Stink Bug Management with Trap Cropping

Dr. Russell F. Mizell III, University of Florida

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http://www.extension.org/organic_production

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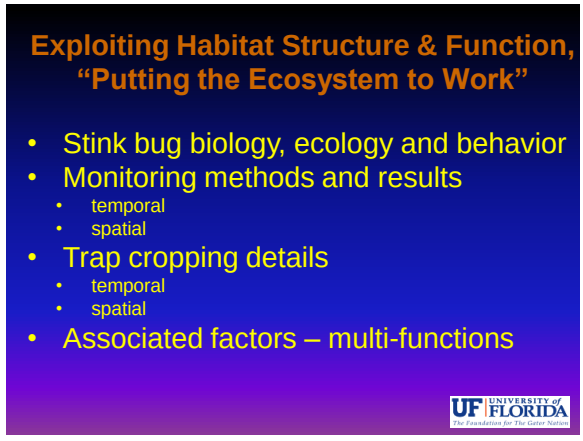
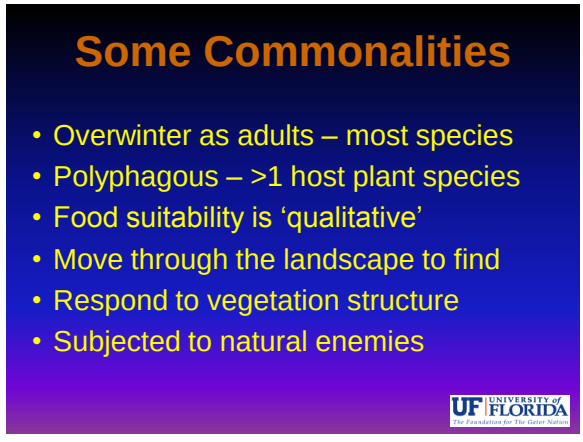




Some Commonalities

- Have common natural enemies
- Highly tolerant to insecticides
- Relatively little knowledge for some spp.
- Other tools not available – big problem!
- Incremental approach required

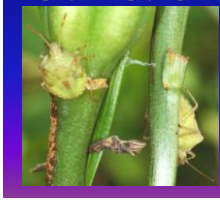
4 Major Species of Stink & Leaffooted Bugs In Southeast

Euschistus servus

Nezara viridula

Chinavia hilaris (was Acrosternum hilare)

Leptoglossus phyllopus



Other Common Phytophagous Stink Bugs

Euschistus
Thyanta
Banasa
Oebelus
Proxys
Brochymena
**Piezodorus*
**Halyomorpha*
**Megacopta*

**New invasive species-bad*

Common Stink Bug Immature Life Stages

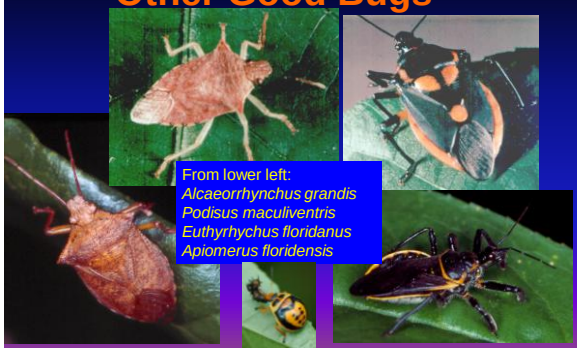
Stink Bug Morphology By Sex (*Euschistus servus*)

Other True Bugs

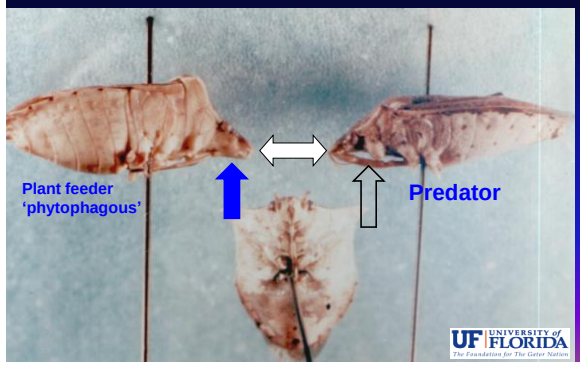
Acanthocephala femorata

Largus succinctus L.

