Updates on Turf Insect Integrated Pest Management

Adam Dale, PhD

Turf & Ornamental Entomology

Entomology & Nematology Department

UF|IFAS

UNIVERSITY of FLORIDA

Urban & residential landscapes

- Over 90% of Florida's 21+ million people live in urban/residential areas
- Turfgrasses are arguably the most common plant in these spaces
- Turfgrass management & health directly affects most people

Unfortunately…

Lawns are frequently attacked by insect pests…

- The evidence
  - Southern chinch bug, *Blissus insularis*
  - Southern & tawny mole crickets, *Neoscapteriscus spp*.
  - Tropical sod webworm, *Herpetogramma phaeopteralis*
  - Tuttle mealybug, *Brevennia rehi*
  - Fall armyworm, *Spodoptera frugiperda*
  - Several more…

Pest-damaged Lawns

- Increased pesticide applications and maintenance inputs (irrigation and labor)
- Reduced benefits (water filtration, cooling, carbon sequestration, aesthetic value)
- Additional costs to homeowners and lawn managers

Integrated Pest Management (IPM)

- Science-based, sustainable decision-making process that uses pest biology, environmental data, and technology to manage pest damage while minimizing economic costs and risks to people, property, and the environment.

- Multiple factors are at play in a landscape keeping things in balance (plants healthy, pests low)
- Incorporate multiple strategies to preventively manage plant pests with reduced inputs

Integrated Pest Management

1. **Identification**
2. Monitoring
3. Decision making
4. **Intervention**
5. Evaluation

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ENY-298

Landscape Integrated Pest Management[1]

Eileen Buss and Adam G. Dale[2]

This document will help Extension agents and specialists, lawn and landscape managers, Florida Master Gardeners, and homeowners develop long-term sustainable pest management programs using an Integrated Pest Management (IPM) framework.

Introduction

Every landscape manager has a pest management toolbox, which contains tools that represent different management strategies. People can be quick to use pesticides as an immediate and primary solution to pest infestations. However, an integrated approach using multiple tools can be much safer, have longer lasting beneficial effects, and in some cases cut costs.

Integrated pest management (IPM) is an informed selection and implementation of pest control measures based on their environmental, economic, and sociological consequences (Bottrell 1979). IPM has become more widely implemented in landscapes over the past several years. However, some landscape managers may avoid IPM because it can require more time and effort upfront than their current practices. Although time means money, IPM programs can substantially reduce pest management costs and risks over time when compared to using pesticides only (Raupp et al. 1992). It is increasingly important to consider the effects of selecting a management strategy based on environmental risks, societal demands, and legal consequences. The non-target effects of pesticide applications can be damaging to the environment and human health. In addition, pesticide resistance becomes an issue after insects, plant pathogens, and weeds are repeatedly exposed to the same chemical, a reoccurring problem with chinch bugs (Cherry and Nagata 2005).

To establish an effective IPM program, think of the landscape as an ecosystem. An ecosystem is a community of organisms living in a given area and the environmental conditions affecting those organisms. Landscape ecosystems may always contain pests, but they often remain below damaging levels. Attempting to control pests without considering the ecosystem of the landscape can disrupt the natural equilibrium and lead to ineffective control, secondary pest outbreaks, and higher management costs (Frank and Sadof 2011). Therefore, it is necessary to follow five general steps for a successful IPM program: pest identification, monitoring, decision-making, intervention, and evaluation.

