Redistribution of *Trissolcus japonicus* and the effects of infochemicals on stink bug parasitism

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Specialty Crop Research Initiative

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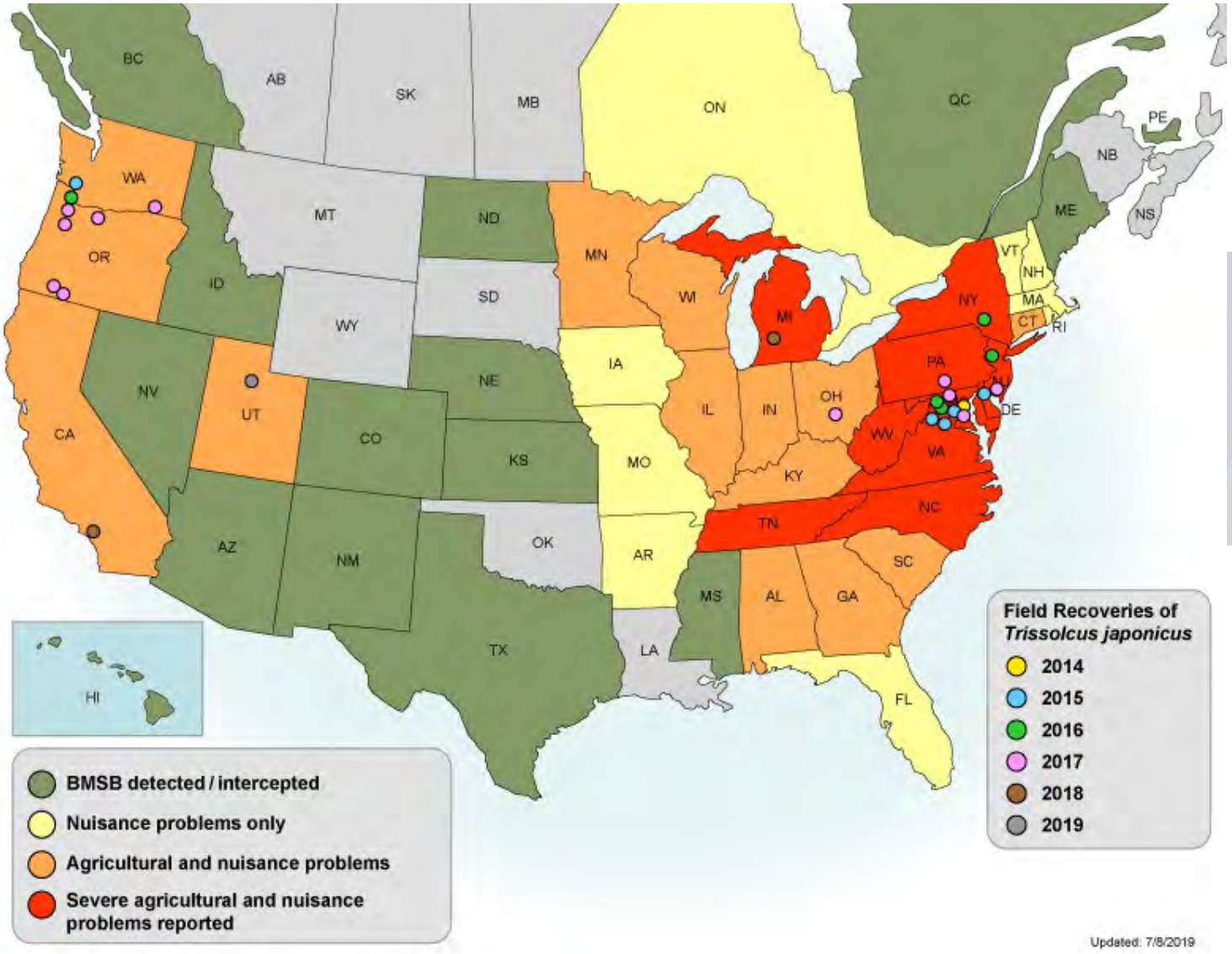
Trissolcus japonicus in North America