Predacious Stink Bugs & Other Good Bugs



Phytophagous vs Predacious



Stink Bug Natural Enemies
Wasp Egg Parasites & Tachinid Flies

Current & Future Management

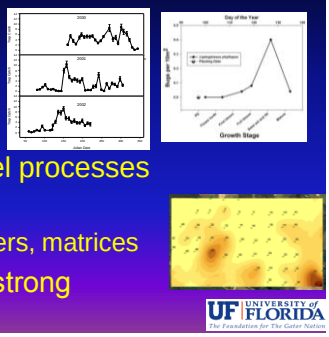
- Insecticides - problematic - tolerance
- No efficient monitoring methods for *Nezara, Chinavia* or *Leptoglossus* spp.
  - perhaps won't be anytime soon - semiochemicals?

My Goals:

- Strategies: scale- & philosophy-neutral
  - habitat manipulation – landscape level
  - exploit structure and function
- Tactics - multiple
  - trap crops (functional plants)
  - augment biological controls
  - use behavioral tools

Understanding Bug Behavior & Dynamics

- Phenology
- Food quality
- Movement
- Landscape level processes
  - structures
  - corridors, barriers, matrices
  - 'edge effect' strong



Monitoring and Detection

- Must have!
- Efficiency – labor, costs
- Statistics – accuracy, precision

Florida Stink Bug Trap

Dr. Russell F. Mizell, III, Inventor

- Captures many Hemiptera species
  - Both phytophagous and predacious
- Visual attraction is primary
- Baits can be easy deployed
- Materials: 4 right triangles
  - 1/4" masonite, screen wire,
  - 1/4" x 4' metal rod, twist ties
- "Triangle's dimensions:
  - 4' high, 11" base, 1" top
- Deploy in the open

Potential Tops for the Florida Stink Bug Trap

A. B. C. D.

A & B will work, C. & D. will not work.

Commercial Traps Available

url:ufinsect.ifas.ufl.edu

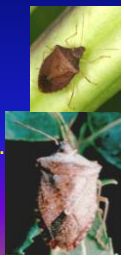
Stink Bug Trap - AgBio, Inc.
www.agbio-inc.com/stink-bug-trap.html

Temporal and Spatial Distributions

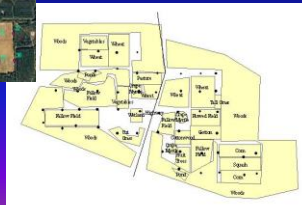
Where are the bugs in time and space?

Landscape Level Distribution & Population Dynamics Study

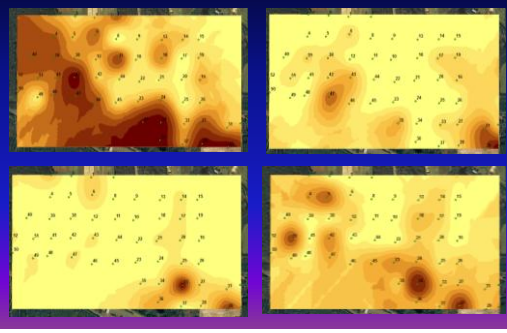
- R. Mizell, J. Greene, T. Cottrell,
- Years 2000-2002
- Locations -Florida and Georgia (2)
- 3 – 1 sq mile plots for 2 years+
- 750' grid of stink bug traps w/pheromone for *Euschistus* spp.



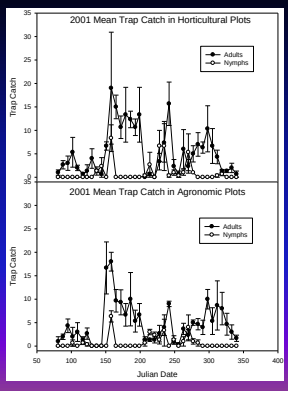
NFREC-Quincy Location



Locations with High Populations of *Euschistus servus* (scale neutral)



Combined Plot Means



- **Temporal patterns are not significantly different, P = 0.909; Repeated Measures Analysis**
- **Note: Nymphs are late instars only**

Summary

- GIS - provides unique perspectives on bug distribution/abundance
- Distribution and abundance driven by food quality and landscape structure
- Application toward new strategies and tactics
- Research: exploiting these ideas and other research toward bug management
- Stink bugs move around – a lot!
  - Aggregated on food plants

Movement Mechanisms?

