# Attract-and-Kill for Brown Marmorated Stink Bug: Results from 2015

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1. Consequences of whole-block intervention against BMSB
2. Data suggesting that BMSB is a perimeter-driven pest
3. Data supporting the potential utility of A&K as a BMSB management tactic at the orchard perimeter
4. A&K project results: Year 1
5. Brief survey of your perceptions about A&K

# Consequences of BMSB management on orchard ecology

Increased reliance on some products not typically used as much in post-bloom programs

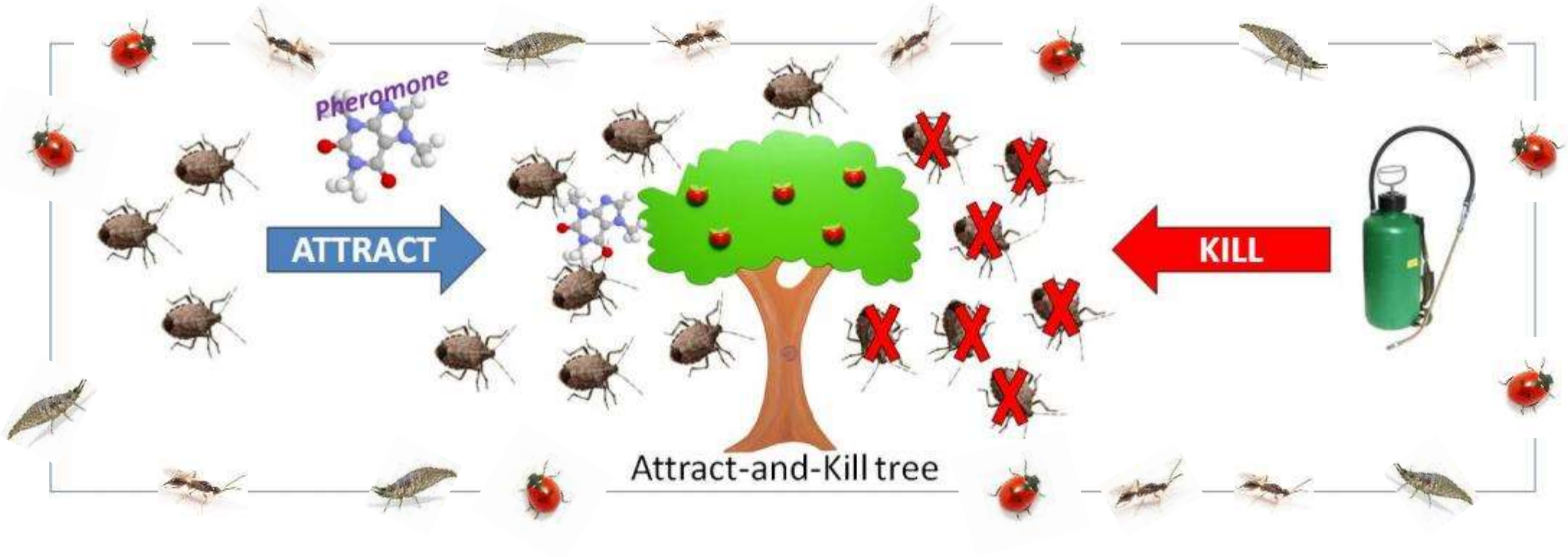
| Insecticide | Efficacy | Residual Activity (3d) | Effects on biocontrol |
|---|---|---|---|
| Lannate | HIGH | LOW - MODERATE | |
| Bifenture, Brigade* | HIGH | LOW | |
| Danitol | HIGH | LOW | |
| Warrior | MODERATE | LOW | |
| Baythroid | MODERATE | LOW | |
| Belay | MODERATE | MODERATE | |
| Scorpion, Venom* | HIGH | LOW | |
| Actara | MODERATE | LOW - MODERATE | |

* Pending Section 18 approvals for 2016

Increased frequency of insecticide sprays

Increased incidences of secondary pest outbreaks via disrupting biocontrol

# Can we reduce orchard insecticide inputs AND manage BMSB effectively AND conserve natural enemies?



# Key factors underlying BMSB pest status in orchards

## Biological/ecological

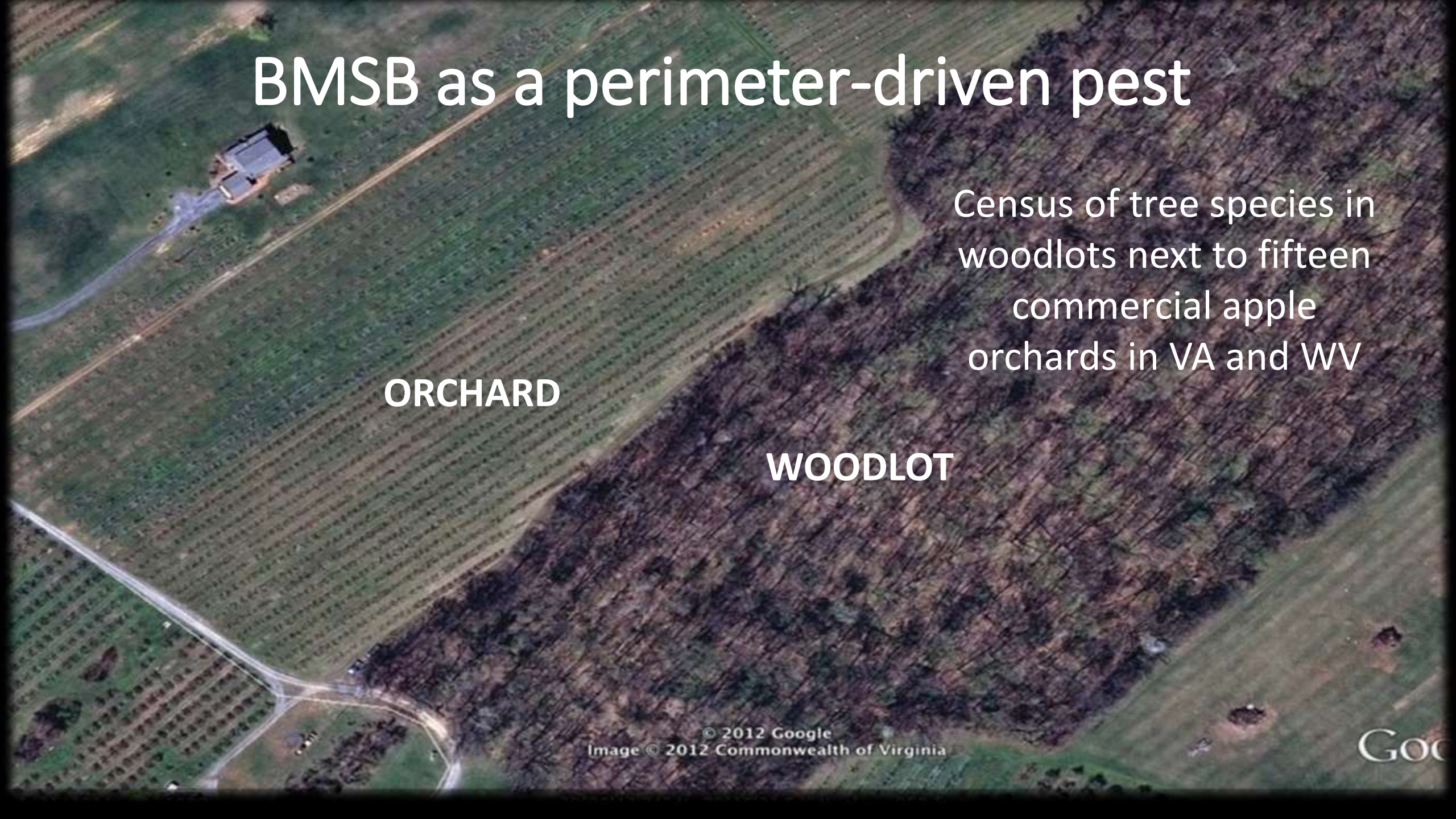
- Landscape scale pest
- Not adequately suppressed by NE's
- Potential for large populations
- Feeds on many plants
- Wild hosts adjacent to orchards are a reservoir
- Present during most/all of the fruiting period of orchard crops

