pheromone-Based IPM Tactics

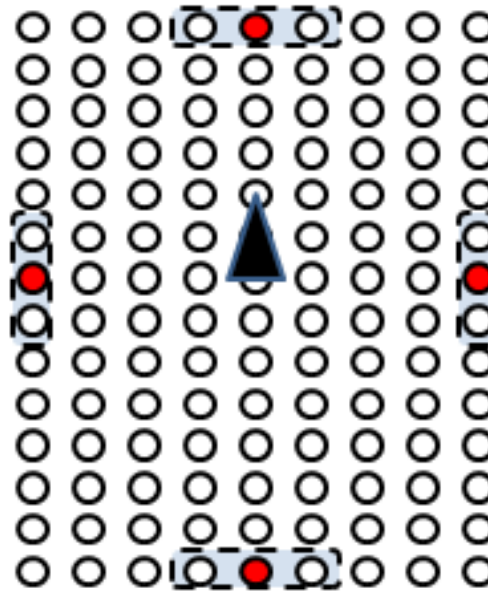
How Can We Reduce Time and Labor?

Trap-Based Treatment Block



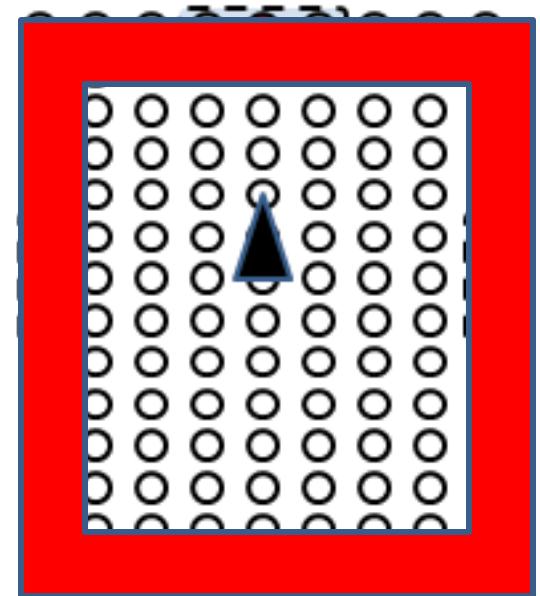
Treat entire block when threshold hit either as two ARMs sprays one week apart.

Attract-and-Kill Block



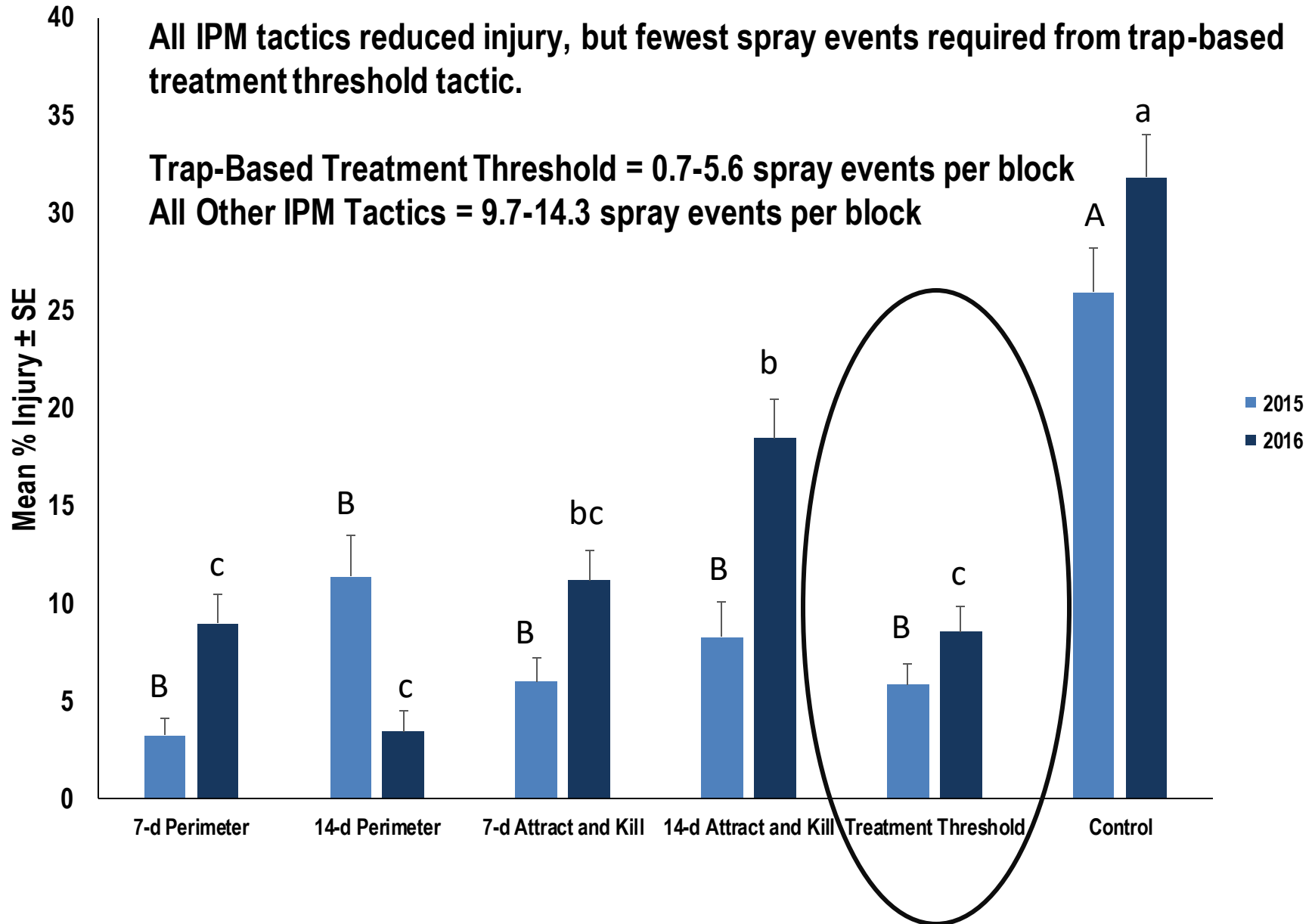
Treat only baited border row trees spaced 50 m apart with an insecticide at 7- or 14-d intervals.