What is driving the behavior ?

How can we exploit it?

Two Important ?? & H_0:

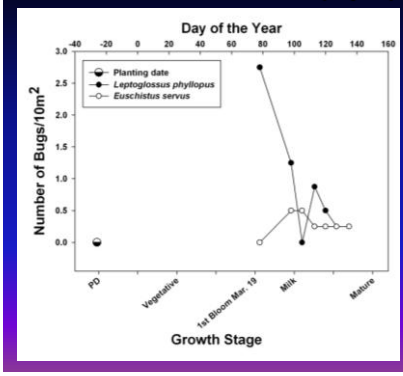
1. Where in Space and what are stink bugs doing over Time at the farmscape level?

2. What biologically-based management strategies could exploit these stink bug behaviors in farmscapes?

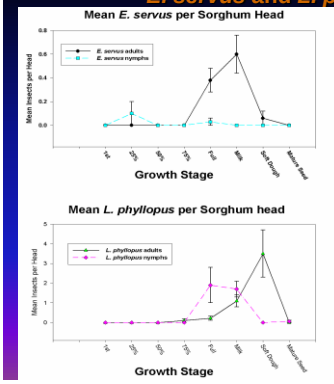
H_0: Trap crops alone or in conjunction with other tools at the interface of two habitats can prevent dispersal of stink bugs into a target crop.

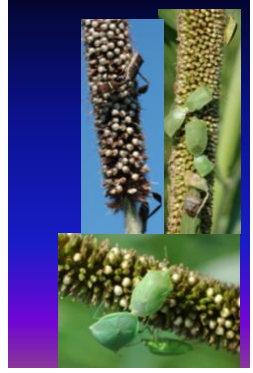
(Slide courtesy of Dr. P. Glynn Tillman)

Differential Use of Triticale Growth Stages by *E. servus* and *L. phyllopus*

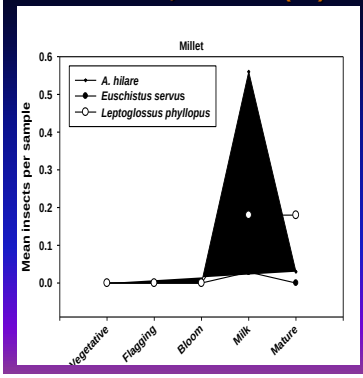


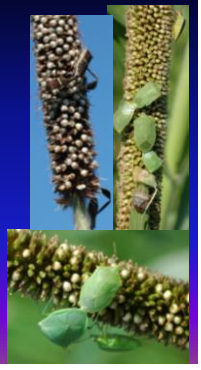
Differential Use of Sorghum Growth Stages by *E. servus* and *L. phyllopus*





Differential Use of Millet Growth Stages by *E. servus, C. hilaris* (Es) and *L. phyllopus*





Mechanism

- Food quality very important!!!
  - not "preference"*, generalists
- Life stages and species differ somewhat – very close
- Phenology (timing) related statistic
- Driving variable!

- **Application – tools, trap crops**

Theory Literature Supports

- **Ecology**
- **Insect population dynamics**
- **Agro-ecology**
- **Insect behavior**
- **Habitat manipulation strategies**
- **Trap crops**
- **Stink bugs**

Potting et al. 2005. "Insect behavioral ecol. & other factors affecting the control efficacy of agro-ecosystem diversification strategies". Ecol. Modeling 182:199-216

Simulation study comparing pest guild behavior and habitat manipulation strategies/tactics

Results:

- Spatial: colonization pattern, movement speed, sensory modality finding host plant
- Trap crop strength of flight inhibition – post alighting type
- Visual and olfaction insects – trap crop attraction and arrestment
- For disruption – strength of emigration inducement by vegetation
- % cover and pest movement rate
- Colonization pattern- spatial arrangement (pattern, size, placement) related to movement method

Summary – So Far

- Behavior – understanding required
- Phenology – seasonal abundance
- Food quality change – mechanism
- Spatial distribution changes - time
- Structure is important – literature
  - affects movement "perceptual range"
  - **Edge effect** very strong
- Exploitation? Habitat manipulation using trap crops and other tools.

