Managing Bad Stink Bugs with Good Stink Bugs

eOrganic Webinar

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West Virginia University

Outline of Presentation

Stink Bugs

- Plant feeder vs. Predator
- Brown marmorated stink bug (BMSB)
- Spined soldier bug

Stink Bug Control Using Stink Bug

- BMSB vs. soldier bugs

Obstacles to overcome

- Prey preference of soldier bugs
- Mass rearing of soldier bugs

Stink Bug

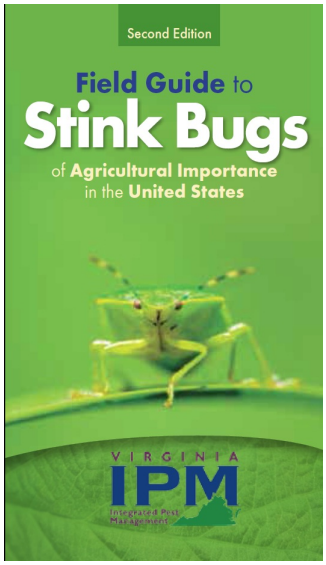
Shield bug

True bug

Stink Bug

Stink Bugs: Exotics

Stink Bug Field Guide



https://pubs.ext.vt.edu/444/444-356/444-356_pdf.pdf

Which Ones are Good Stink Bugs?

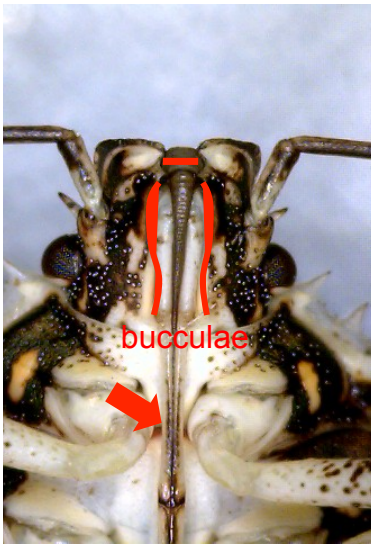
Family: Pentatomidae (stink bug)

Other subfamilies

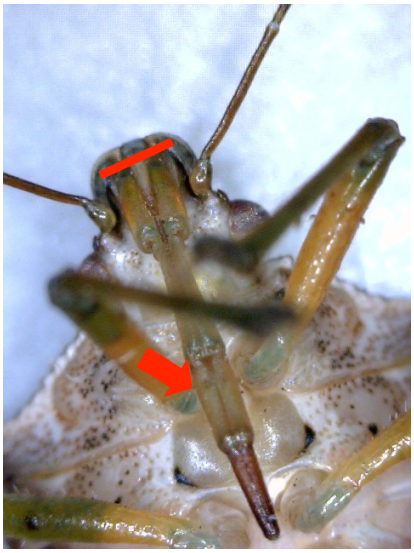
Asopinae

Stink Bugs

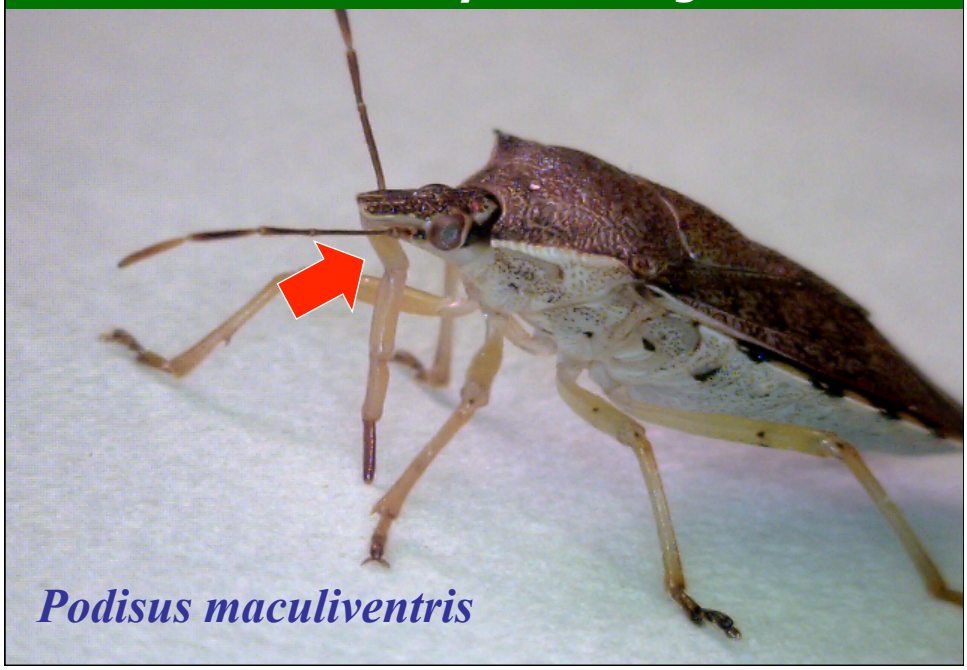
Plant feeder



Predator



Predatory Stink Bug



Example Predatory Stink Bugs

twospotted stink bug
Perillus bioculatus

anchor stink bug
Stiretrus anchorago

spined soldier bug
Podisus maculiventris

Brown Marmorated Stink Bug

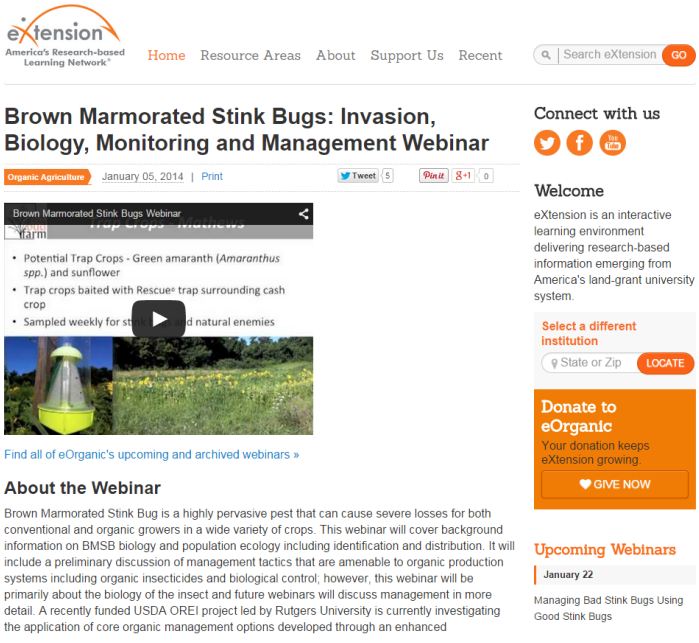
***Halyomorpha halys* (Hemiptera: Pentatomidae)**

