

# Who are the native natural enemies in the southeast?

Glynn Tillman, USDA, ARS

Michael Toews, University of Georgia



*Funding*

 United States Department of Agriculture    National Institute of Food and Agriculture  
Specialty Crop Research Initiative

*Collaborating Institutions*

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.



- 2017-2018: examined predation and parasitism of sentinel BMSB egg masses in orchards, vineyards, vegetables, and row crops and adjacent woodlands in Georgia and Alabama
- 2019: in addition examined wild egg masses for predation and parasitism in row crops

# Categories of predator damage to stink bug eggs

- ❖ Chewing predation
  - Complete chewing
  - Incomplete chewing
- ❖ Piercing-sucking predation
  - Stylet sucking
  - Non-stylet sucking
  - Hole sucking (newly described)
- ❖ Punctured sucking predation
- ❖ Taken predation (newly defined)

# Complete chewing

52.6% of total predation

Grasshoppers  
Katytids  
Crickets



Video by Aaron Prewitt



Photo by Elijah Talamas

# Egg removal

22.7% of total predation

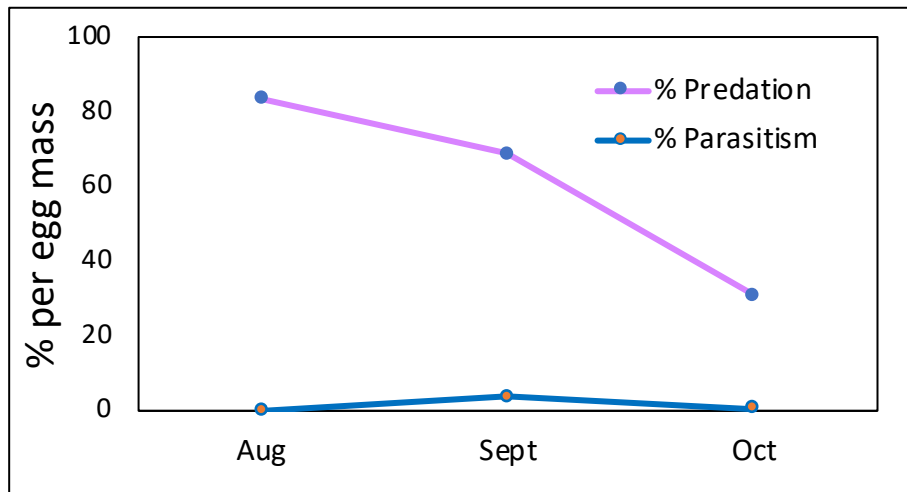
Ants



Video by Rao Balusu

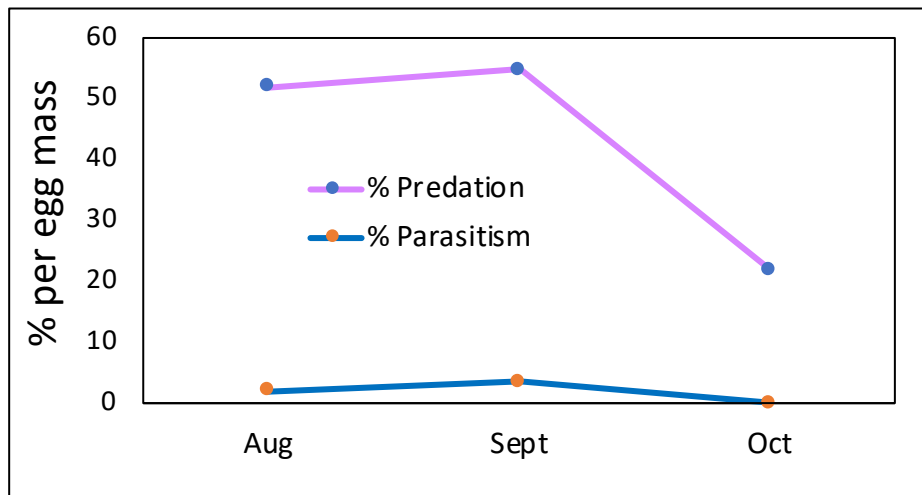
# Fate of sentinel BMSB egg masses in cotton and soybean at Prattville Research Center in Alabama in 2017