Trap Crop Approach

- Small area w/ highly competitive hosts
- Economical - $$$
- Strategic placement (GIS/GPS)
  - adjacent (?) to cash crops (Potting et al. 2005)
  - must intercept them!!!!!
- Minimize side effects & mgmt difficulties
- Combine with other tactics
- For all growing seasons

Cash Crop-Trap Crop Coincidence (phenology)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cash Crop		++++	++++	++++	++++	++++	++++	++++	++++	
Trap crops		------	------						-----	------
⬇			------	-----	------	------				
					-----	------	-----	------		
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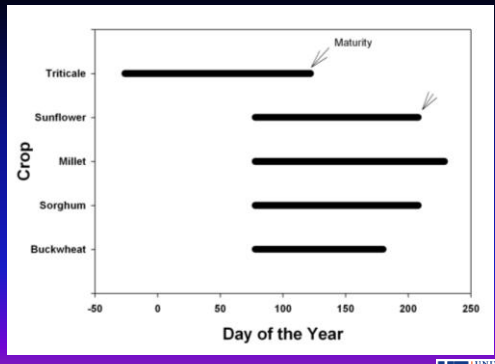
Characters: maturity date, longevity, ratooning, other

Time of Year by Trap Crop Species



What Are the Ideal Features of Trap Crops?

- Attract required pests (multiple species)
- Seeds available (natives?)
- Economical -$$$
- Culture & management - seasons
- Minimal side effects (invasive, other pests)

Trap Crop Ideal Features, cont.

- Maturity time – length, cv range
- Good duration (ratooning)
- Height – barrier
- Multi-functions (beneficials, poll., wildlife)
- Special note*: native vs exotic plant use

Must have something that works!

What Information Is Required for Success?

- Host plant range and phenology
- Source - inside or outside cash crop
- Dispersal – movement behavior
- Behavioral cues
- Natural enemies

Required Information for Success, cont.

- Insecticide susceptibility
- Monitoring methods
- Trap crop hosts – C&M, $, physical
- Other tools to combine
- Methods- removal from trap crop

Trap Crop Specifics

Fall-Spring:

- Triticale (crimson clover, h or c vetch (F)- NE)
- Sunflower, buckwheat (Sp), barnyard grass

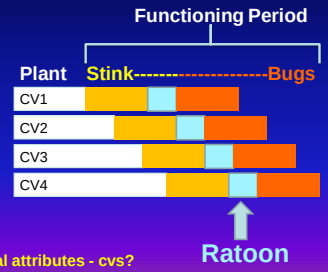
Spring-Fall

- Sorghum, millets, sunflower, buckwheat
  - barnyard grass, field peas, okra (pots?),
- Maturity times – multiple CVs
- Ratoon – after heading
- Use multiple tactics

Trap Crop Novel Features

- Ratooning = **Mowing**
  - At strategic time
  - All plant species NOT amenable
  - Saves plantings by extending efficacy
  - Saves $$ - less input time & costs
  - Negative: same location – double cropping

How to Exploit Sorghum Maturity Range & Ratooning



Physical attributes - cvs?
Height, color, etc.