= also known as *H. mista* in Asian countries

marble

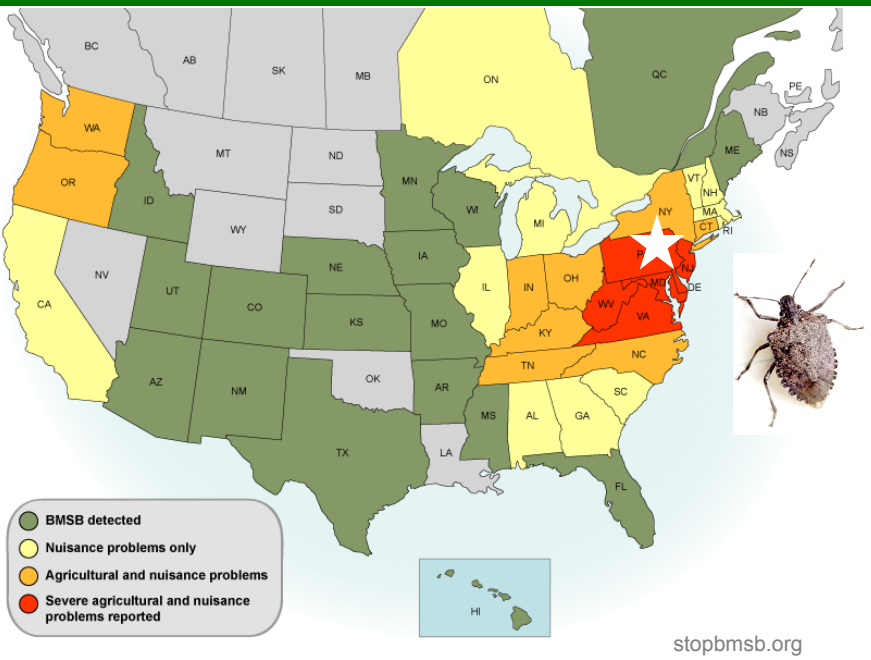
http://www.stopbmsb.org

BMSB Webinar



Invasion to Production Agriculture

Current Distribution in North America



Two Important BMSB Characteristics

#1 Highly mobile

Strong flier

> 5 km per day (adult)

Wiman et al. 2004. J. Pest Sci.

Strong walker

3 m per 30 min. (nymph)

Lee et al. 2004. J. Ins. Behav.

Amazing hitchhiker

Using railroad and vehicles

Wallner et al. 2004. PLoS One

Major U.S. Highways

Hitchhiking

Hitchhiking

Two Important BMSB Characteristics

#1 Highly mobile

#2 Wide host range

> 200 plants listed, including

Fruits,
Vegetables,
Field crops,
Herbs,
Ornamentals, and
Trees

Fruit Damage

Photo source: http://www.hgic.umd.edu/content/timelytips.cfm

Current BMSB Management

Heavily rely on insecticides

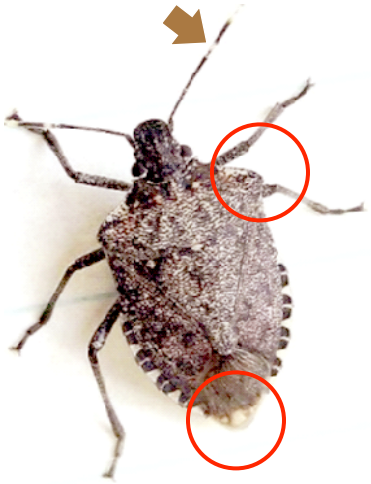
- **Not always successful**
  - Re-infestation from outside of treated areas
- **Recover from some insecticides**
  - e.g. Pyrethroid

Other methods are being developed

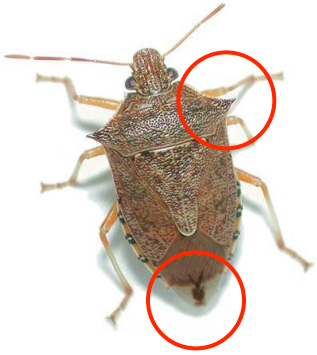
- **Biological control**
  - Classical and augmentative biological control
- **Semiochemicals**
  - Aggregation pheromone has been identified
- **Cultural control**
  - Trap crops

BMSB and Spined Soldier Bug

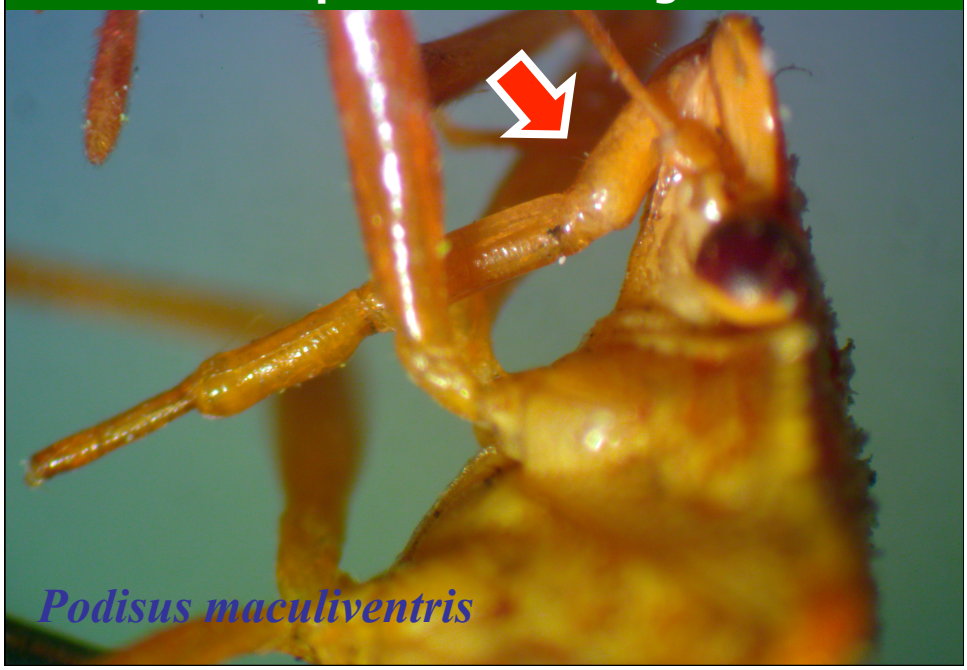
Brown marmorated stink bugs (BMSB)