Cotton



Grasshoppers and fire ants  
key predators in soybean and  
cotton

Soybean



# Incomplete chewing

6.4% of total predation

Carabidae  
Dermaptera

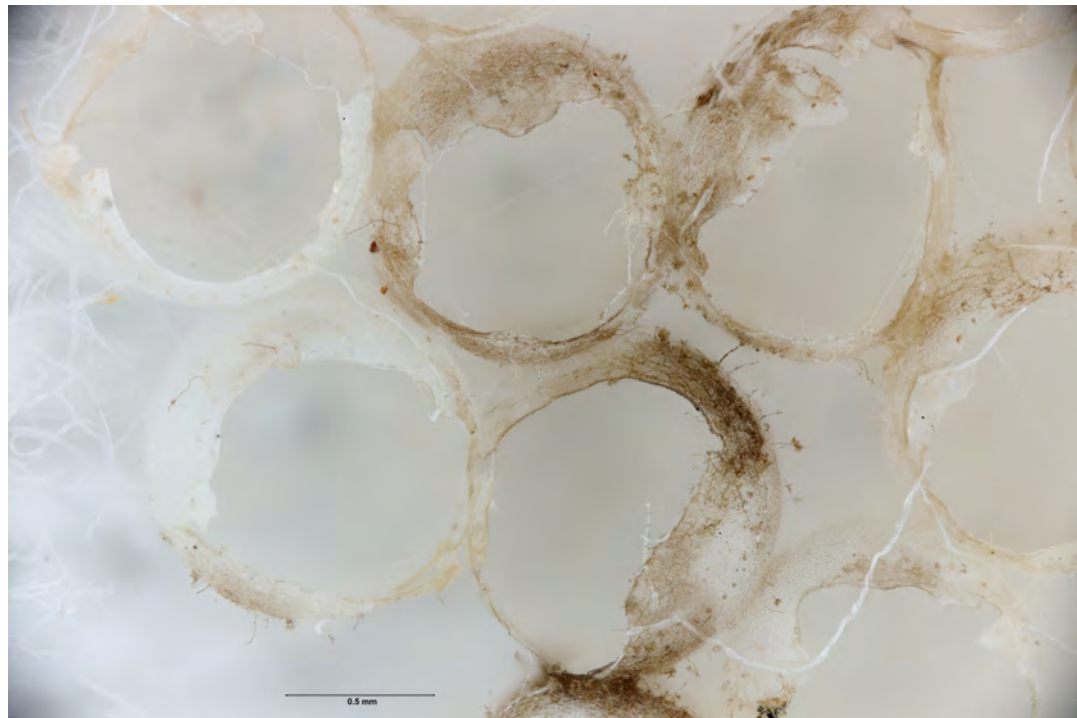
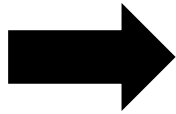