## Behavioral

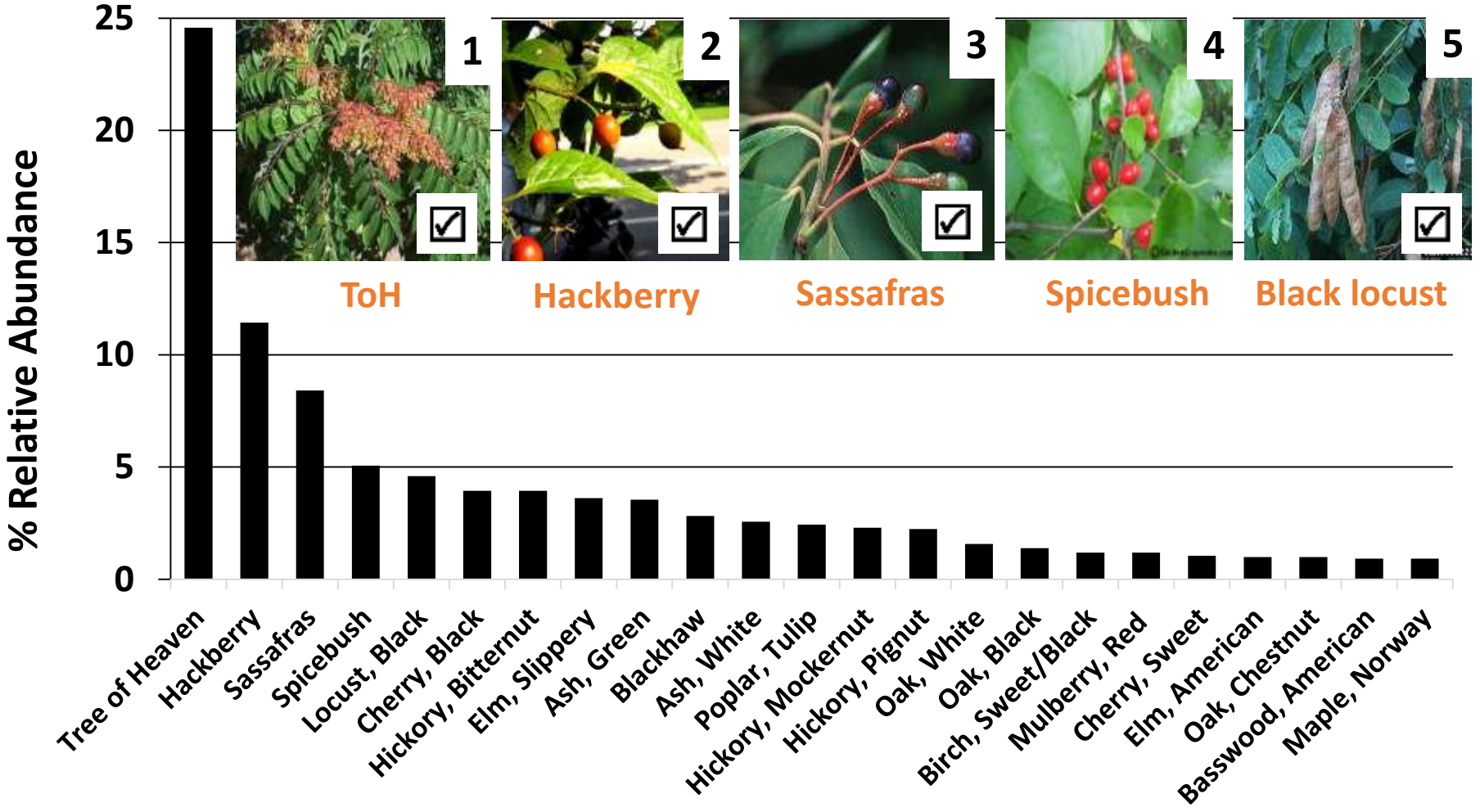
- Does not reside permanently in any crop
- Highly mobile adults & nymphs
- Potential for orchard invasion season-long
- Nymphs & adults can injure fruit

# BMSB as a perimeter-driven pest

Census of tree species in woodlots next to fifteen commercial apple orchards in VA and WV



# Woods edge

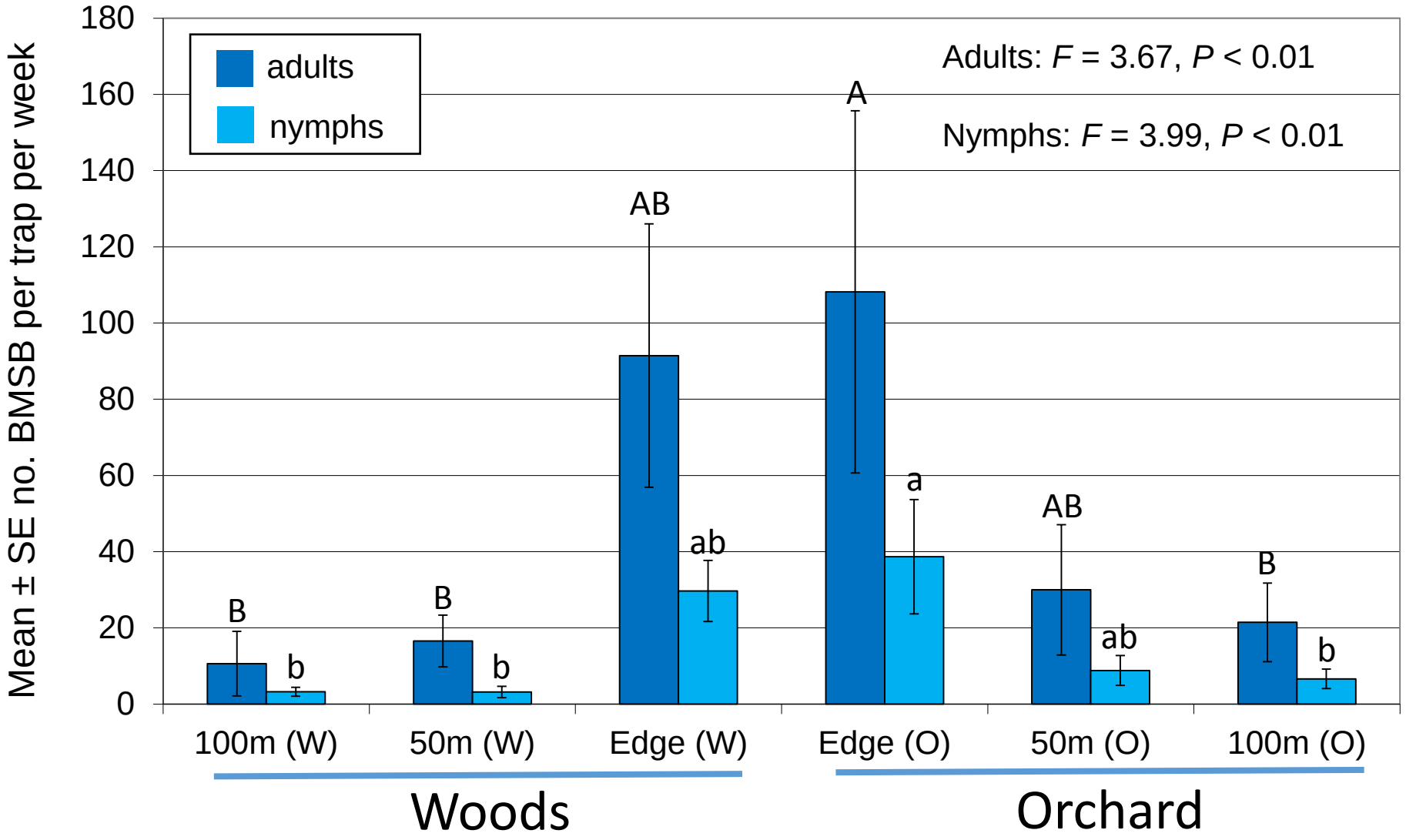



Of these 23 tree species found at the woods edge next to orchards, 21 are considered hosts of BMSB