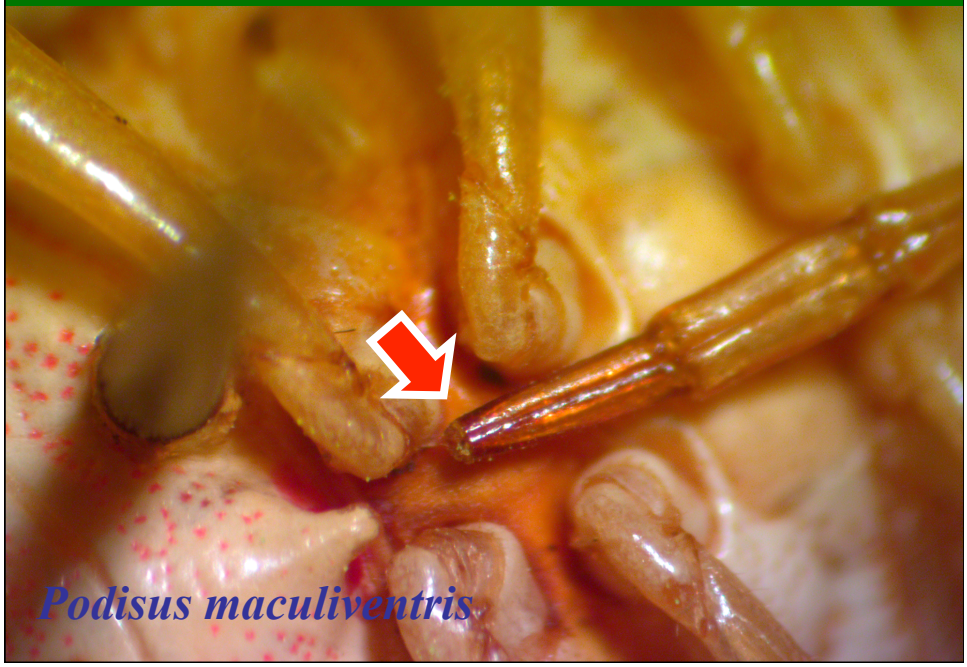
Spined soldier bug



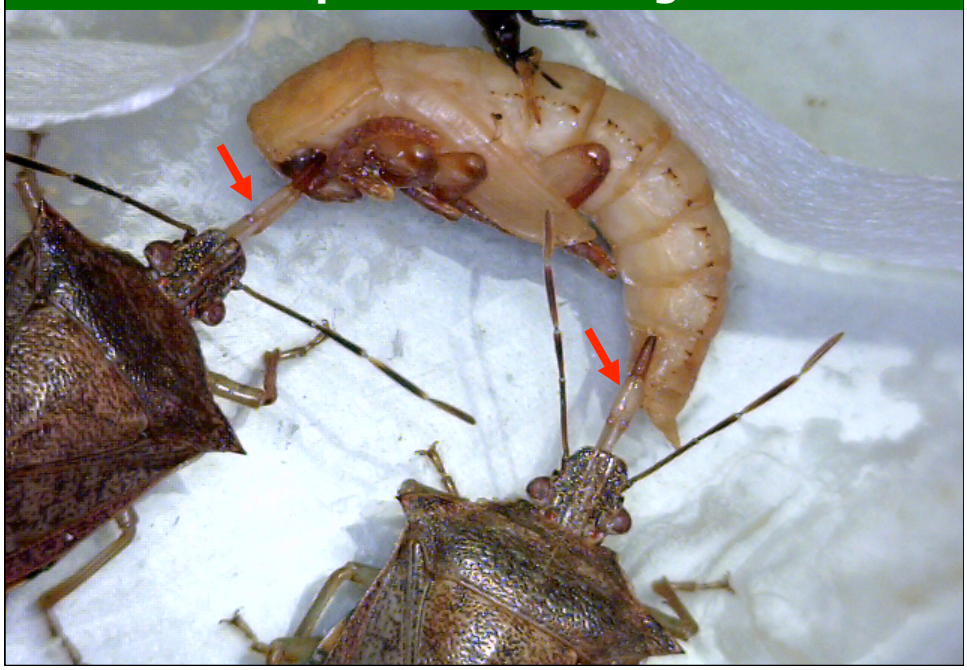
Spined Solder Bug



Spined Solder Bug



Spined Solder Bug



Spined Solder Bug

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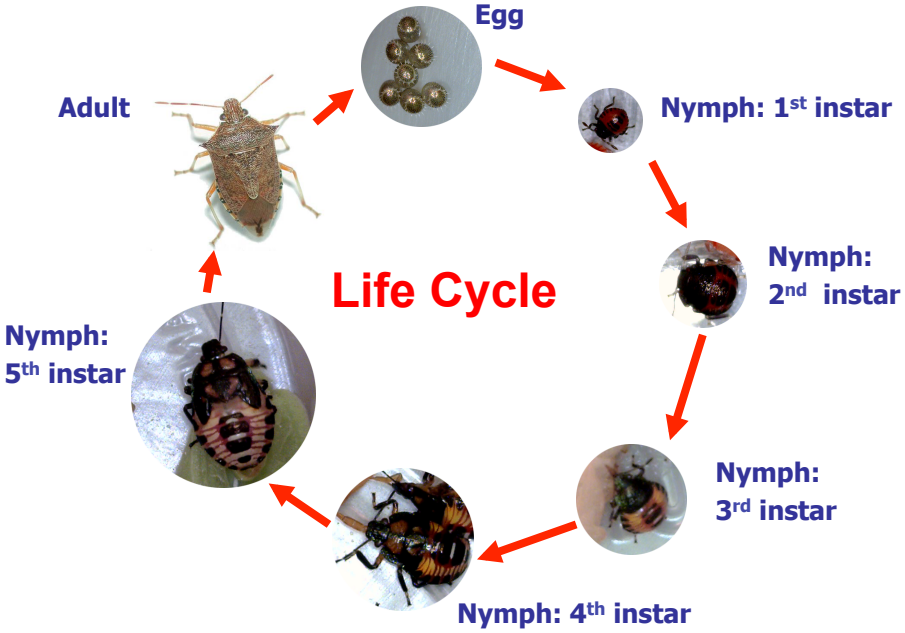
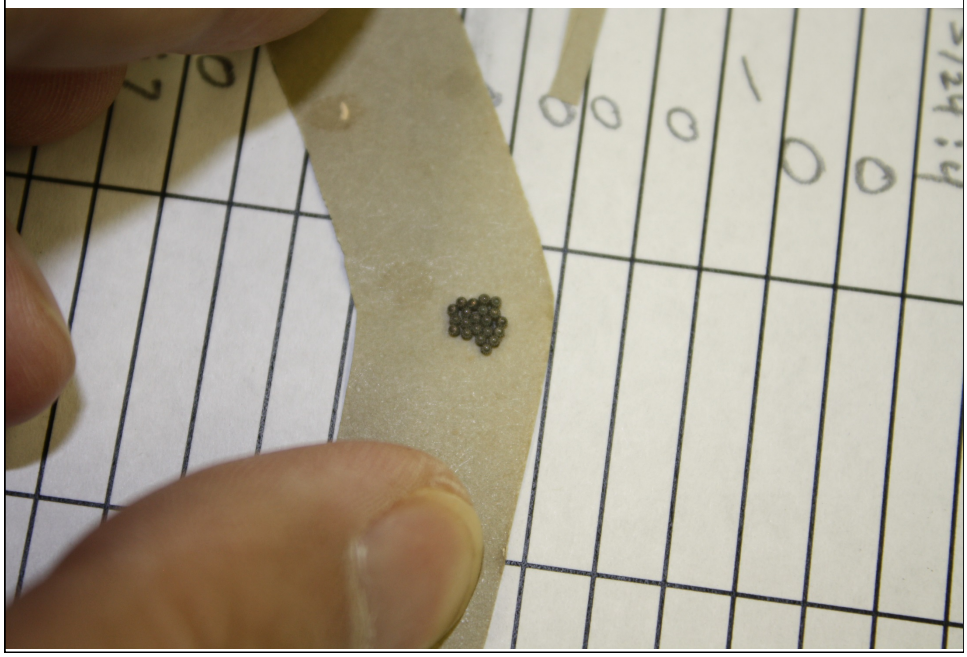