Parasitoid redistribution and the effects of release numbers

- *T. japonicus* is establishing across a broad geographic range
- However local population densities are quite variable
- Redistribution efforts may increase spread, local density, and biological control impact

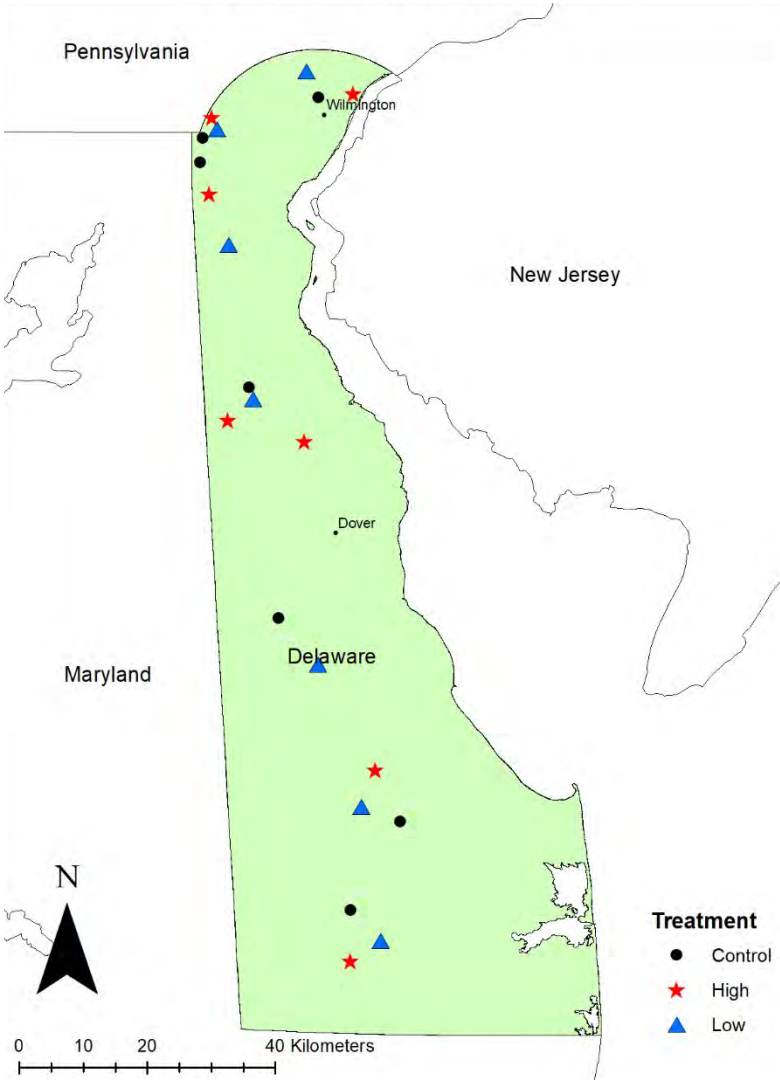
What is the optimal release strategy??