Pest Identification

Accurate identification of the pest is essential because different pests may not be controlled by the same method. Utilize pest identification guides or contact your local county Extension office to help identify a pest of concern. Note the type of plant it was found feeding on as well as the observed damage. For example, chewing pests, like beetles or caterpillars, will physically remove leaf material (Figure 1). Brown or yellow speckling on leaf surfaces (Figure 2) may indicate piercing-sucking damage from pests like aphids, lace bugs, or spider mites. Secondary symptoms, like sooty

Tuttle Mealybug
(*Brevennia rehi*) (aka: Rice mealybug)

- Found globally
- First found in FL in 1975 (Pompano Beach), rarely damaging until early 2000s
- WIDESPREAD IN FLORIDA
- Attacks zoysiagrass and sometimes bermudagrass

Tuttle mealybug

- Sap-feeding insects
- Bodies are <2 mm long, pink; make white wax
- Look for gray-brown areas and white wax
- Closely inspect declining plant material to confirm identity

Forms of Intervention in IPM

Incorporate as much of 1-3 as possible and #4 wisely

1. **Cultural practices**
2. Mechanical control
3. Biological control
4. Chemical control*

also suffer economic losses if grass being grown from sprigs or plugs becomes damaged during the establishment period because this reduces sod quality and increases the time to harvest. Golf courses afflicted with bermudagrass mite infestations struggle with reduced quality of play, which can negatively affect business. Currently, the most effective and primary method for controlling these pests is chemical control, which can be expensive and, in many cases, cost-prohibitive.

Damage

Plants affected by eriophyid mites show a range of symptoms from complete defoliation and gradual plant death to various types of tissue modification. Eriophyid mites feed on succulent plant tissue and generally cause plant galls, or modified clusters of plant tissue, to protect themselves and to act as a nutrient source. After the mites induce plant cells to change, they do not always remain in the damaged site, which can make detection difficult.

Rather than causing direct feeding damage, bermudagrass mites inject plant growth hormones from their salivary secretions into the plant tissue, which inhibits cell growth and leads to distorted new growth (Salisbury and Ross 1985). The most characteristic symptom of bermudagrass mite outbreaks is called rosetting or tufting, where leaf tips of infested grass lose their color, and internodes become shortened and stunted so that small clumps form (Figure 5). These tufts of plant growth tend to form at the tips of stolons that have not rooted into the soil. Large areas may die (Figures 1 and 2) and become infested with weeds. In general, bermudagrass mite populations and their associated plant damage tend to flare during early spring and into early summer throughout Florida.

Management

Due to the low success rate associated with reducing heavy bermudagrass mite infestations, an integrated approach using multiple strategies to manage this pest is critical.

Cultural Control

Correct maintenance practices following UF/IFAS-recommended best management practices (BMPs) like proper fertilization, mowing, and irrigation will promote a healthy and vigorously growing stand of bermudagrass, which should reduce the risk of mite damage (http://edis.ifas.ufl.edu/lh007). Although recycling grass clippings is generally recommended, this is not the case if you suspect a bermudagrass mite infestation (more detail in "Mechanical Control" below).

Figure 5. Characteristic tufting damage to 'Celebration' bermudagrass shoots in a heavily-infested golf course fairway.
Credits: Craig Weyandt, GCS

One of the best cultural control strategies is the use of resistant bermudagrass cultivars. Resistant cultivars have been identified in various studies and include: Cardinal, Midlawn, Tifsport, FloraTex, Tifdwarf, and Midiron (Reinert et al. 1978, Reinert et al. 2008). Cultivars recognized as susceptible to this pest and highly symptomatic include: FloraDwarf, Ormond, Tifdwarf, TifEagle, Tifgreen, Tiflawn, and Celebration. 'Tifway' has demonstrated susceptibility and resistance in different tests, so it may be considered intermediate in susceptibility (Buss 2008).

Mechanical Control

When severe infestations are detected, mowing as low as possible (scalping the turf) and collecting and disposing of grass debris away from the site can reduce bermudagrass mite populations and subsequent damage. Afterwards, minimize turf stress and promote rapid regrowth by watering the area for several days. UF/IFAS research has found that simply scalping and removing infested bermudagrass clippings can reduce bermudagrass mite damage by 50% from the time of mowing to 28 days later when the turf has regrown (Figure 6). However, this is more effective when done during late spring compared to early spring.

Chemical Control

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Tuttle mealybug management options

- Proper cultural management of zoysiagrass is critical for effective Tuttle mealybug management
- Mowing height & frequency, irrigation, fertilization, and **thatch management**

What is thatch?