Spined Solder Bug Eggs

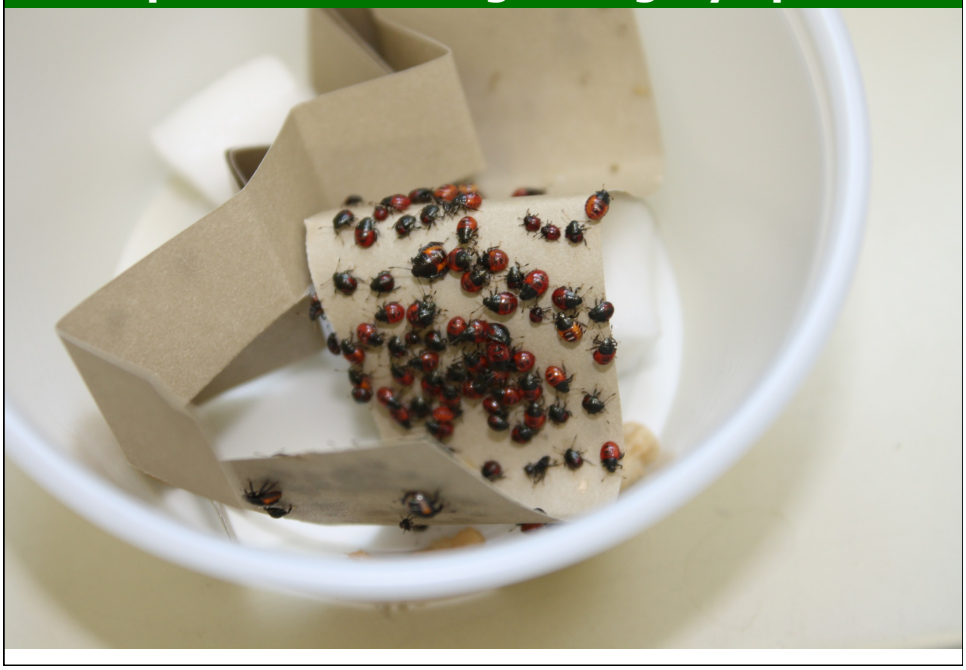


Spined Solder Bug Eggs

Other stink bugs

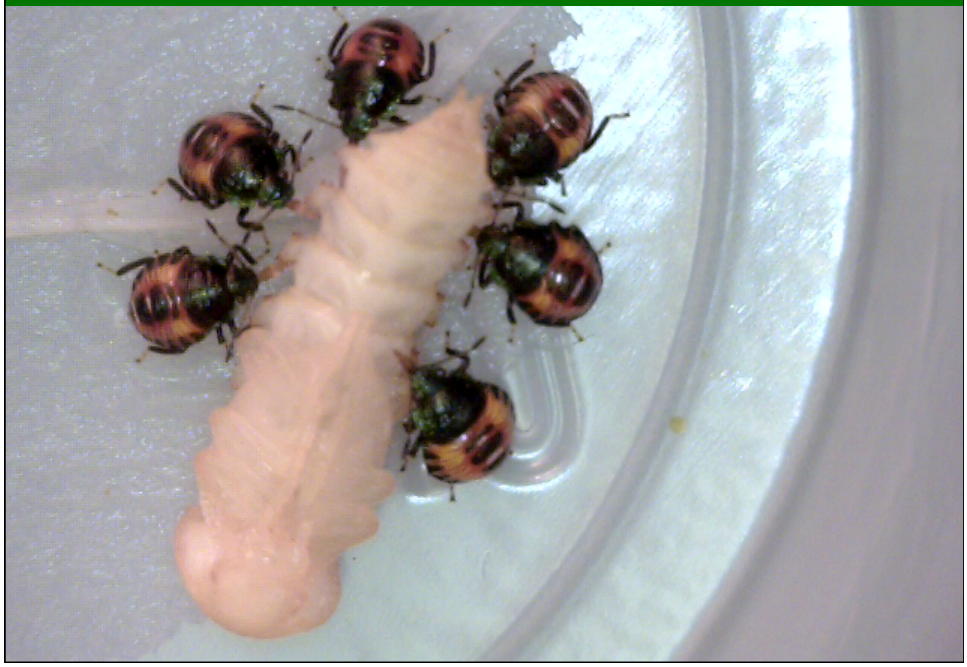
Spined soldier bug

Spined Solder Bug Young Nymphs



Spined Solder Bug 1st and 2nd Instars

Spined Solder Bug 3rd Instars



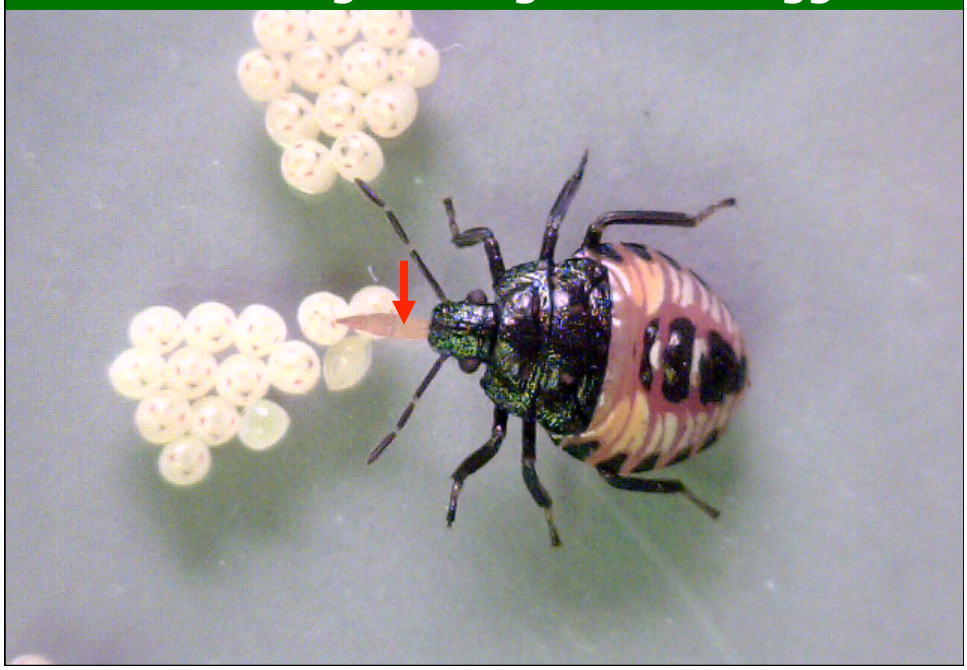
Spined Solder Bug 4th Instars

Spined Solder Bug 5th Instar and Adult

Spined Solder Bug Adult Male and Female

Spined Solder Bug

Soldier Bug Feeding on BMSB Eggs



Soldier Bug Feeding on BMSB Eggs

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Soldier Bug Feeing on BMSB 1st Instars