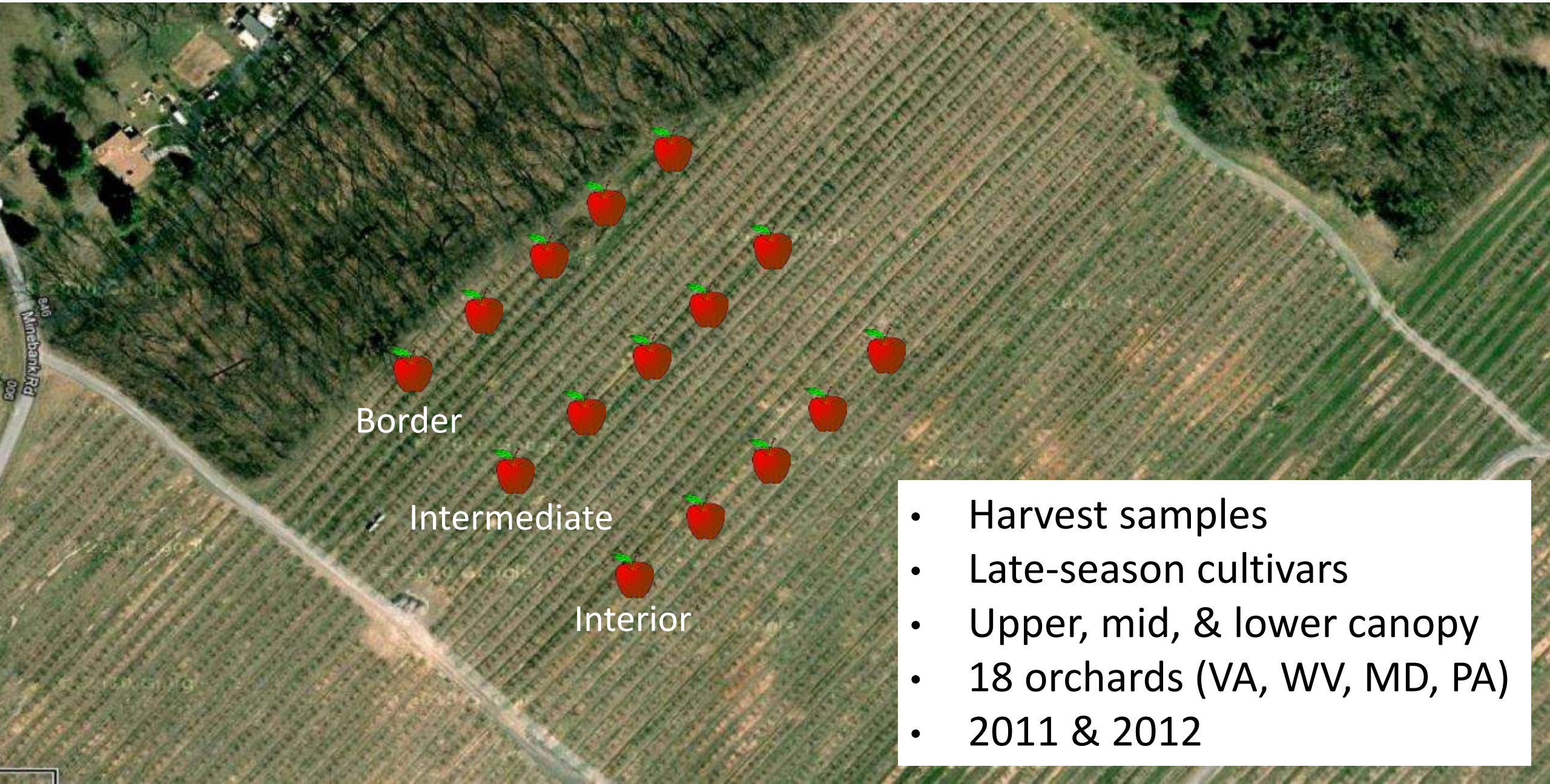
# Pheromone trap transect: 2014


- 5 processing apple blocks
- minimally sprayed for BMSB
- mid-April to mid-October

# Mean weekly captures

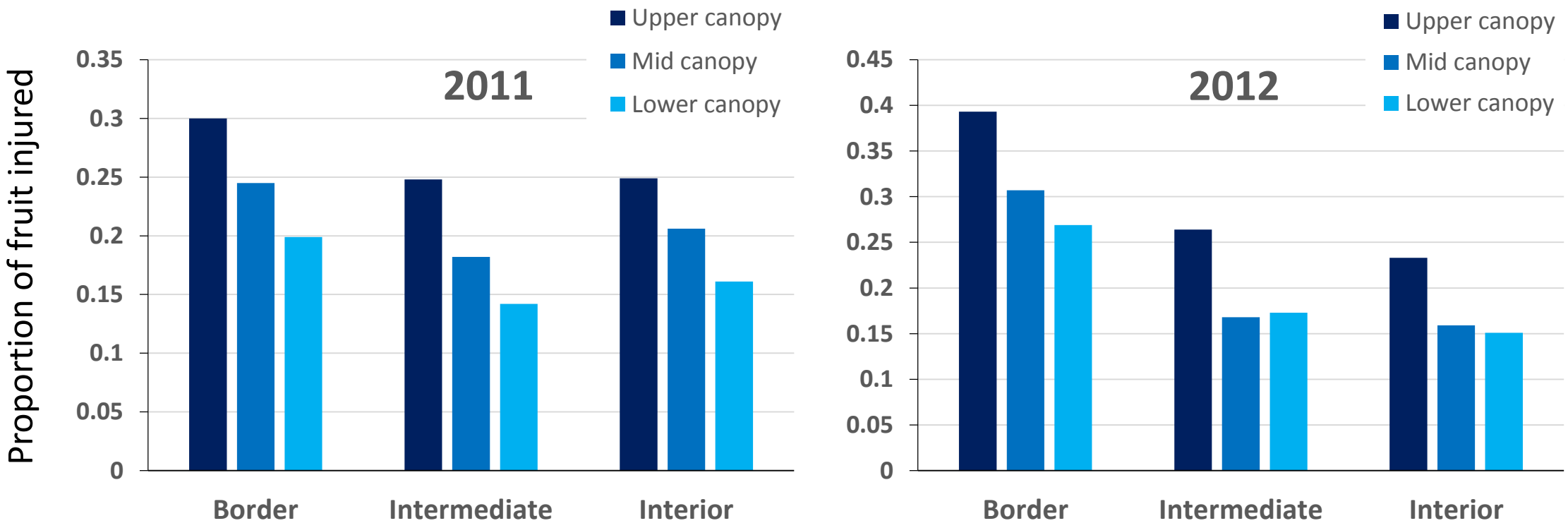


# Distribution of BMSB injury to apples at harvest




- Harvest samples
- Late-season cultivars
- Upper, mid, & lower canopy
- 18 orchards (VA, WV, MD, PA)
- 2011 & 2012