Photo by Elijah Talamas

# Stylet sucking

12.6% of total predation

Anthocoridae



Pentatomidae



Photos by Kristie Graham

Photo by Elijah Talamas



# Non-stylet sucking

3.0% of total predation

Nabidae

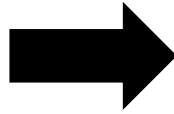


Photo by Kristie Graham

Photo by Elijah Talamas

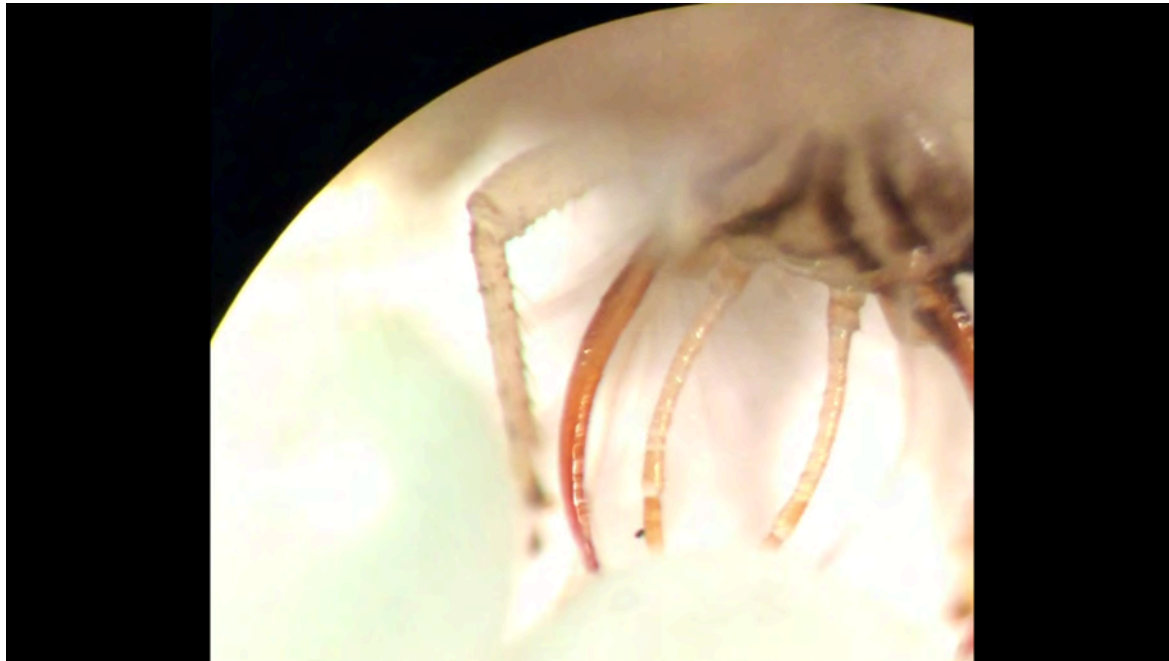
# Hole sucking

1.0% of total predation

Chrysopidae



Late instar green lacewing  
Photo by Brian Little



Video by Kristie Graham

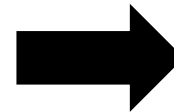


Photo by Elijah Talamas

# Punctured sucking

1.7% of total predation

Salticidae



Photo by Aaron Prewitt



Photo by Elijah Talamas

# Native Stink Bug Species in the Southeast US

- *Nezara viridula* - southern green stink bug (SGSB)
- *Euschistus servus* – brown stink bug (BSB)
- *Euschistus tristigmus*
- *Euschistus quadrator*
- *Euschistus ictericus*
- *Chinavia hilaris* – green stink bug (GSB)
- *Thyanta c. custator* - red shouldered stink bug
  
- *Edessa bifida* - Edessa stink bug (ESB) (soybean)
  
- *Podisus maculiventris* – spined soldier bug (PM)

# Parasitoid species emerging from native stink bugs in row crops and woodlands in the southeast in 2002-2019

Parasitoid species	Stage	Row crops					Woodlands			
		corn	cotton	peanut	soybean	sorghum	elderberry	mimosa	black cherry	pecan
<i>Trissolcus edessae</i>	E	ESB	GSB/ESB		GSB/ESB		GSB/BSB	GSB	GSB	GSB
<i>Tr. euschisti</i>	E	BSB	BSB			BSB	BSB			
<i>Tr. brochymenae</i>	E	BSB/SGSB	BSB				BSB			
<i>Tr. basalis</i>	E			SGSB/BSB						
<i>Tr. thyantae</i>	E	BSB/SGSB		BSB/SGSB		BSB/SGSB				
<i>Telenomus podisi</i>	E			BSB-PM/SGSB			BSB		BSB	
<i>Gryon obesum</i>	E	SGSB/BSB	SGSB/BSB	BSB						
<i>Anastatus redivii</i>	E						GSB/BSB	GSB	GSB	GSB
<i>Anastatus mirabilis</i>	E						GSB			
<i>Ooencyrtus spp.</i>	E			SGSB-BSB			SGSB-BSB			
<i>Acroclisoides sinicus</i>	E		SGSB/Ted-Tba					GSB/Ted		
<i>Trichopoda pennipes</i>	N-A				SGSB +					
<i>Cylindromyia binotata</i>	A				BSB +					