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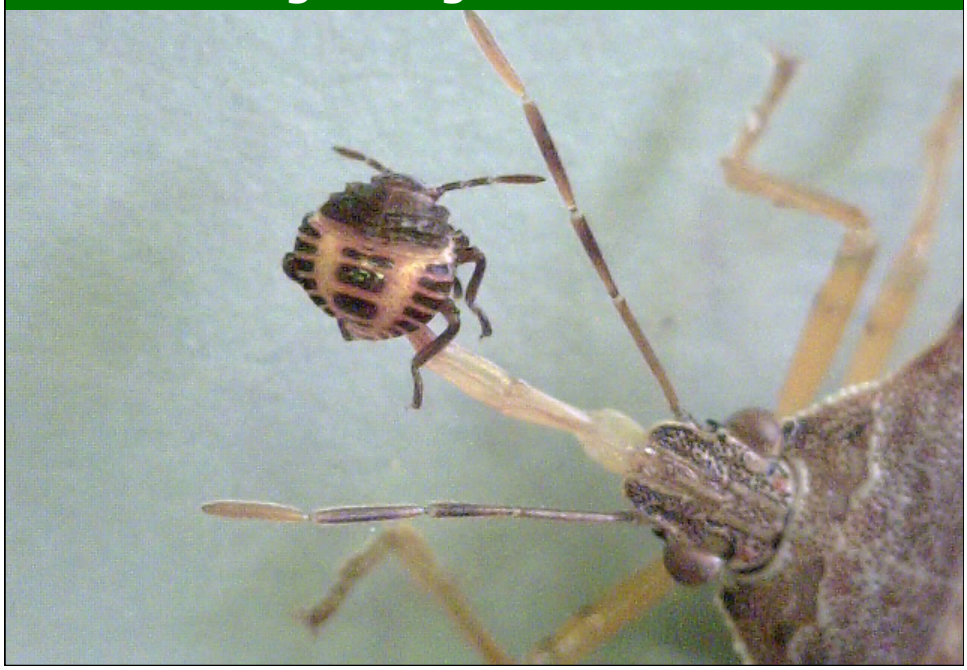
Soldier Bug Feeing on BMSB 1st Instars



Soldier Bug Feeding on BMSB 2nd Instars

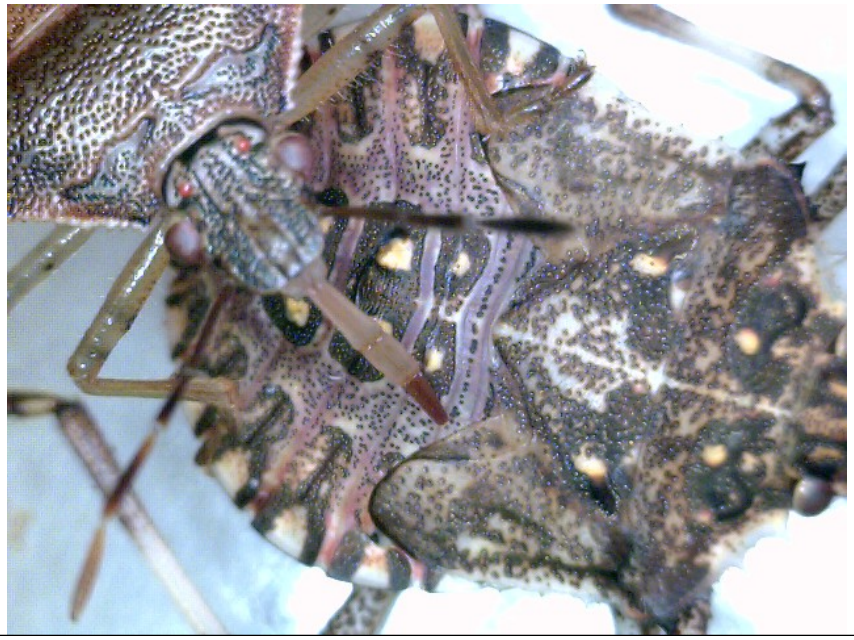
Soldier Bug Feeding on BMSB 2nd Instars

Soldier Bug Feeding on BMSB 2nd Instars

Soldier Bug Feeding on BMSB 5th Instars

Soldier Bug Feeding on BMSB 5th Instars

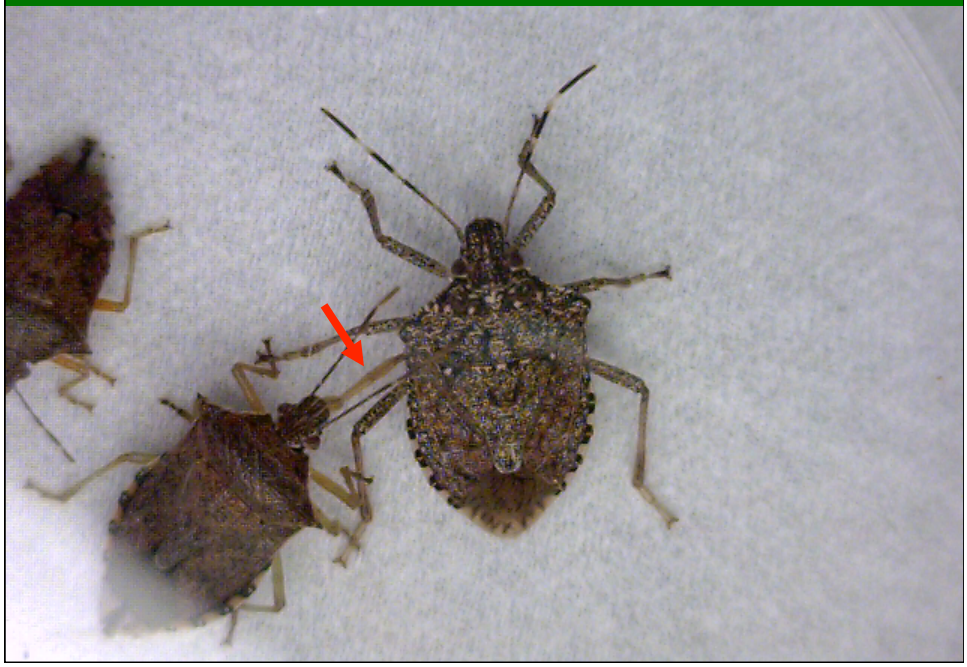
Soldier Bug Feeding on BMSB 5th Instars



Soldier Bug Feeding on BMSB 5th Instars

Soldier Bug Feeding on BMSB 5th Instars

Soldier Bug Feeding on BMSB adults



Solder bugs for BMSB Control?