Border Row Spray Block



Treat only the perimeter of orchard at 7- and 14-d intervals.

Results of IPM Tactics Comparison





Developing Thresholds For Clear Sticky Panels and Commercial Lures

Sticky Panel Threshold Results

2017

Treatment	No. Sprays	% Fruit Injury
1 Adult/Trap	7.00 a	2.80 a
10 Adults/Trap	2.67 b	4.50 a
20 Adults/Trap	1.17 c	3.50 a
Unsprayed Control	0.00 d	15.80 b

2018

Treatment	No. Sprays	% Fruit Injury
1 Adult/Trap	5.83 a	2.67 a
10 Adults/Trap	1.33 b	7.68 b
20 Adults/Trap	0.67 b	8.83 b
Unsprayed Control	0.00 b	7.50 b

2019

Treatment	No. Sprays	% Fruit Injury
1 Adult/Trap	4.85 ab	2.67 ab
4 Adults/Trap	2.15 bc	4.33 b
4 Nymphs/Trap	0.67 c	7.76 b
Unsprayed Control	0.00 d	5.67 b
Always Sprayed	8.33 a	0.66 a

4 Adults / Trap

- Reduced Sprays by 72% compared with Always Sprayed
- Reduced Sprays by 52% compared with 1 Adult/Trap
- Injury at 4.33%

NC State Commercial Orchard Results

Number of insecticide applications and percent BMSB damage to apples treated with insecticides based on a trap threshold (cumulative of 4 bugs/trap) versus grower standard.

Orchard	Variety	\bar{X} Total BMSB capture	# Insecticide Applications*		% Damage	
			Thres.	Grower	Thres.	Grower
Fruitland 1	Gala	39.7	5	3	0	0
Fruitland 2	Gala	46.3	3	3	0	0
Fruitland 3	Golden	46.0	5	4	1.8	3.3
Edneyville 1	Rome	29.3	3	2	1.5	2.3
Dana 1	Rome	36.0	4	2	0	0
Mean	—	38.9	4.0	2.8	0.7	1.1

*All orchards were sprayed with Voliam Flexi at petal fall, which is not included in the total applications.

**Provisional Threshold for Baited Panel Trap in Apple Orchards
~4 Adults/Trap (cumulative) Is Workable But Further Refinement Warranted**



Improving Attract and Kill for BMSB



What if we could eliminate sprays for attract and kill?



D-TERRENCE

**LONG-LASTING
INSECTICIDAL
SCREEN**

Attract and Kill Trials in Commercial Orchards

Baited LLINS Outside Orchard

**decouples attractive stimuli
(host plant and pheromone
combined) from killing agent*



Baited LLINS on Border Trees

**best behaviorally*



Standard Grower Program



Baited LLINS Next To Border Trees

**compromise between
behavior and regulatory
issues*



Attract and Kill Results Support Coupling Attractive Olfactory Stimuli (Host Plant and Pheromone) With Killing Agent (LLIN)

Year	2017	2018	2019*
Baited LLINS on Trees	2.0 a	4.3 a	9.2
Grower Standard	13.0 b	3.5 a	7.0
Baited LLINS Outside Orchard	--	12.5 b	12.7
Baited LLINS Next To Border Row Trees	--	--	6.5

**Significant at 0.0527*



Baited LLINS
Next To
Border Trees
Looks Promising



Next Steps

- Remain vigilant.
- Refine thresholds for apple. Try a similar approach for peach.
- Continue with LLIN-based attract and kill and verify that the “next to” approach works well.
- Integrate biological control.

Acknowledgements



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