An intermingled layer of living and dead stems, stolons, rhizomes, and roots between the green vegetation and the soil surface.

- Dead material – but living material must grow through and across the thatch to reach the soil.
- Failure to remove clippings after mowing *generally* does <u>not</u> cause thatch buildup.

Published March, 1988

TURFGRASS

...fects of Clipping Disposal, Nitrogen, and Growth Retardants on Thatch and Tiller Density in Zoysiagrass

D. Z. Soper, J. H. Dunn,* D. D. Minner, and D. A. Sleper

ABSTRACT

...ch is a cultural problem affecting managers
...Zoysia japonica Steud.). Research was un-
...e effects of clipping disposal, N fertiliza-
...ts on thatch accumulation and resistance
...ition. In a 2-yr field study, clipping dis-
...ots); N fertilization (98.0 kg ha^{-1} yr^{-1});
...mefluidide (N-[2,4-dimethyl-5-[[(triflu-
...nyl]acetamide) applied twice each year
...nd flurprimidol (α-(1-methylethyl)-
...yrimidine-methanol) applied at 1.1,
...each year were examined for their
...rdure, and stolon weight. Relative
...as compared by in vitro digestion
...rned clippings increased thatch
...nsity by 12% when N was ap-
... tiller density. Growth retar-
...n of leaves (64%) by the cel-
...50%). The reduction in tiller
...gs may be due to shading
...ng in leaf etiolation and
...ings contributed slightly
...their physical accumu-
...ing. Both stolons and,
... thatch accumulation
...he culture of Meyer
... appearance, might
...ppings is not rec-
...ll contribution to
...ients.

...primidol, Her-
...fgrass, Zoysia

...nposed,
...he soil
...fgra...

course tees and fairways. One of the problems associated with the use of zoysiagrass, however, is its tendency to form thatch.

Mechanical methods used to reduce thatch accumulation include topdressing, vertical mowing, and core cultivation (Carrow et al., 1987; White and Dickens, 1984). Considering the cost of frequent use of these management procedures, thatch may be the most important cultural condition restricting the use of zoysiagrass.

It was the premise of this study that information regarding the relative resistance of specific tissues to decomposition and the quantity of tissue produced is important in selecting cultural practices to control thatch. Thatch development in Meyer zoysiagrass was investigated by (i) altering leaf and stolon growth via growth retardants, increasing plant growth with N; and (ii) clippings, and increasing leaf litter by returning comparing the degradation of leaves and stolons in vitro.

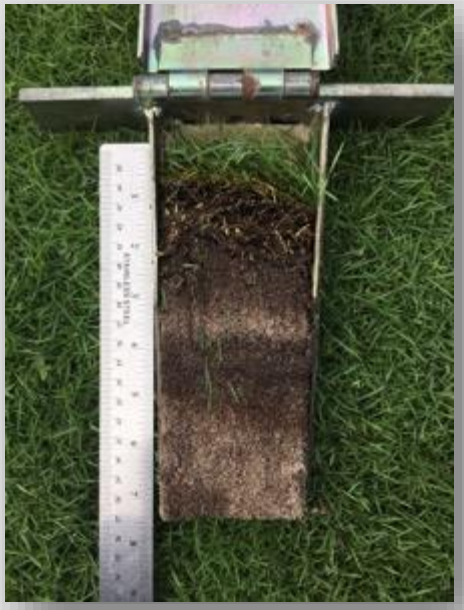
MATERIALS AND METHODS

The study was conducted on a uniform, 14-yr-old stand of Meyer zoysiagrass during 1984 and 1985. Turf was severely verticut 1 yr before the study began in order to eliminate most of the thatch layer. Soil was a Mexico silt loam (Udallic Ochraqualf). Treatment plots measuring 1.2 × 3.0 m were arranged in a randomized complete block design with all possible combinations of treatments in four ... cations. Three parameters were analyzed as a ... torial: clipping disposal (remove from pl... growth retardants (no growth re... at 1.1, 1.7, or 2.2 kg a.i. ha... or 0.8 kg a.i. ha... ysis of...