Only the 4 species with gray background not found in corn; *Anastatus* only in woodlands.

# Occurrence of primary parasitoid species emerging from parasitized BMSB egg masses in woodland, orchard, vegetable, row crop, and vineyard habitats in cropping systems in 2017 and 2018

5

Frequency (%) by habitat for a species

Parasitoid species	Woodland	Orchard	Vegetable	Row crop	Vineyard
<i>Anastatus redivii</i>	55.3	43.7	.	0.5	0.5
<i>Anastatus mirabilis</i>	75.0	25.0	.	.	.
<i>Trissolcus brochymenae</i>	56.2	37.5	1.6	1.6	3.1
<i>Trissolcus euschisti</i>	43.3	52.2	.	1.5	3.0
<i>Trissolcus edessae</i>	10.8	59.5	.	5.4	24.3
<i>Ooencyrtus</i> sp.	25.2	35.5	33.7	5.1	1.1
<i>Telenomus podisi</i>	21.8	33.3	20.3	14.5	10.1
<i>Trissolcus solocis</i>	25.0	37.5	.	37.5	.
<i>Trissolcus basalis</i>	.	.	86.7	13.3	.
<i>Gyron obesum</i>	.	7.1	85.8	7.1	.

- *Anastatus* spp., *Tr. brochymenae*, and *Tr. euschisti* most prevalent species in woodland and orchard habitats
- *Tr. edessae* primarily in orchards
- *Te. podisi* and *Ooencyrtus* sp. predominant species in row crops
- *Tr. basalis* and *G. obesum* mainly present in row crops and vegetables

# New Record of a Native Parasitoid Species Emerging from BMSB Eggs



*Trissolcus solocis*  
photo by Elijah Talamas

- unmanaged cotton and sassafras in 2017 in Alabama
- unmanaged blueberry and plum in 2018-2019 in Georgia
- Rarely recovered from BMSB eggs and never recovered from native stink bug eggs
- Emerged from only frozen BMSB eggs; further research needed to determine if the species is physiologically able to develop in viable eggs

# New Record of a Native Parasitoid Species Emerging from BMSB Eggs in the US



- Emerged from both fresh and frozen BMSB eggs in tomato, okra, corn, cotton and soybean
- Previously reported emerging from BMSB eggs in Italy and China

*Trissolcus basalis*

Photos by Elijah Talamas



# Occurrence (%) of parasitoid species emerging from wild stink bug eggs in row crops at the Prattville Research Center in 2019

Stink bug species	Parasitoid species	Corn	Cotton	Soybean
SGSB	<i>Tr. basalis</i>	89.7	82.3	79.9
	<i>Ooencyrtus</i> sp.	4.9	8.1	17.7
	<i>Te. podisi</i>	1.6	2.6	2.3
	<i>Anastatus</i> males	3.8	0.6	
	<i>Tr. edessae</i>		0.4	0.1
	<i>Acroclisoides sinicus</i>			6.0
BMSB	<i>Ooencyrtus</i> sp.	100	60.9	82.1
	<i>Tr. euschisti</i>			
	<i>Anastatus</i>		27.2	0.3
	<i>Tr. basalis</i>		1.1	14.2
	<i>Tr. brochymenae</i>			
	<i>Te. podisi</i>		1.1	1.5
	<i>Tr. edessae</i>		9.8	1.8

*Tr. basalis* primarily parasitizes SGSB in row crops but will parasitize BMSB if occur together.