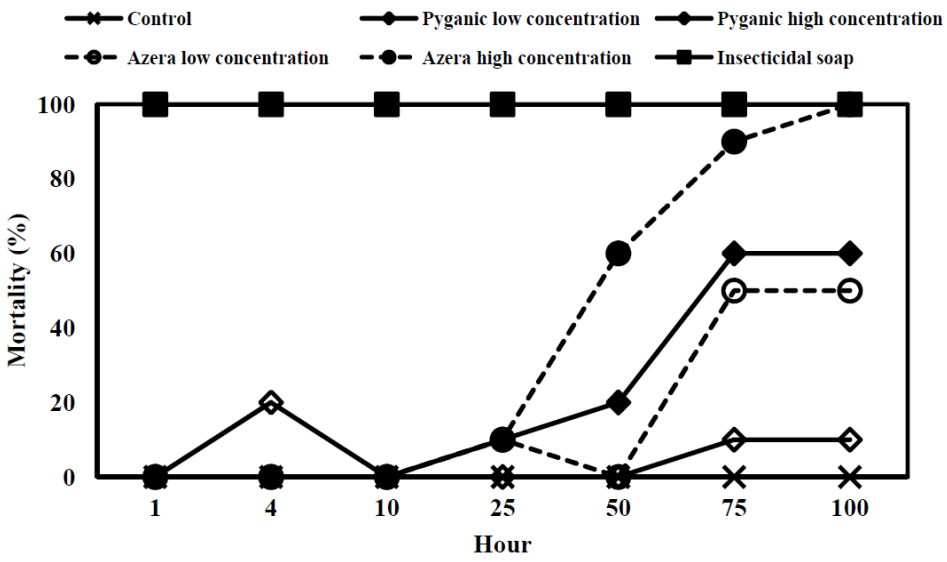
Table 1: Amount of weight loss (mean ± SEM) of *T. molitor* by *P. maculiventris* feeding and feeding equivalency when the feeding amount by second instar is set as 1.00. Note that first instar is not predacious.

P. maculiventris stage	N	Weight loss of *T. molitor* per day (g)	Feeding equivalency
2nd instar	30	0.003 ± 0.001 c*	1.00
3rd instar	30	0.006 ± 0.002 c	1.83
4th instar	30	0.019 ± 0.006 b	5.13
5th instar	30	0.035 ± 0.011 a	9.45
Adult male	15	0.023 ± 0.010 ab	6.21
Adult female	15	0.021 ± 0.009 b	5.67

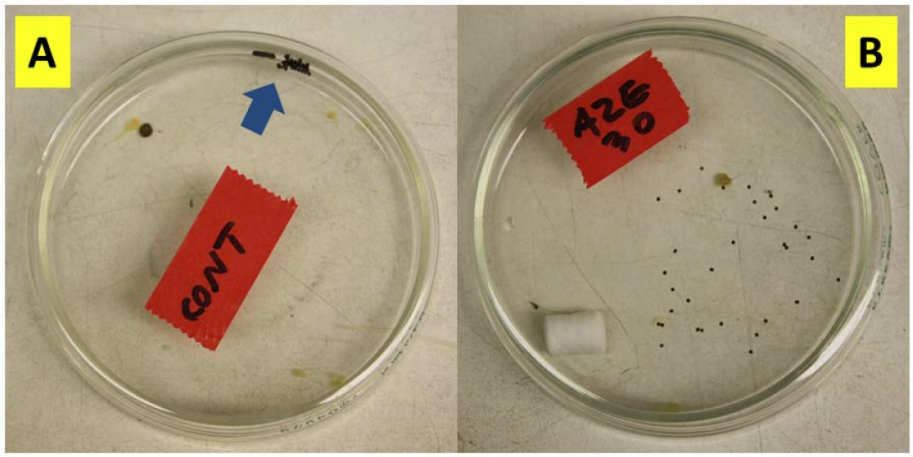
* Mean weight loss followed by the same letters is not significantly different ($P > 0.05$; Tukey's HSD test).

Citation: Gyawaly S, Park YL. Feeding Potential and Prey Acceptance of *Podisus maculiventris* (Hemiptera: Pentatomidae): Implications for Biological Pest Control. J Plant Biol Soil Health. 2013;1(2): 5.

Solder bugs for BMSB Control?



Solder bugs for BMSB Control?



Solder bugs for BMSB control?

Can soldier bugs kill BMSB?

Yes!

Florida Entomologist 85(1) March 2002

PREDATION BY *PODISUS MACULIVENTRIS* ON DIFFERENT LIFE STAGES OF *NEZARA VIRIDULA*

PATRICK DE CLERCQ[1], KRIS WYCKHUYS[1], HARLEY N. DE OLIVEIRA[2] AND JOHANNETTE KLAPWIJK[3]

Solder bugs for BMSB control?

Can soldier bugs kill BMSB?

Yes!

Can soldier bugs effectively control BMSB?

Limited control for immature BMSB

Can soldier bugs be a key solution for BMSB control?

Maybe not!

➡ **Two obstacles to overcome**

Soldier bugs for BMSB control?

Obstacle 1. Not readily available and expensive

SKU: 128

Our Price: $143.50

Item 50 Large Nymphs/Adults

Quantity 1

ADD *to* CART

FREE SHIPPING in the contiguous 48 United States.