- Opportunity to study colonization processes

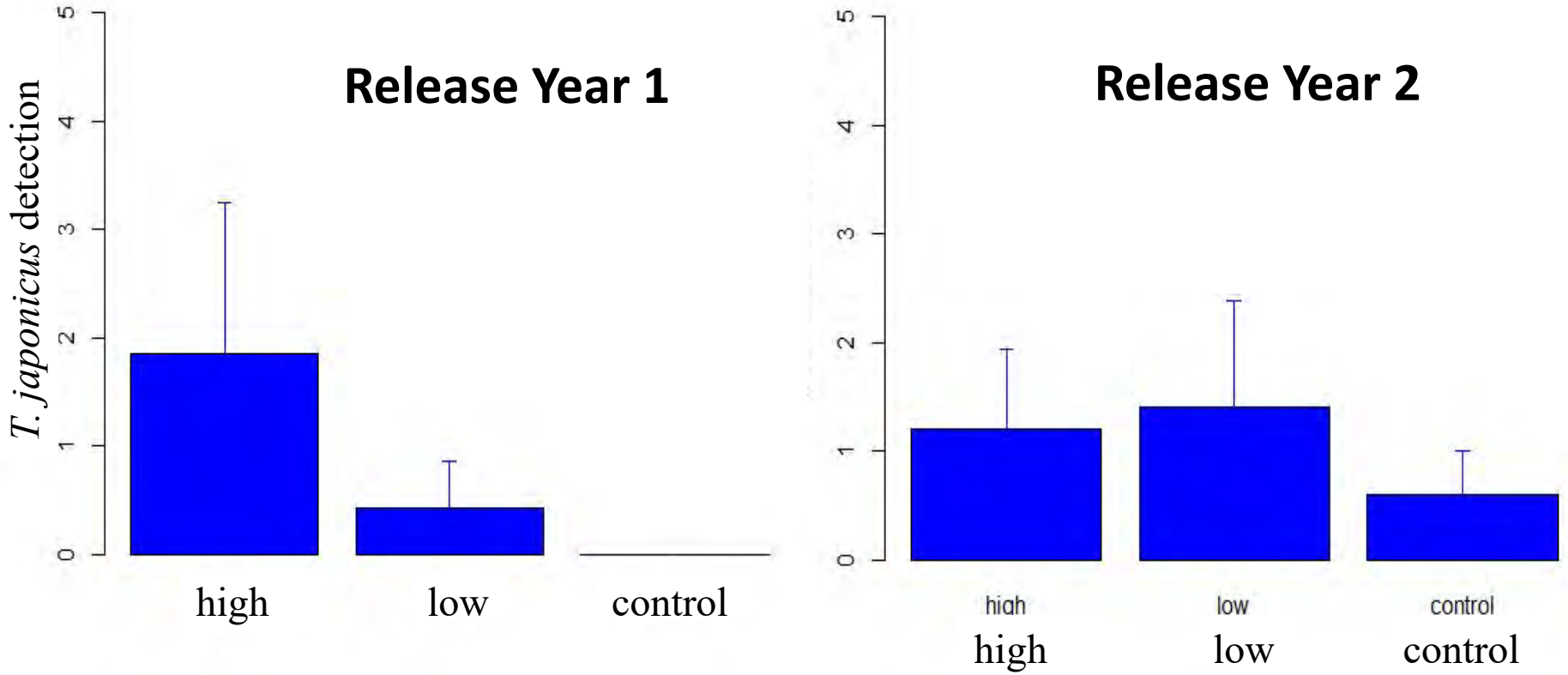
Delaware redistribution

High release: 15-20 parasitized egg masses *per release*, i.e. about 400 female wasps
Low release: 1-2 parasitized egg masses *per release*, i.e. about 40 female wasps
Control: no released wasps

- Minimum separation of 2 km between release locations
- Randomized complete block design
- All release sites were forested habitat edges