# Distribution of apples with external injury at harvest




Joseph et al. 2014. JEE 107

# Development of attract-and-kill as an alternative strategy: Baseline information & questions

**Baseline information:**

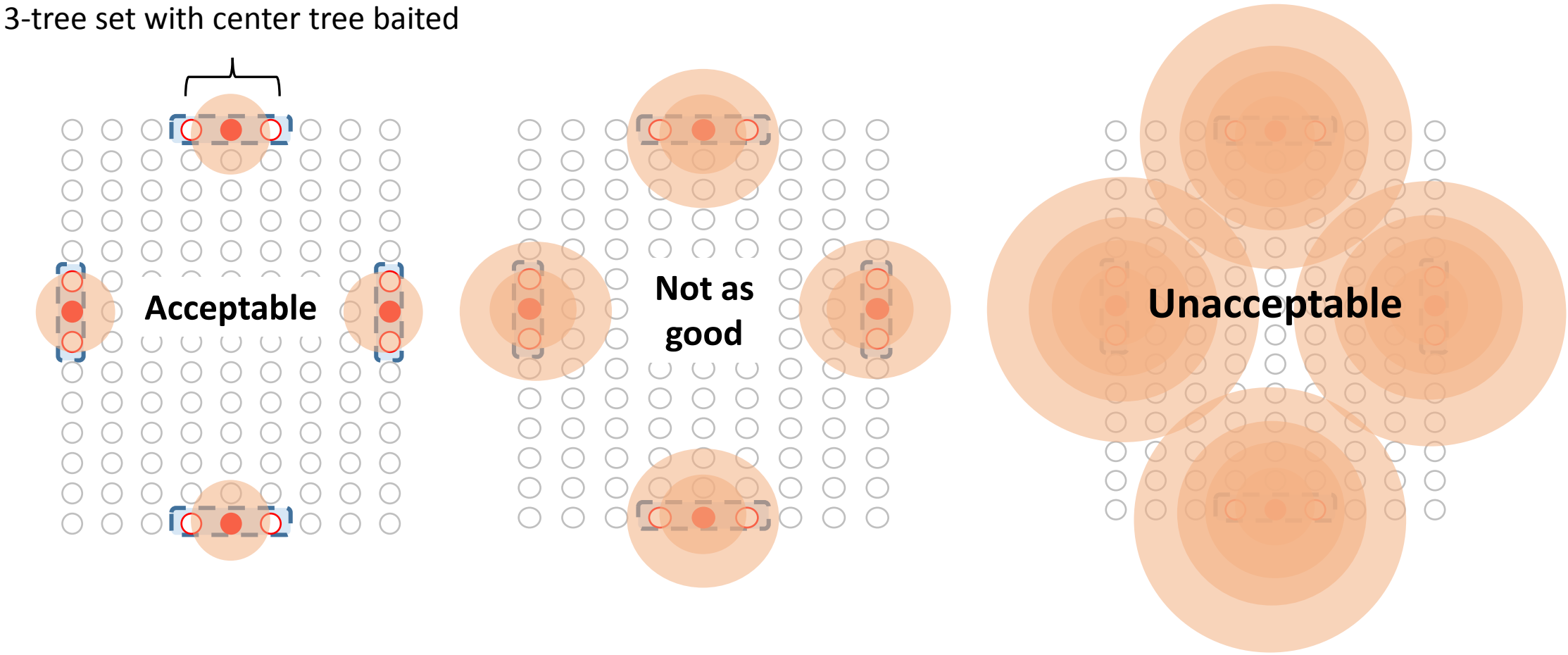
- Aggregation pheromone that draws BMSB to the vicinity of lures
- BMSB pheromone + synergist are attractive season-long

**Baseline questions:**

- What is the area of arrestment of BMSB around a pheromone source?
- How long do BMSB adults stay on baited vs. non-baited crop hosts?

# Why is it important to understand the area of arrestment around a pheromone source?

- Need to measure the “spillover” of BMSB that respond to a pheromone source in a specific location



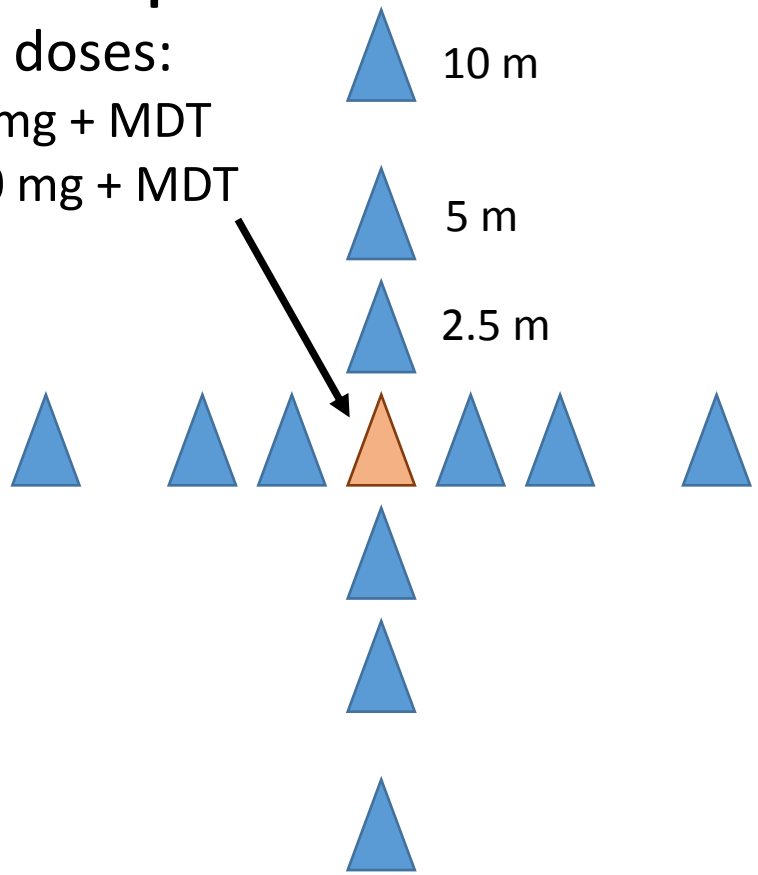
# Response of “wild” BMSB to an array of traps with a pheromone-baited central trap

**Baited trap**

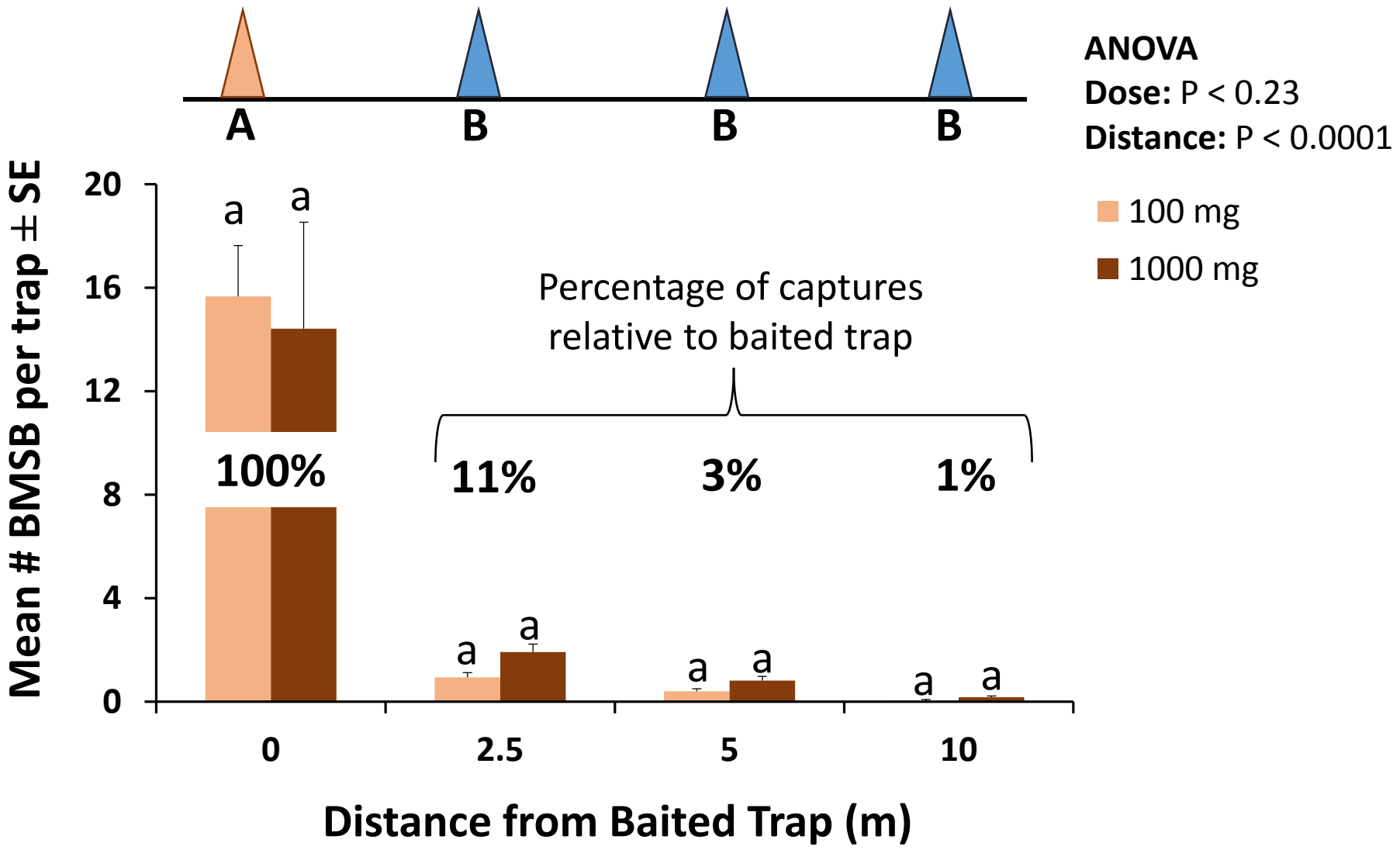
Two doses:

100 mg + MDT

1000 mg + MDT

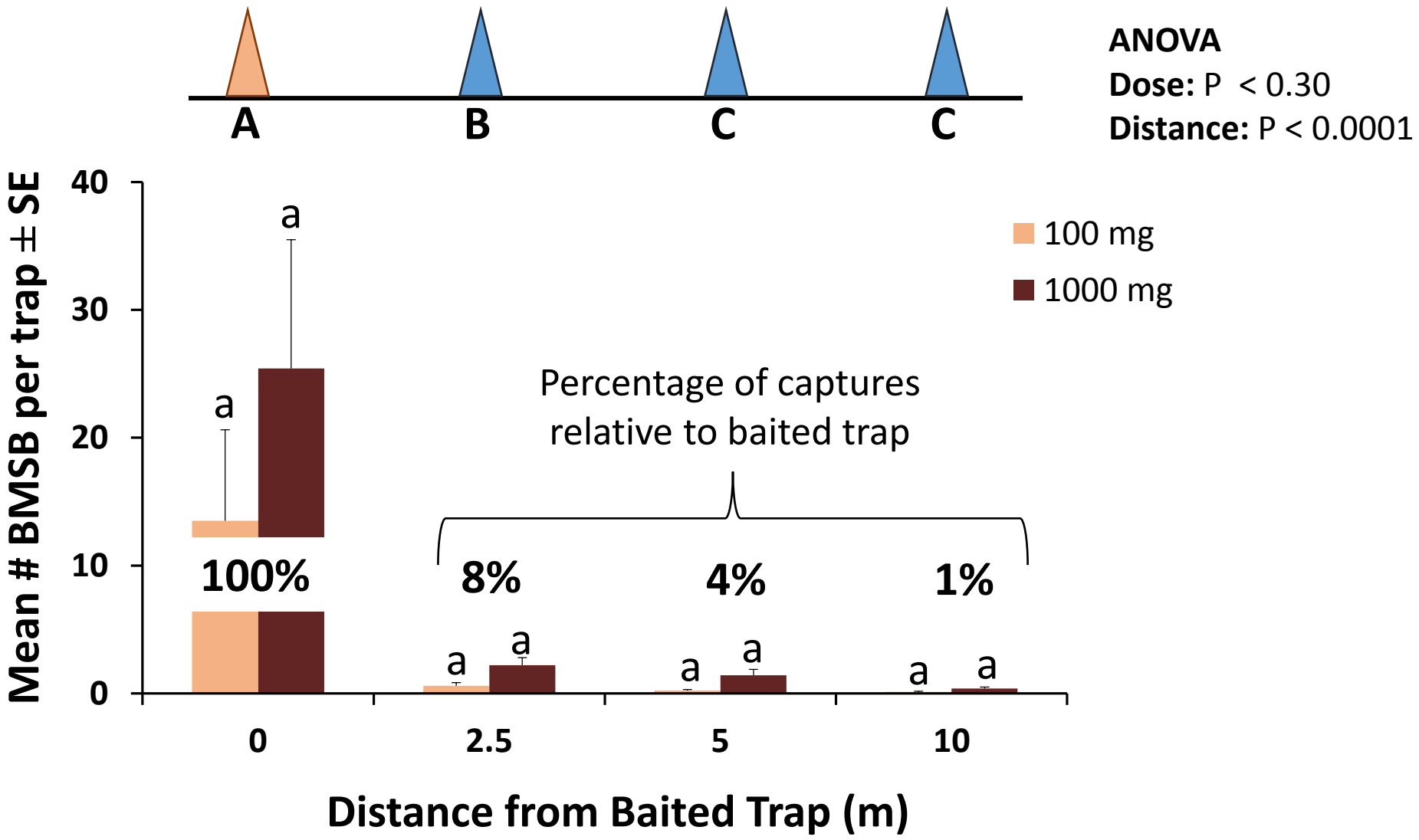



# Adults




Morrison et al. 2015b

# Nymphs



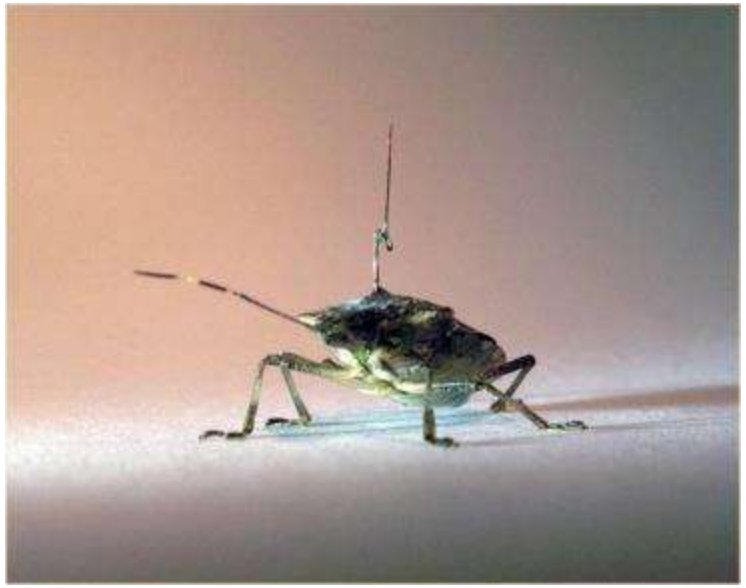

Morrison et al. 2015b

# Why is it important to understand how long BMSB is retained by a pheromone bait in an apple tree?

- Longer retention increases probability of kill via exposure to insecticide residue or direct contact
- Allows grower to localize management action

# Harmonic Radar

- Marine radar device
- Emitted signals are reflected from tag and received and translated into sound



100% detection rate
(Lee et al. 2013; Morrison et al. 2015)

Does not impair behavior or survival (Lee et al. 2013)

Durable tag (Lee et al. 2013)

