Stink Bug Management with Trap Cropping
Dr. Russell F. Mizell, III, University of Florida

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Exploiting Habitat Structure & Function, “Putting the Ecosystem to Work”

• Stink bug biology, ecology and behavior
• Monitoring methods and results
  • temporal
  • spatial
• Trap cropping details
  • temporal
  • spatial
• Associated factors – multi-functions

Webinar’s Application by Location? Depends! Southeast – Yes!
I will discuss what is known and what one needs to know. Apply it?
• Stink bugs and related spp. are ubiquitous
• Other species in similar ecological niches
• Behaviors somewhat variable – similarities
• Principles are common among species
• Trap crop plants may need tweaking – natives vs invasives?

Some Commonalities

• Overwinter as adults – most species
• Polyphagous – >1 host plant species
• Food suitability is ‘qualitative’
• Move through the landscape to find
• Respond to vegetation structure
• Subjected to natural enemies
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)

- Female
- Male

Other True Bugs

- Acanthocephala femorata
- Largus succinctus L.
Predacious Stink Bugs & Other Good Bugs

From lower left:
Alcaeorrhynchus grandis
Podisus maculiventris
Euthyrhychus floridanus
Apiomerus floridensis

Phytophagous vs Predacious

Plant feeder "phytophagous"

Predator

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

Temporal and Spatial Distributions
Where are the bugs in time and space?

Commercial Traps Available
www.agbio-inc.com/stink-bug-trap.html

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

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 ?? & H₀:

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?

H₀: 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


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)

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<th>Mar</th>
<th>Apr</th>
<th>May</th>
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Characters: maturity date, longevity, ratooning, other

Time of Year by Trap Crop Species

- Triticale
- Sunflower
- Millet
- Sorghum
- Buckwheat

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

Functioning Period

Plant

Stink

Bugs

Physical attributes - cvs? Height, color, etc.

Ratoon

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 Crotolaria poison 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
Unknows
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

Mean Total Stink and Leaffooted Bugs
Mean per sweep of Stink and Leaffooted Bugs

Day of the Year
220 240 260 280 300 320 340
Organic Soybean
Trap crops
Research: Multifunctional Plots Augment Ecological Services

<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Common Name</th>
<th>Seed of Service</th>
<th>Ecological Service</th>
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This entomology adds 150 miles per hour to the pursuit of happiness!

The End
Thank You!

Questions
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