Delaware redistribution

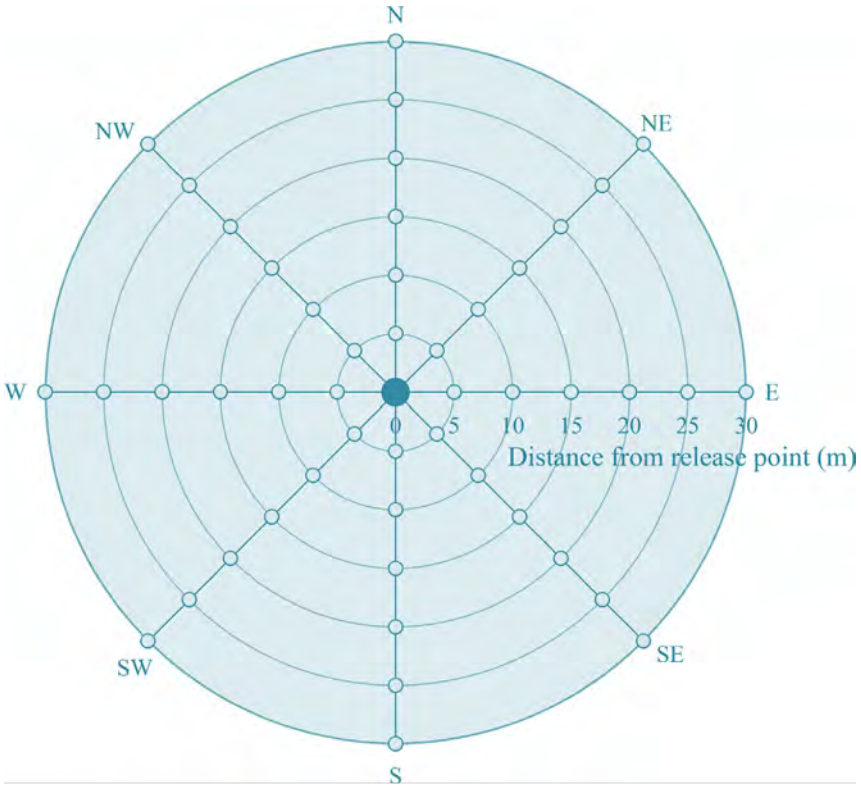


Multi-state redistribution efforts

***Trissolcus japonicus* redistribution is ongoing in…**

Delaware – Kaser, Tatman, Owens & Hoelmer
Maryland – Shrewsbury & Potter
New Jersey – Girod, Hamilton & Nielsen
New York – Jentsch & Agnello
Michigan – Pote & Szucs
Ohio – Welty
Oregon – Wiman & Lowenstein
Virginia – Bergh & Quinn
Washington – Beers & Milnes

T. japonicus dispersal



~1700 female adult wasps released

Half of trees exposed to BMSB adults (contact kairomone)

T. japonicus Dispersal

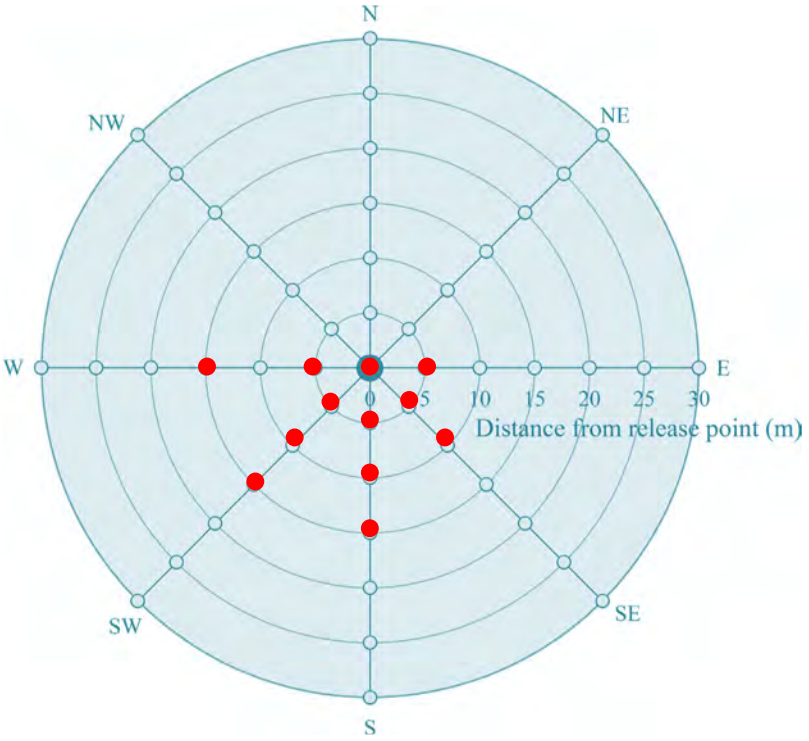
Logistic regression: Parasitism~Distance+Treatment+ Distance*Treatment