Mass Rearing for Five Years @ WVU

Development Time for Soldier Bugs

Stage	Temp. (°C)	*n*	Mean ± SE (days)	Median (days)	Survival (%)
Egg to adult	13.2	0	_	_	0.0
	18.4	20	53.5 ± 0.98a	52.305	6.1
	21.7	48	40.4 ± 0.36b	39.557	31.2
	23.7	56	27.6 ± 0.20c	26.982	29.6
	27.2	76	22.7 ± 0.18d	22.042	31.1
	32.7	84	21.5 ± 0.24e	20.814	8.6
	35.2	0	_	_	0.0
	40.6	0	_	_	0.0

[a] Means within a column for each stage followed by the same letter are not significantly different ($P > 0.05$; Tukey's HSD test at 5 % error rate)

[b] No individual survived

Simulation of Development of Soldier Bugs

Survivorship

$$S(T) = k \times \exp\{-0.5 \times [\ln(T/T_m)/\rho]^2\}$$

Development distribution

$$f(x) = \frac{100}{1 + \exp[-\alpha(x - \beta)]}$$

Rate of development

$$R(T) = n \times T(T - T_b)(T_L - T)^{\frac{1}{m}}$$

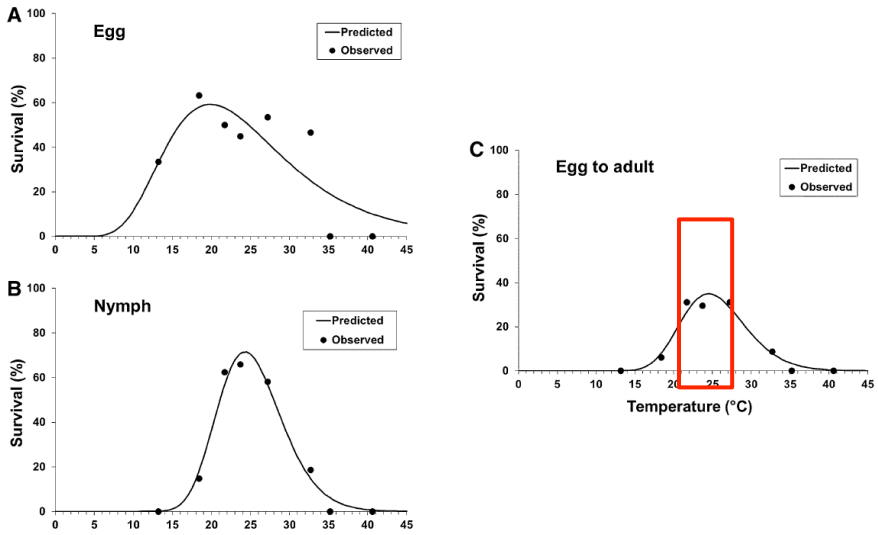
Simulation

$$F(t, T) = \frac{N \times S(T)}{1 + \exp\{-\alpha[t \times R(T) - \beta]\}}$$

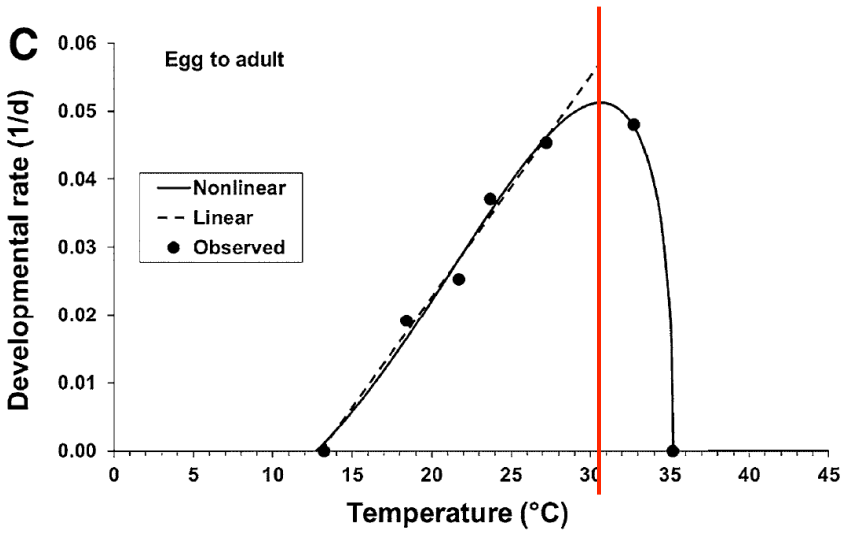
Temperature-dependent development and survival of *Podisus maculiventris* (Hemiptera: Pentatomidae): implications for mass rearing and biological control

J Pest Sci (2014) 87:331–340

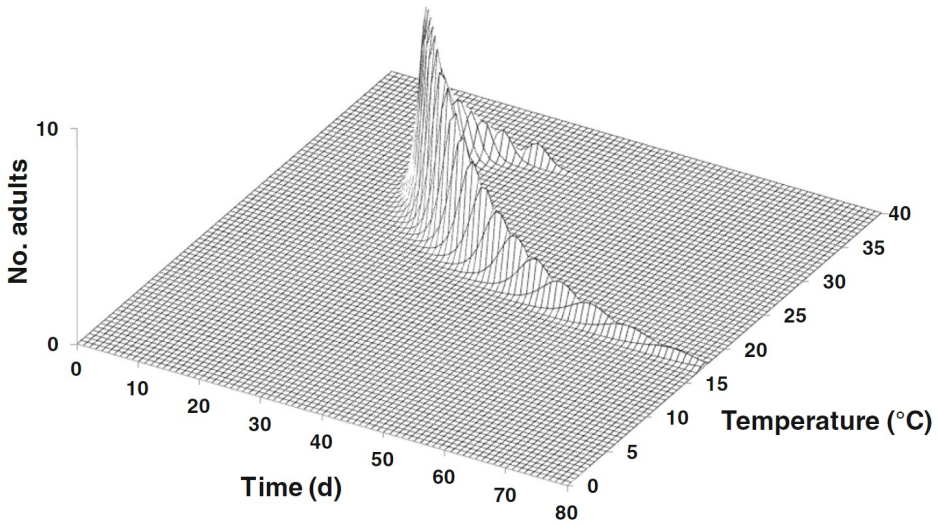
Temperature-Dependent Survivorship



Temperature-Dependent Development



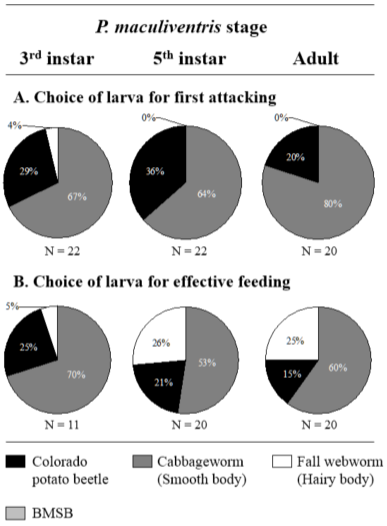
Simulation of Development



24.5ºC for highest survival and 30.6ºC for fastest development

Soldier bugs for BMSB control?