**Unbaited apple tree**

**Unbaited mowed grass**

**Baited apple tree**

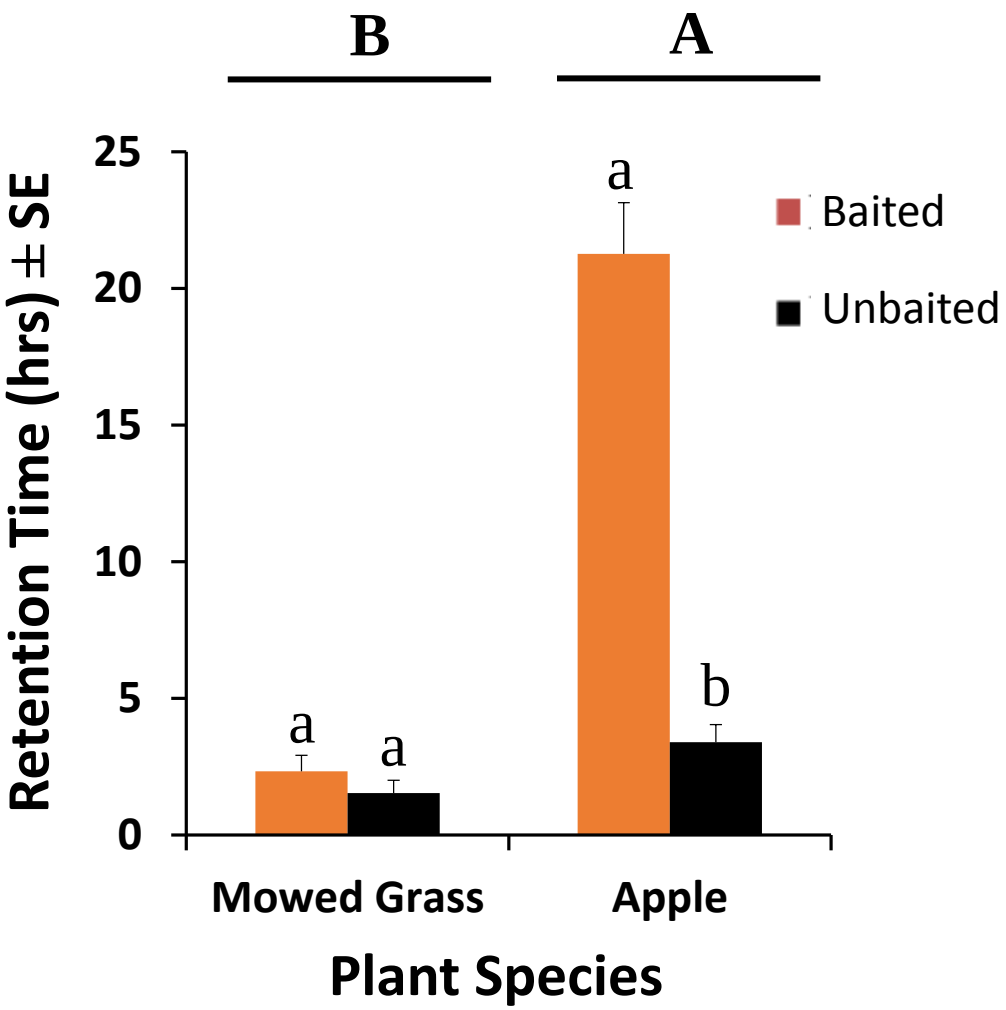
**Baited mowed grass**

Sampling at 1, 3, 6, and 24 hours after bugs released

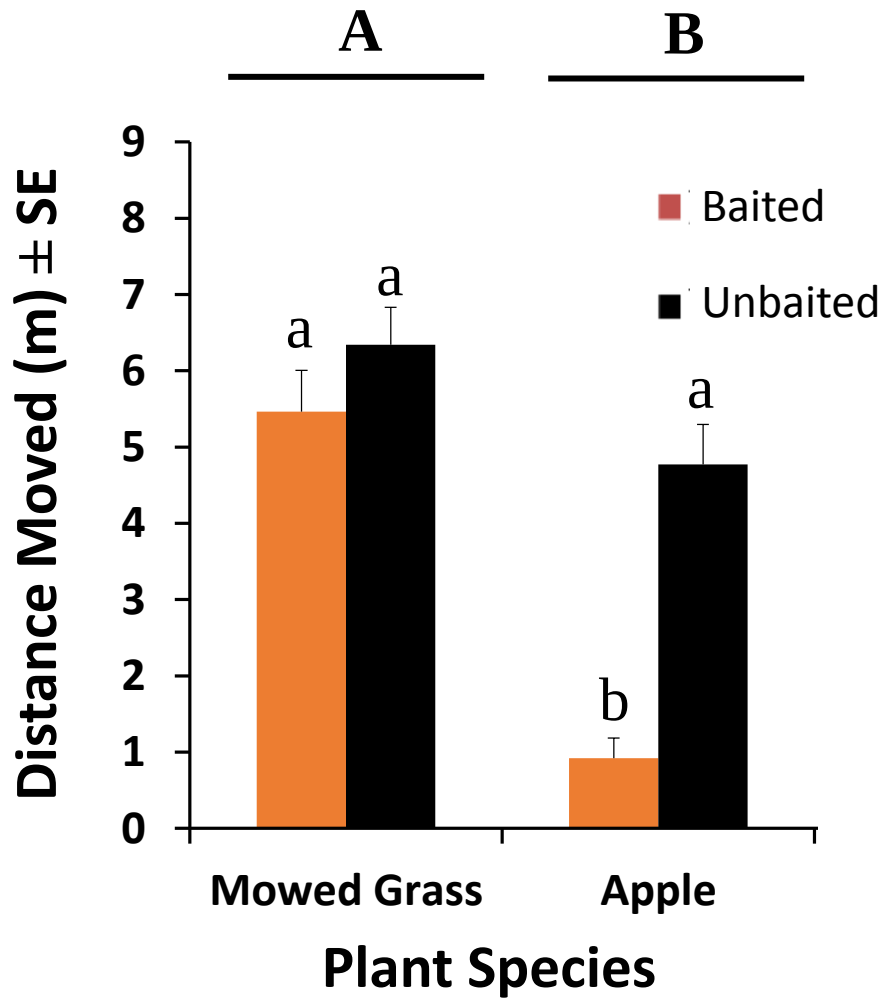
**Measured:**

1. Retention time
2. Distance from release point

# Retention time




# Distance moved




Morrison et al. 2015b

## Summary

- Most bugs were confined to a 2.5 m radius around the baited trap
- Very little spillover to adjacent traps
- Adults remained in baited trees longer than in unbaited trees or in baited or unbaited grassy field

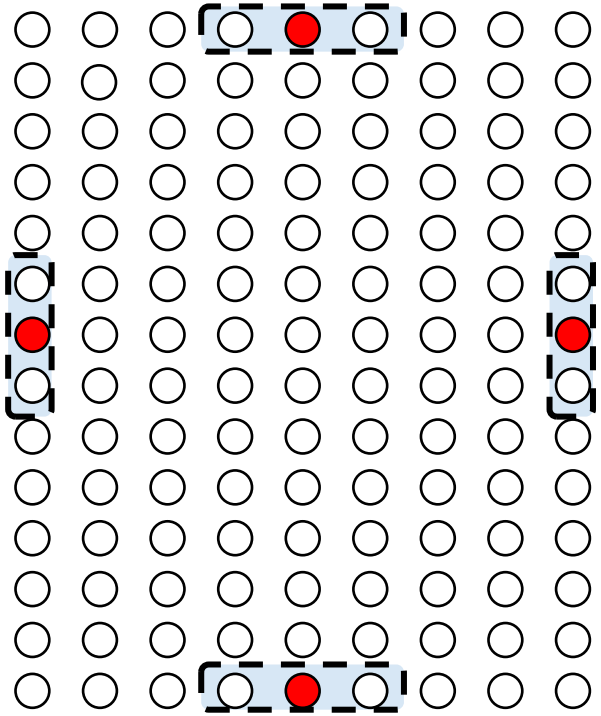
## Implications for A&K

- Appears that spillover from baited trees should not be an issue for growers
- Retention of BMSB in baited trees likely long enough for insecticide uptake
- Both good news for attract-&-kill