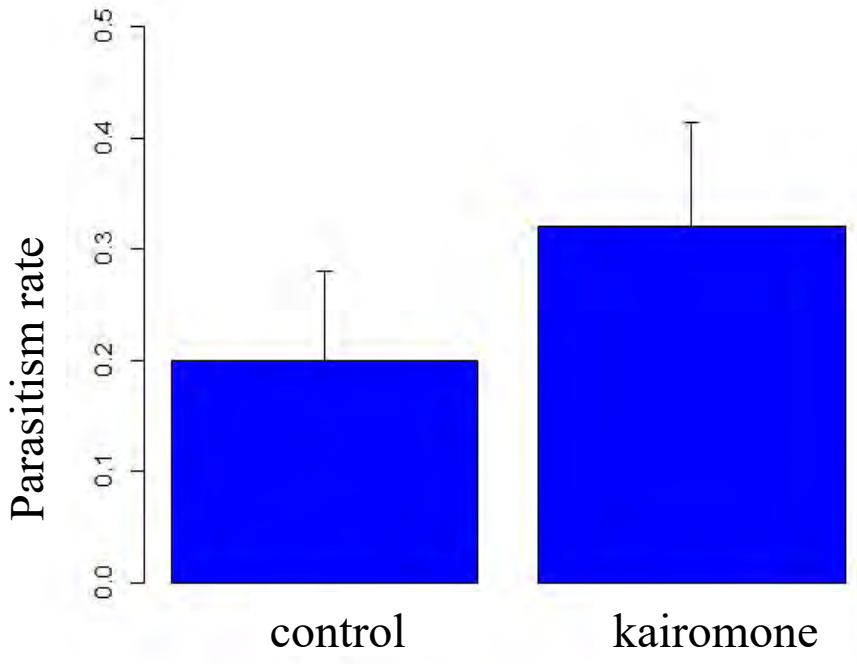
Distance: ***P* = 0.035**

Treatment: $P = 0.47$

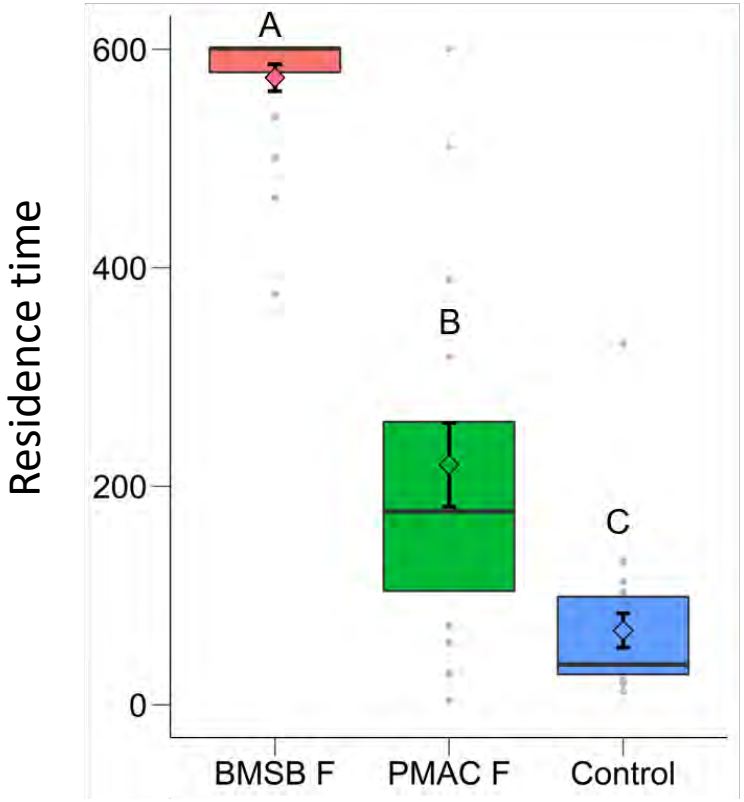
Distance x Treatment: $P = 0.89$

26% parasitism
By 0.7% of females





Foraging wasps and chemical “footprints”



- Lab assays conducted using the behavioral software EthoVision
- *T. japonicus* detects chemical cues left by adult and nymphal stink bugs
- Wasps track BMSB better than non-target *P. maculiventris*
- Suggests reduced risk for *P. maculiventris*

But what do these lab results mean for parasitism in the field?