Obstacle 2. They are generalist predators

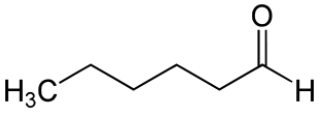


Attracting Soldier Bugs



Attracting Soldier Bugs

Aggregation pheromones



(E)-2-hexanal

Aggregation Pheromones

Pheromones are commercially available

Spatial Relocation of Soldier Bugs

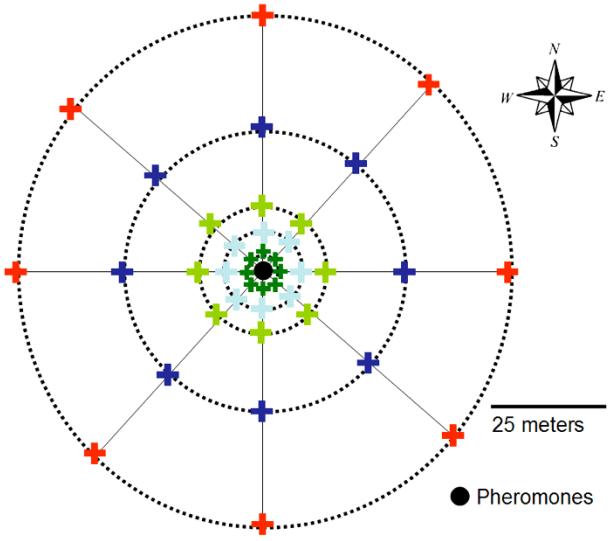
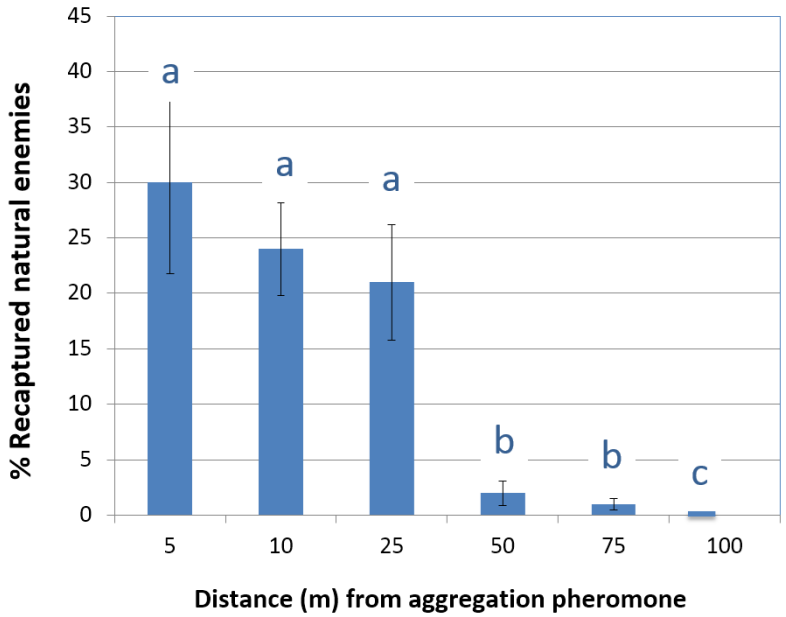


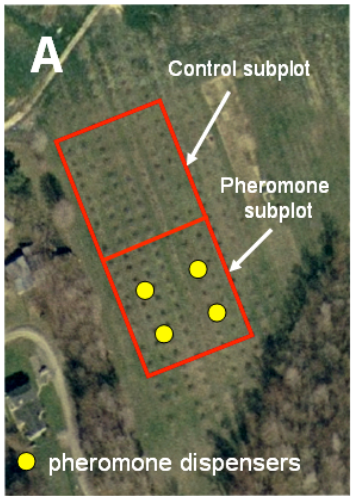
Fig. 1. Spatial layout of natural-enemy releasing locations (✚).

Spatial Relocation of Soldier Bugs

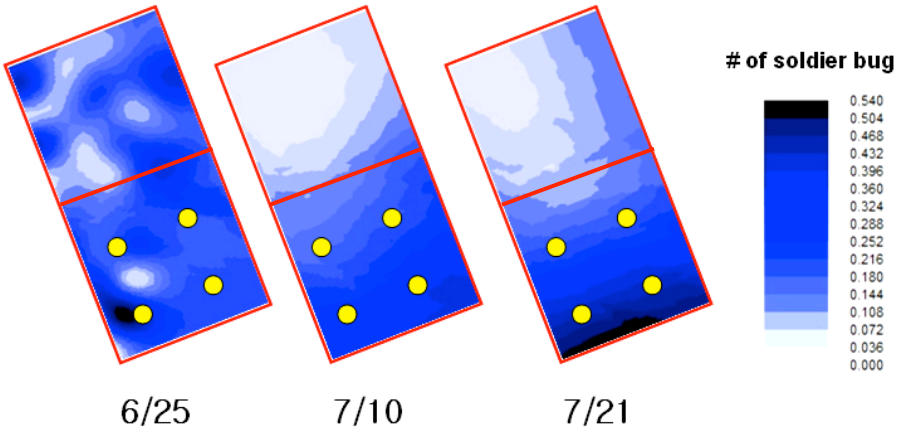


Spatial Relocation of Soldier Bugs

Using aggregation pheromone



Spatial Relocation of Soldier Bugs



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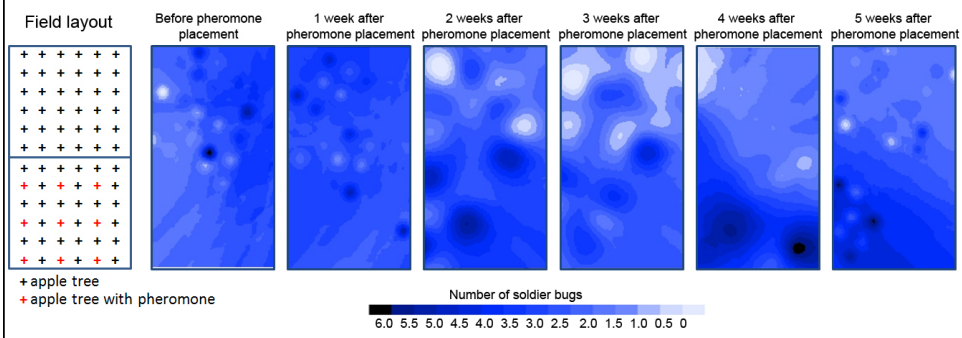
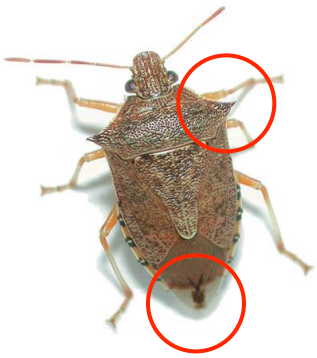


Take-Home Message

Spined soldier bug



Correct identification

Generalist predator

Control immature BMSB

Attracting using pheromone

Pesticide susceptibility

Acknowledgement

Funding Sources

- USDA NIFA OREI
- WV Specialty Crop Block Grant
- State Horticulture Association of PA

Stink Bugs