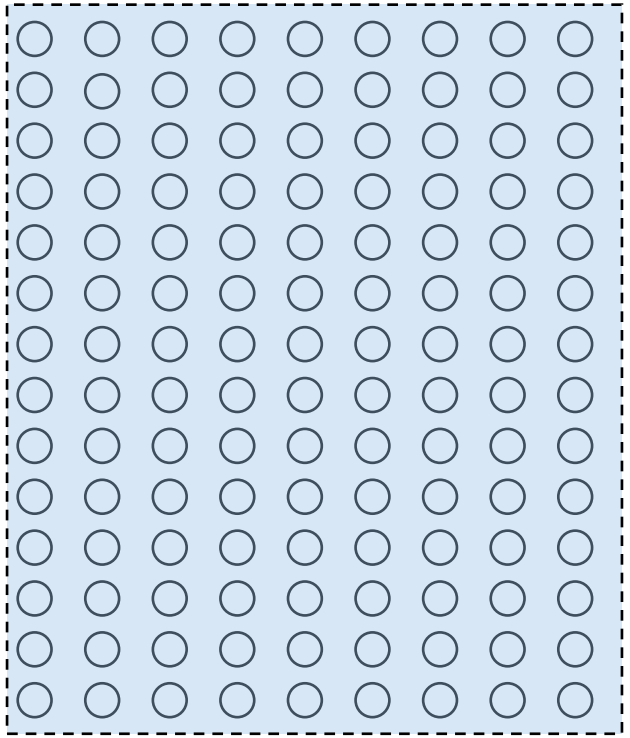
# Attract-and-Kill Set-Up

- 10 commercial apple orchards in MD, WV, VA, PA and NJ
- ≤ 2 acres per block x 2 blocks/farm
- Two treatments: 'Attract and Kill' and Grower Standard

**Attract-and-Kill Block**



**Grower Standard Block**



# Baited Attract-and-Kill Trees

- Trees baited with 1000 mg BMSB pheromone + 66 mg pheromone synergist
- Spaced 50 m apart along block perimeter
- Attract-and-Kill trees and tree on each side sprayed weekly
- Sprays applied only to outer half of canopy

# Tarps deployed beneath trees in A&K and grower standard blocks to collect dead BMSB

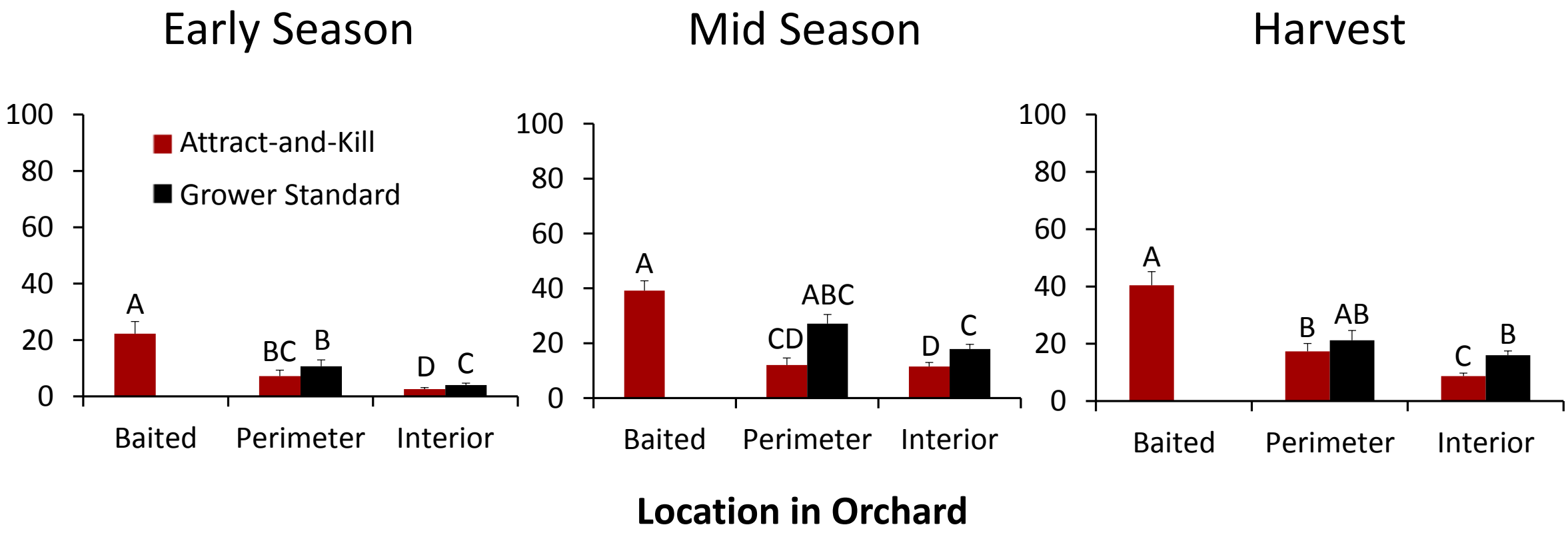
# Monitoring BMSB in A&K and Standard Blocks

- Both monitored with 3 pheromone-baited pyramid traps
- Traps deployed in center of blocks and checked weekly
- If captures reached a cumulative threshold of 10 adults per trap, a whole-block spray was recommended

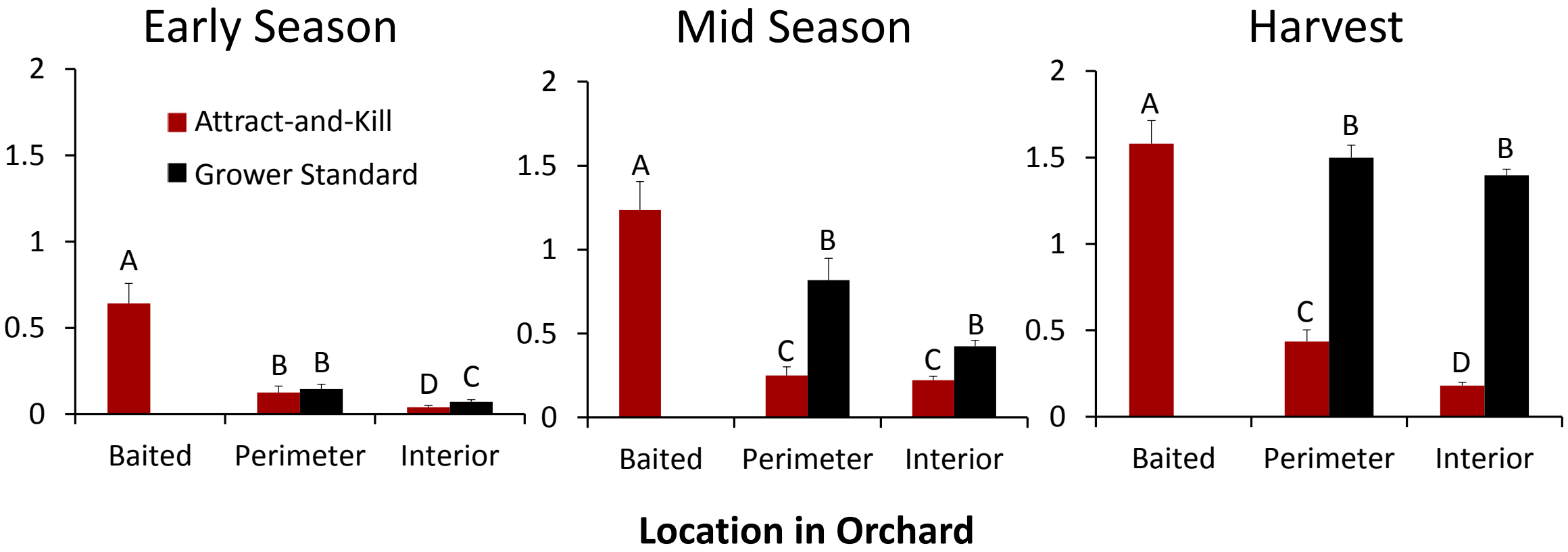
# Fruit Injury Assessments

- 10 fruit/tree from 16 interior trees, 4 exterior trees and baited attract-and-kill trees
- Early-season, mid-season, and harvest
- Number of internal damage sites