Malek et al. (in revision) *Biological Control*

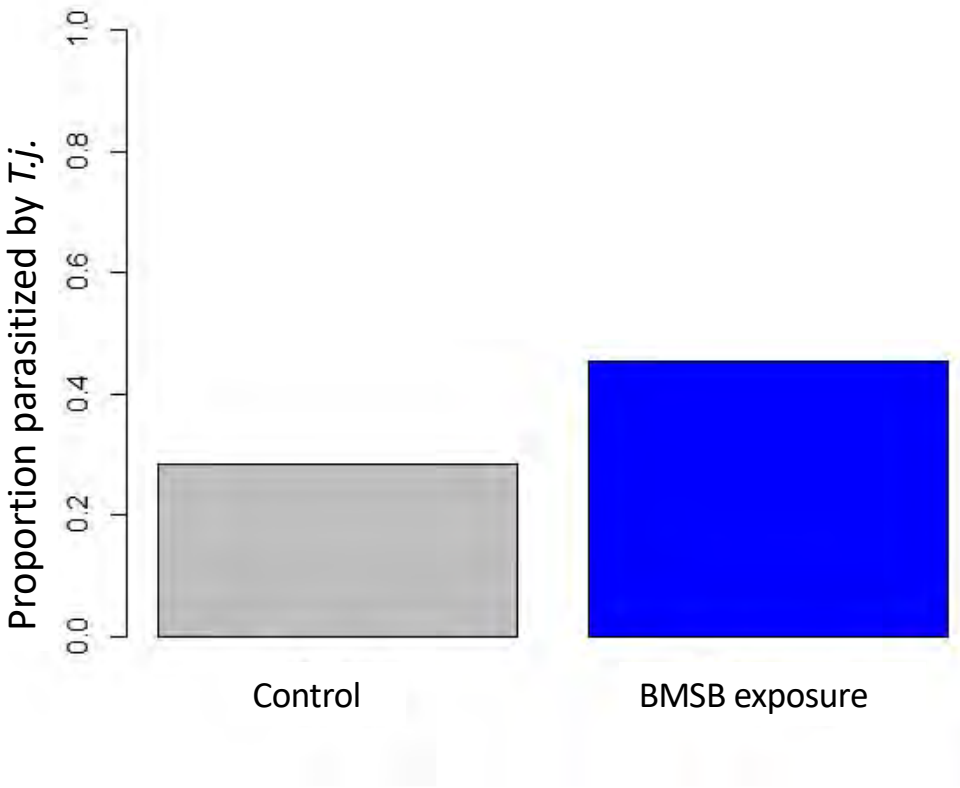
Impact of kairomones in the field

- Maple trees ~2 meters tall
- 3 spatial blocks
- Each block included a circle of 16 trees (10m radius, ~3m between trees)
- Each tree is experimental unit
- Parasitoids released at the center of each circle to increase parasitism rates (200-2000 females per release)

Experiment 1:
Prior exposure of BMSB adults

- 4 BMSB adult females bagged on a branch
- Controls were bagged without bugs
- After 48 hours, bags and bugs were removed
- BMSB egg masses were affixed to each treatment or control branch
- Wasps were released
- Egg masses collected after ~ 5 days and parasitism recorded