# Predation and Parasitism of Wild BMSB and SGSB Egg Masses at the Prattville Research Center in 2019

Stink bug species	Corn		Cotton		Soybean	
	% Predation	% Parasitism	% Predation	% Parasitism	% Predation	% Parasitism
BMSB	28.3	20.3	32.8	22.2	33.7	24.7
SGSB	24.7	46.4	10.4	54.4	14.1	71.9

Parasitism higher for SGSB than for BMSB in each crop

# Three points

- Prevalence of parasitoid species emerging from BMSB eggs is mainly habitat specific.
- The composition of parasitoid species attacking BMSB eggs reflects the composition of the pentatomid fauna in that habitat. Important to have some data on native stink bug species in a habitat, even if just trap data.
- Parasitism of stink bug eggs higher for preferred host
  - SGSB: *Tr. basalis*
  - BSB: *Te. podisi*
  - GSB: *Tr. edessae*
  - BMSB: *Tr. japonicus*

*Trissolcus basal* 1<sup>st</sup> instar



Very active; mandibles present

# *Acroclisoides sinicus*



*Acroclisoides sinicus*  
photo by Elijah Talamas

## Hyperparasitoid

- Southeast US:  
GSB: *Tr. edessae*, mimosa  
SGSB: *Tr. basalis*, cotton  
BMSB: *Tr. edessae*, pecan
- Attacks *Anastatus* in other locations
- Recently reared for first time in my lab and lab of Giuseppino Sabbatini Peverieri (Italy)
- Hypothesized attacked later instars of *Trissolcus* spp. because 1<sup>st</sup> instar aggressive
- Based on parasitism at various times of *Trissolcus* development it appears to be attacking late instars or prepupae of *Trissolcus*