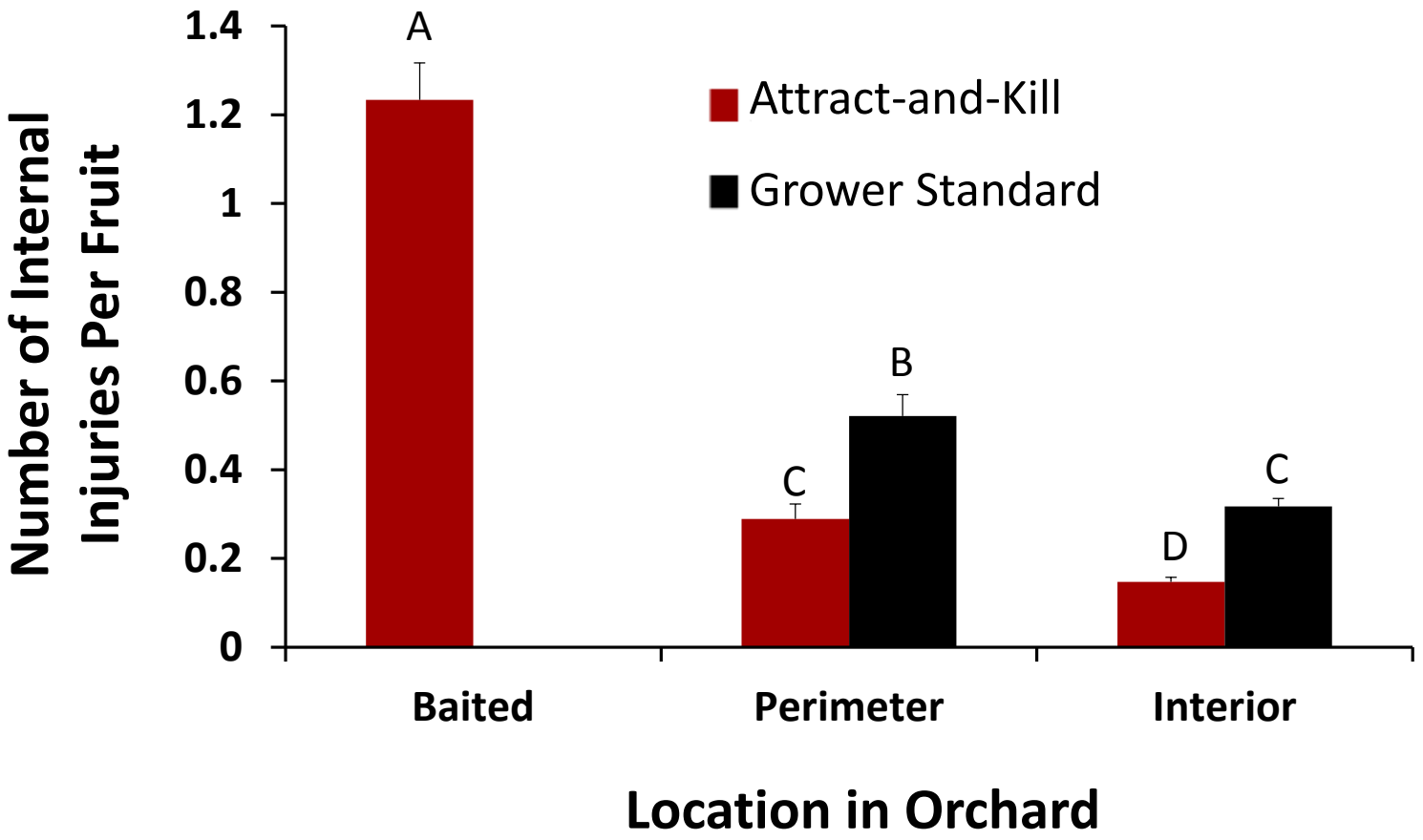
# Percentage of Injured Fruit



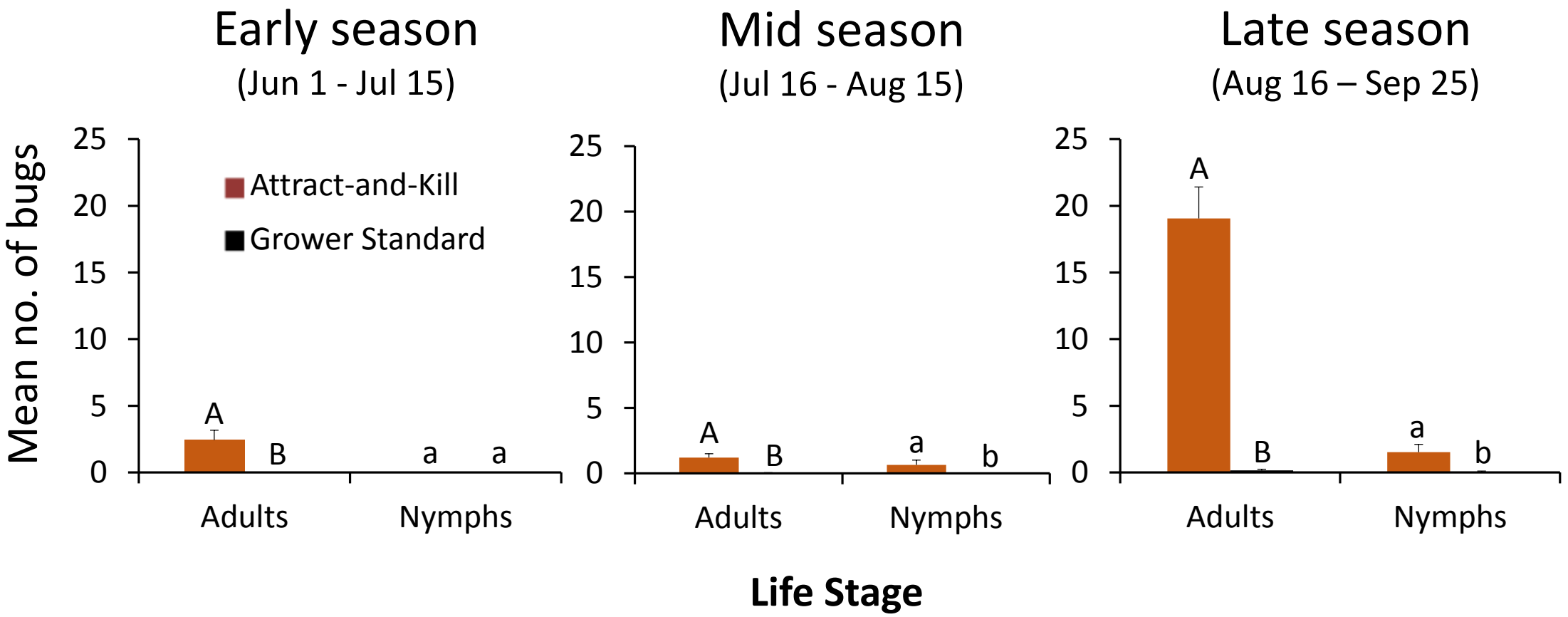
# Number of internal injuries per fruit



# Internal Injuries Across Sampling Periods



# Numbers of adults and nymphs on tarps



# Additional Comparisons

| | Attract-and-Kill | Grower Standard |
|---|---|---|
| Percentage of orchard treated | 3-4% | 100% |
| # of spray events | 15 | 3 |
| Additional sprays triggered by traps | 0.5 | 1.5 |
| Cost of pheromone/acre/season | ~$1536 | ~$36 |
| Cost of insecticide/acre/season | ~$6-20 | ~$30-100 |
| Spider mite & predator mites | Data not yet tabulated | |
| Other pests (e.g. WAA) & natural enemies | Data not yet tabulated | |

Other factors: fuel use, extra trips to field, labor costs, 2$^{o}$ pest management

# Tentative Conclusions & Future Directions

- Pheromone-based tools, including traps for decision support and attract-and-kill, hold promise for BMSB management in apple orchards
- Cost of pheromone for attract-and-kill must be reduced cost via marketplace competition and refinements such as fewer baited trees, fewer baits per tree and/or lower lure loading
- Potential benefits of pheromone-based tools include increased ecological and economic sustainability for growers

# Tentative Conclusions & Future Directions

- Attract-and-kill and other perimeter-based tactic must be evaluated further under higher BMSB pressure than was the case in 2015
- Need to continue the development, evaluation, & refinement of creative solutions to BMSB management in fruit orchards and other vulnerable crop systems

Thank you for your attention

# Questions?

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