Experiment 1: Results

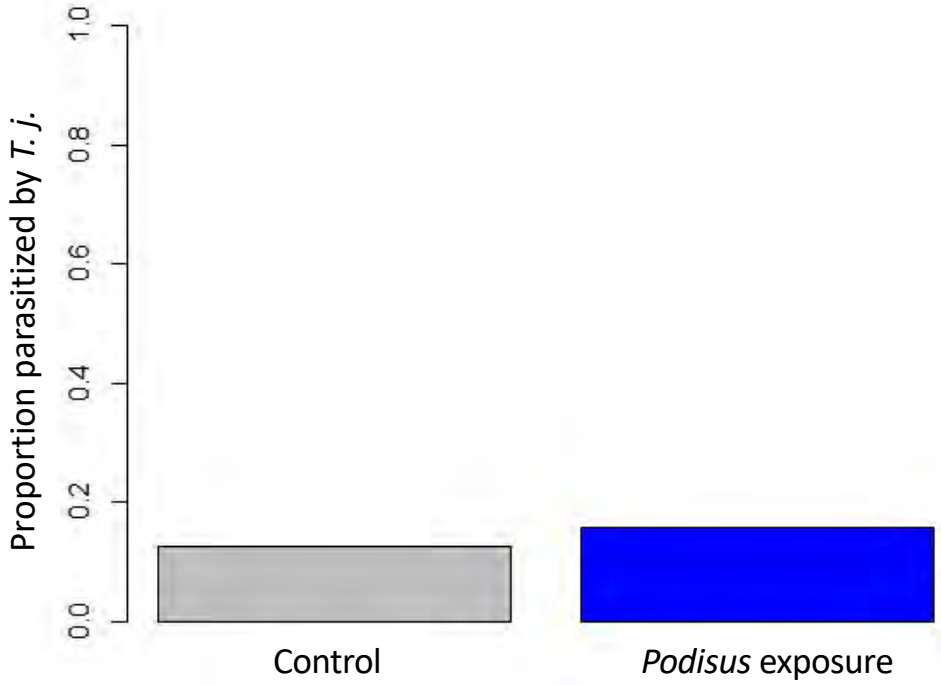


- n=176
- **P=0.017**: prior exposure of BMSB resulted in higher parasitism by *T. japonicus* (45% vs. 28%)
- There was no impact of treatment on parasitism by native parasitoids (kairomone=9%; control=18%)

Experiment 2:
Podisus maculiventris adults

- 4 *Podisus* adult females bagged on branch
- Controls were bagged without bugs
- After 48 hours, bags and bugs were removed and *Podisus* egg masses were affixed to the treatment or control branch
- Wasps were released
- Egg masses collected and parasitism recorded

Experiment 2: Results



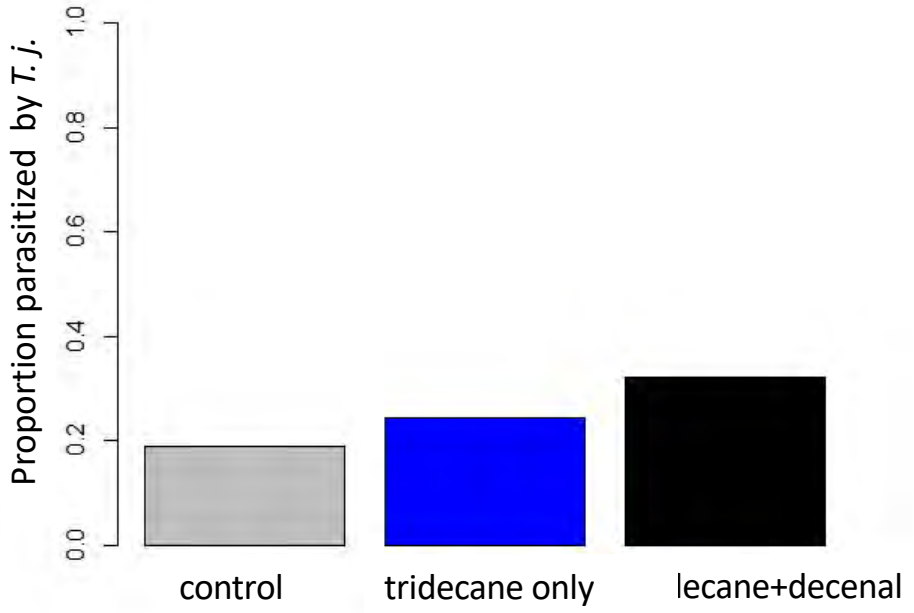
- n=64
- No significant impact of *Podisus* exposure on parasitism by *T. japonicus* (12% vs. 16%)
- There was no impact of treatment on parasitism by native parasitoids (kairomone=16%; control=22%)

Experiment 3: Synthetic kairomones

Filter papers treated with:
1) *n*-tridecane (168 microgram) in hexane solution (200 nanoliter);
2) a 9:1 ratio combination of *n*-tridecane and (*E*)-2-decenal in hexane solution; and
3) a hexane control

- Egg masses were affixed to the center of filter paper
- Filter papers were hung in trees and wasps were released within 2 hours of application of solution