# *Gyron obesum* and *Telenomus podisi*



*G. obesum* photo by Elijah Talamas

- Not common: natives and BMSB
- SGSB, row crops
- BMSB, tomato, soybean, peach

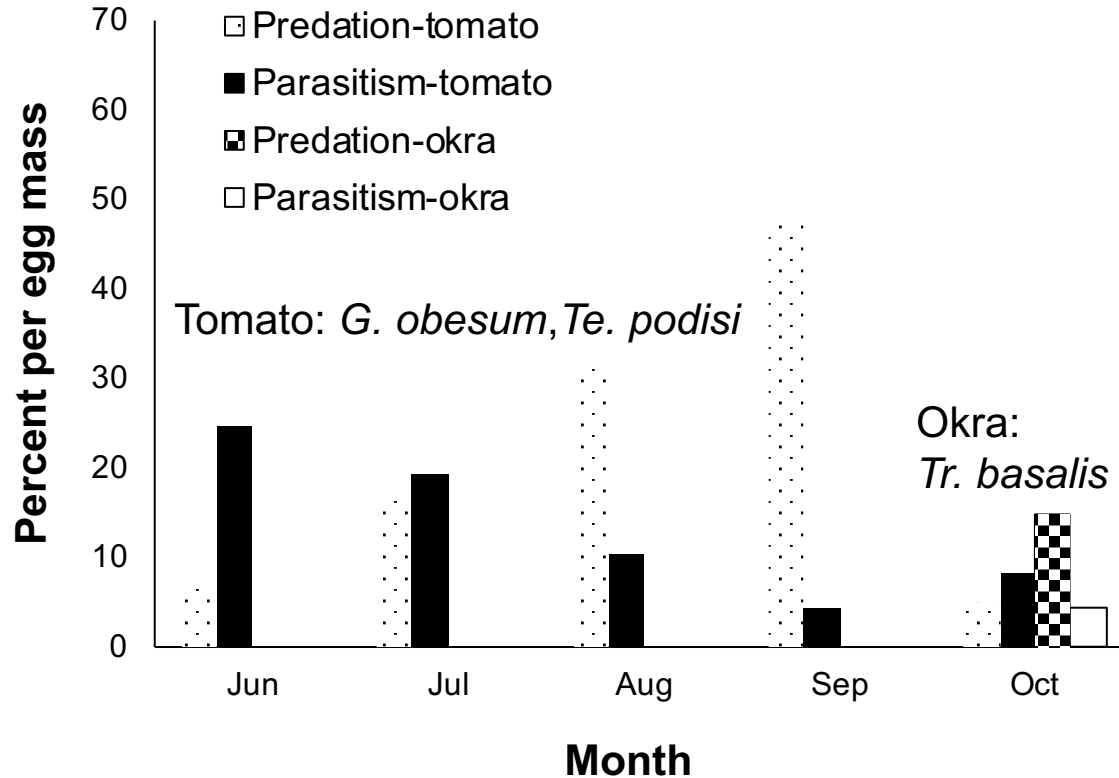


*Te. podisi* photo by Emily Ogburn

- Very common in eggs of BSB and other *Euschistus* species, mainly row crops and woodlands
- Parasitized BMSB in all habitats examined

Successful development to adults and parasitism of BMSB eggs per egg mass were lowest for *G. obesum* and *Te. podisi* indicating a difficulty for these two parasitoid species to develop in BMSB eggs.

# Fate of sentinel BMSB egg masses in tomato and okra at Snow's Bend vegetable farm in 2017



25% parasitism in June

# *Ooencyrtus sp.*



Photo by Ted Cottrell

Attacks BMSB and all native stink bugs in all habitats examined

Occurrence (%) of *Ooencyrtus sp.* emerging from stink bug eggs in host plants at Prattville Research Center in 2019

Species	Corn	Cotton	Soybean
BMSB	100	60.9	82.1
SGSB	4.9	8.1	17.7

Primary parasitoid emerging from BMSB in row crops



# *Trissolcus edessae*, *Anastatus redivii*, and *A. mirabilis*



*Tr. edessae* photo by  
Beatriz Moisset

## *Tr. edessae*

- primary parasitoid species of GSB eggs in woodlands, soybean, and cotton
- parasitized BMSB primarily in orchards, but also woodlands
- successful development to adults, sex ratio, and parasitism of BMSB eggs per egg mass were highest for this species

## *Anastatus* spp.

- both species parasitize mainly GSB eggs in woodlands
- parasitized BMSB primarily in woodlands and orchards
- successful development to adults and sex ratio were high for *An. redivii*

Eggs of both the GSB and BMSB are highly suitable for development of these “woody” parasitoids.