Trap Crops Farm Scale and Philosophy Neutral

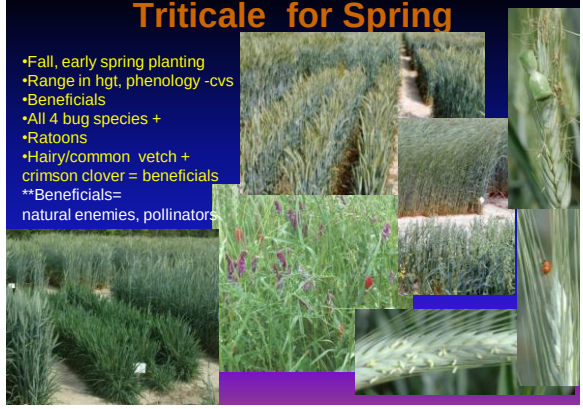
Where do you place them relative to the cash crop for interception?

Trap Cropping 2006-2007 NFREC
Beneficial Augmentation as Side Benefit

Triticale for Spring

- Fall, early spring planting
- Range in hgt, phenology -cvs
- Beneficials
- All 4 bug species +
- Ratoons
- Hairy/common vetch + crimson clover = beneficials

**Beneficials= natural enemies, pollinators



Buckwheat

- Cheap, easy
- Fast maturing – 4-5 wks
- Ratoon, easy plant
- Soil temp, frost – good
- All 4 species +
- Organic crop
- "RELAY" crop
- Beneficials!!

Sorghum

- Maturity- 70-90 days
- Soil temp & frost -kills
- Ratoons well
- Germplasm – variable
- All 4 species +
- Beneficials
- Pots
- Organic

Pearl Millet

- Cheap, easy
- Low soil temp & frost - bad
- Ratoons
- 70-90 days to maturity
- Beneficials
- Pots
- Germplasm- variable
- Organic crop
- All 4 species +

Sunflower

- Cheap, easy
- Low soil temp & frost - good
- Beneficials!!!!!
- Containers
- Germplasm- variable
- Organic crop, biodiesel
- Ratoon- no

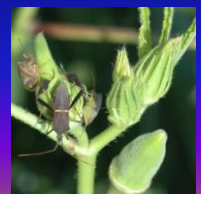
Japanese Millet: 'Barnyardgrass' *Echinochloa crus-galli*

- Cheap, easy
- Maturity 6-7 weeks
- Beneficials
- Containers
- Germplasm
- All 4 species +
- Short attraction time
- 3-4' in height
- *Can be invasive - aquatic*

Other Species w/Potential? Field Peas & Okra

Field Peas
- Cheap - easy
- Extrafloral nectaries
- Previous work+
- Height-short; trellis?
- Cultivars

Okra: (containers)
- Cheap, must manage!
- Beneficials, EFN
- Rootknot nematodes neg.
- Ratoons



Other Species w/Potential? Hemp Sesbania (Y/N?), Hairy Indigo, *Crotolaria* – (N)

Hemp Sesbania: ??
- Height – tall - barrier
- Not all SB species
- *Oebalus* spp.
- Invasive

Hairy indigo – weedy, nematode suppressor+

Showy Crotalaria- poisonous to cattle

Other Species w/Potential? Browntop Millet – No; Wildlife

- Cheap, easy
- Doesn't last long
- 5-6 weeks
- Height - short
- Attracts beneficials, pollinators
- +*Oebalus* spp.
- Weedy - invasive

Containers for Portability, Visual/chemical Cues Enhance

Yellow trap –Attraction - 4X increase in *H. axyridis*

Trap Crop Summary

Fall-Spring:
- Triticale (crimson clover, hairy vetch) (F)
- Sunflower, buckwheat (Sp)

Spring-Fall
- Sorghum, millet, sunflower, buckwheat
  - okra, field peas, others
- Multiple species and cultivars
- Ratoon – after heading
- Portable containers, greenhouse starts
- Remove pests: by hand, vacuum or spray
- Add in other tools: traps, pheromones, BC, etc.

Some Other Ideas

Physical properties, barriers:

- Height ⬆-trap crop via cultivar selection
- Configuration of plants
  - – short to tall toward cash crop
  - – density of trap crop plants
- Trellis of vines like field peas - ⬆ height
- Exploit visual components
  - – Use of visual repellent – UV mulch
  - – Use best colored cultivar
- Artificial materials – netting, etc.