Experiment 3:
Synthetic kairomone components



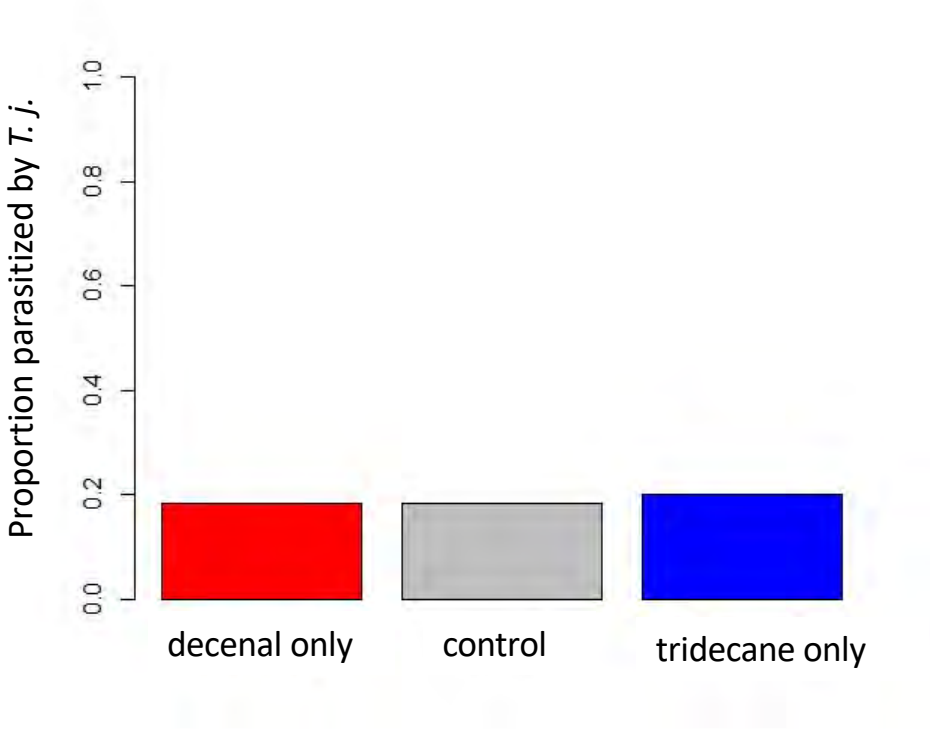
- N=96
- No significant impact of synthetic kairomone components on parasitism by *T. japonicus* or native parasitoids

Experiment 4: Synthetic kairomones

Filter papers treated with:
1) *n*-tridecane in hexane solution;
2) (*E*)-2-decenal in hexane solution; and
3) a hexane control

- Egg masses were affixed to the center of filter paper
- Filter papers were hung in trees and wasps were released within 2 hours of application of solution

Experiment 4: Results



- n=32
- No significant impact of synthetic kairomones on parasitism by *T. japonicus*; not enough native parasitism to analyze

Response from ambient field populations in Maryland

Treatments:

1) 9:1 ratio
2) Tridecane only
3) Control

- Blocked on 10 different landscape trees (*Acer*, *Catalpa*, *Lagerstroemia*, *Malus*, *Syringa*, *Tilia*)
- Frozen eggs
- Exposed for 72 hours on 4 dates

Results

	# of egg masses	Preyed upon egg masses	Parasitized egg masses	*Anastatus* spp.	***Trissolcus japonicus***	*Trissolcus euschisti*	Dead paras. only
Mix	40	17	14	4	**2**	9	0
Tridecane	40	17	15	4	**3**	8	2
None	40	21	19	4	**3**	6	7

- No effect of treatment on predation or parasitism
- Compounds are highly volatile
- No compound present after 2 days, and only 1 part per 1000 after 1 day

Conclusions

- Prior exposure of BMSB increased foraging efficiency and parasitism rate by *T. japonicus*
- *P. maculiventris* exposure had no discernable impact on parasitism
- Results consistent with initial conclusions about reduced non-target risk
- Application and composition of synthetic kairomones needs further research
- In the field, do these chemicals act as volatile attractants or contact kairomones?

Thank You

It’s time for a few polling questions