*An. redivii* photo  
by Emily Ogburn

# *Trissolcus euschisti* and *Tr. brochymenae*



*Tr. euschisti* photo by Elijah Talamas

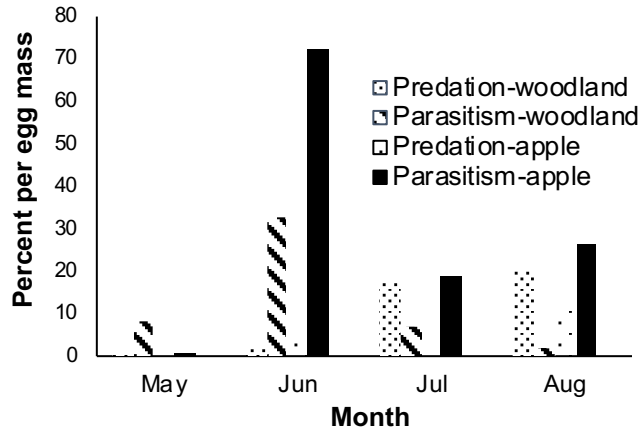


*Tr. brochymenae* photo by Emily Ogburn

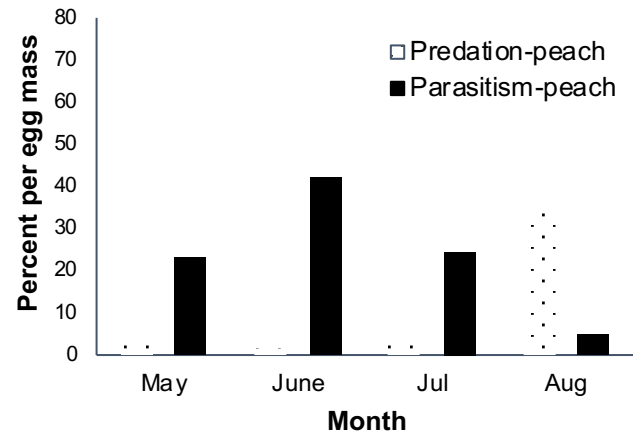
- *Tr. brochymenae*, *Tr. euschisti*, and *Anastatus*, most prevalent species of BMSB in “woody” (woodland and orchard) habitats
- Successful development to adults, sex ratio, and parasitism of BMSB eggs per egg mass relatively good for *Tr. brochymenae* and *Tr. euschisti*

# Parasitism of BMSB Egg Masses in Orchards

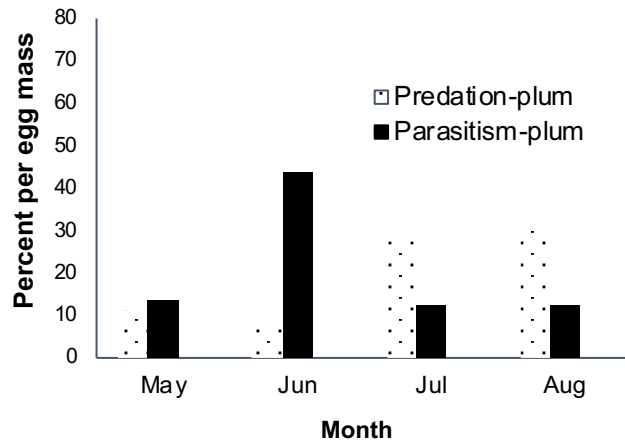
**Woodland: Tbr Teu Ted Tp**      **Apple: Tbr Teu Ted**



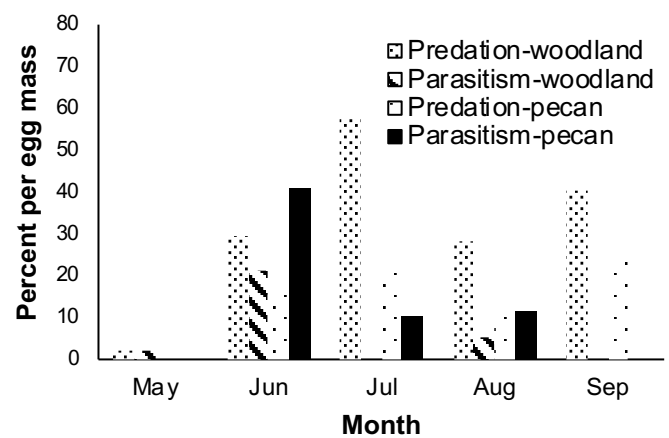
**Peach: Teu Ted**



**Plum: Ar Teu Oo**



**Woodland: Ar Tbr Oo**      **Pecan: Ar Tbr Teu Oo**



Highest rates of parasitism occurred in orchards, and “woody” parasitoid species parasitized BMSB sentinel egg masses in both woodland and orchard habitats.

# Sentinel versus wild egg masses of BMSB in soybean in 2019

Date	Natural egg masses		Sentinel egg masses	
	% Predation	% Parasitism	% Predation	% Parasitism
7/19/19	20.1	46.2	76.3	11.1
7/27/19	40.6	27.6	48.0	25.6
8/3/19	27.9	12.8	52.5	8.4
8/10/19	30.4	20.2	37.7	4.1

- Using sentinel eggs can result in overestimating predation or underestimating parasitism in soybean
- Examine wild eggs if possible. Use ovipositional cages for natural egg masses.