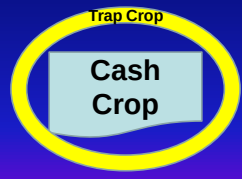
Brown Marmarated Stink Bug

- **Invasive pest, like few others!**
- **Double whammy – plants and buildings**
- **Major research efforts underway in conventional and organic**
- **Trap crops: are being developed and tested. Look to have promise.**
- **Various cucurbits and others? TBD**

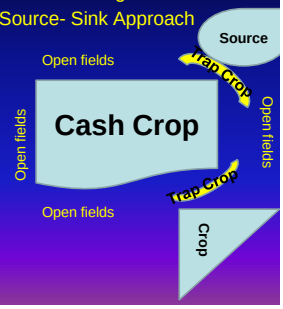
Trap Crop Spatial Orientation
Interplanting- NO!!!
Edge Interception – Yes!

Spatial Configurations
Aerial Plats

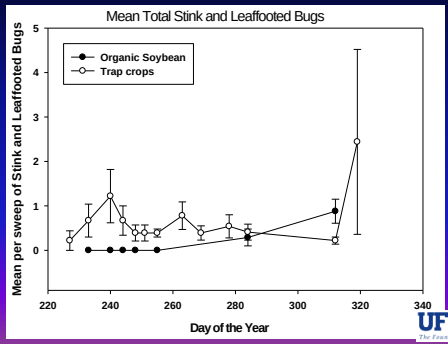
Unknowns
Default – Ring It



With Knowledge:
Source- Sink Approach

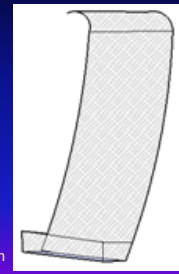


Trap Crop Efficacy,
Edge of Organic Soybean



Management in the Trap Crop

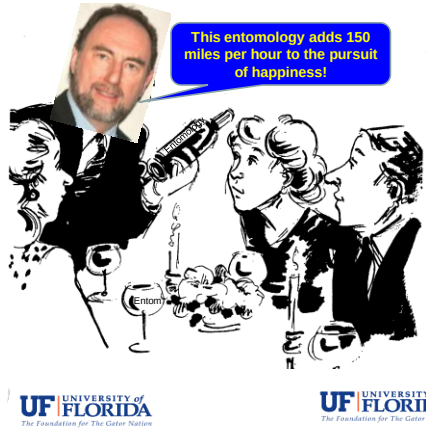
- **Insecticides ?**
- **Mechanical**
  - – by hand
  - – sweep net
- **Vacuum device**
- **Blower – catcher**



4' x 7' PVC frame with netting + blower

Research: Multifunctional Plots Augment Ecological Services

Plant Species	Common Name	Season of Service	Ecological Service: Flowers, Nectar[1], Pollen, Fruit and Seeds for: Pollinators	Beneficial Insects[2]	Butterflies	Wildlife	Trapping: Stink and Leaffooted Bugs
Trees							
Callistemon viminalis	Weeping bottlebrush	Wi-Sp	X	X	X	X	
Cercis canadensis	Redbud	Sp-Su	X			X	
Cornus florida	Dogwood	Sp				X	
Ilex opaca	American holly	Su-Fa	X	X		X	
Lagerstroemia indica/fauri	Crapemyrtle	Su-Fa	X	X	X		
Malus angustifolia	Crabapple	Su-Fa	X	X		X	
Osmanthus fragrans	Tea olive	Wi-Sp	X				
Prunus persica	Peach[3]	Sp	X	X	X	X	
Prunus sp.	Wild Plum, plum[3]	Sp-Su	X	X		X	
Shrubs							
Abelia sp.	Glossy abelia	Su-Fa	X		X		
Camellia spp.	Camellia	Wi-Sp	X	X			
Clifionia monophylla	Buckwheat tree[3]	Sp	X			X	
Fatsia japonica	Japanese aralia	Fa-Wi	X	X	X		
Lonicera fragrantissima[4]	Win. honeysuckle	Wi-Sp	X			X	



The End

Thank You!

Questions

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