# Challenges natural enemies of stink bugs face in farmscapes in the southeast US

Insecticides: direct contact, residual contact, and ingestion of Bidrin kills *Trichopoda pennipes*

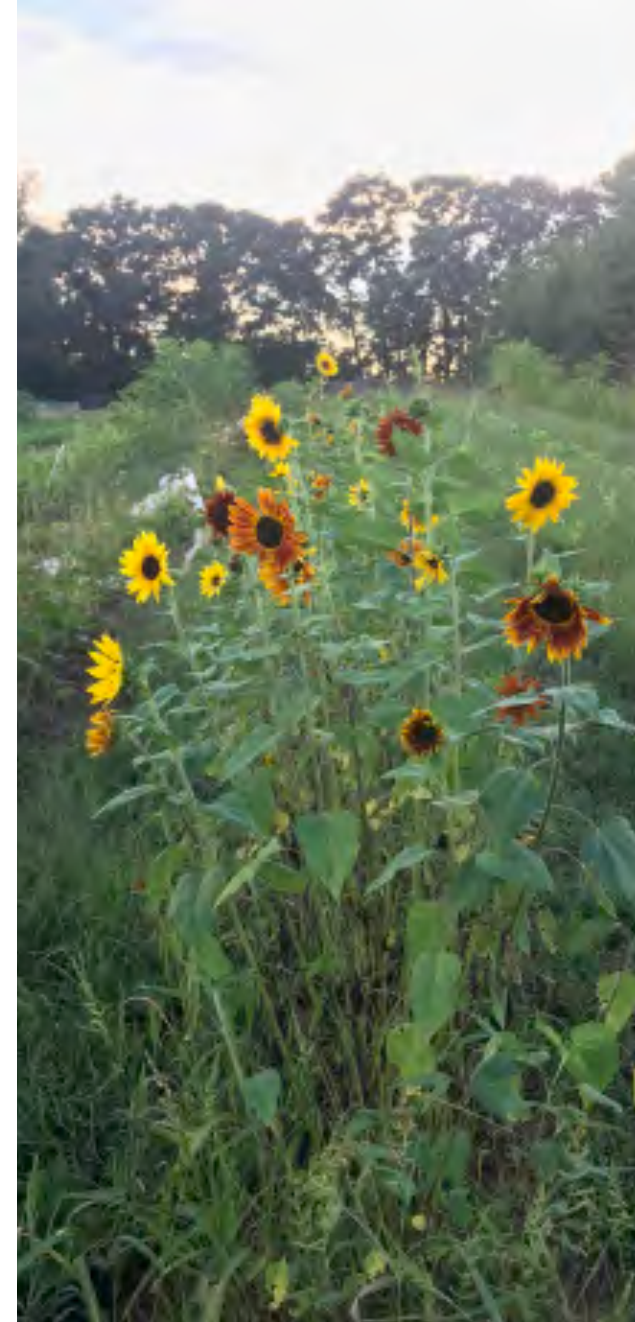
Lack of food for adult parasitoids

Variable weather conditions

# Wildflower Plantings for Resources and a Refuge

All stink bug parasitoids currently present in the southeast face these challenges and so will *Tr. japonicus* when it arrives.

Wildflower plantings bordering crops or woodlands could provide needed resources such as nectar, serve as a refuge from pesticides, and in addition improve pollinator health.



**Foster-Brady  
Certified  
Naturally-Grown  
Vegetable Farm  
Monroe, GA**

- Blueberry and strawberry early season; tomato and okra late season
- Flowers planted in patches and rows for food for parasitoids and insect pollinators and protective habitat for predators

Thanks to my technician  
Kristie Graham (orange  
shirt) and all my student  
workers for their hard  
work scouting for BMSB.  
Wherever...