Too much or too little?

A 0.5” thatch layer on most turfgrass areas is good.

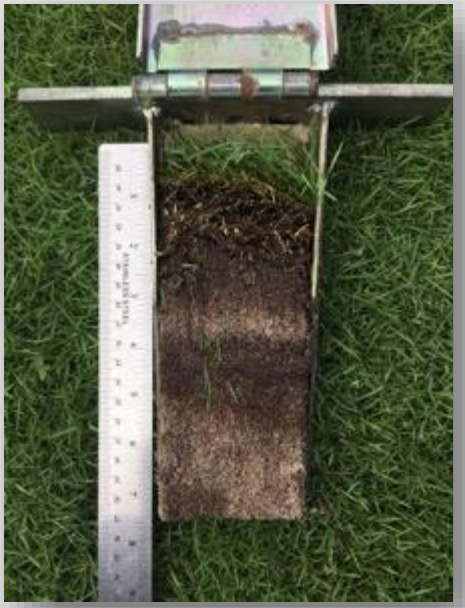
- Helps cushion turfgrass crowns and roots from traffic damage.
- Degraded thatch becomes the organic component of soil formed by the decomposition of leaves and other plant material by soil microorganisms.
  - Influences the bulk density of soil and contributes to moisture & nutrient retention



Too much or too little?

Too much thatch:

- Provides refuge for insect pests
- Harbors moisture that may promote pathogen issues
- Inhibits penetration of pesticides
- Ultimately, creates effective lawn management more difficult



Thatch mitigation

- Dethatching – process of thatch removal but has some influence on microbial environment.
- Aerification – process that encourages microbial activity but also removes some thatch.
- Topdressing – promotes microbial activity.

Tuttle mealybug management

Minimizing thatch:

- Reduces favorable mealybug habitat
- Exposes any resident mealybugs to insecticide applications
- Helps insecticides penetrate into thatch and root layers

Forms of Intervention in IPM

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2. Mechanical control
3. Biological control
4. **Chemical control**

also suffer economic losses if grass being grown from sprigs or plugs becomes damaged during the establishment period because this reduces sod quality and increases the time to harvest. Golf courses afflicted with bermudagrass mite infestations struggle with reduced quality of play, which can negatively affect business. Currently, the most effective and primary method for controlling these pests is chemical control, which can be expensive and, in many cases, cost-prohibitive.

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Rather than causing direct feeding damage, bermudagrass mites inject plant growth hormones from their salivary secretions into the plant tissue, which inhibits cell growth and leads to distorted new growth (Salisbury and Ross 1985). The most characteristic symptom of bermudagrass mite outbreaks is called rosetting or tufting, where leaf tips of infested grass lose their color, and internodes become shortened and stunted so that small clumps form (Figure 5). These tufts of plant growth tend to form at the tips of stolons that have not rooted into the soil. Large areas may die (Figures 1 and 2) and become infested with weeds. In general, bermudagrass mite populations and their associated plant damage tend to flare during early spring and into early summer throughout Florida.

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Chemical control

Chemical management:

- If you have a heavy infestation and have not managed the thatch, **deal with thatch, then treat**
- Use sufficient spray volume in liquid applications
- Insecticides: Use systemic products
  - If large infestation, combine with a contact toxic product (e.g. pyrethroid) for initial treatment
  - Zylam, Arena, Meridian (systemic with residual activity) have shown effective control

Another Recent Challenge

Mite Pests of Turfgrass

- Bermudagrass mite
  - Eriophyid mite
  - EXTREMELY small (0.2mm)
  - Live & feed under leaf sheath
  - Yellow, tufted areas of grass
  - Rapid generation time (~2 weeks)

Management options

*Golf course use only

<u>Resistant cultivars</u>

- Tifsport & Tifway

<u>Highly susceptible cultivars</u>

- Celebration

<u>Chemical control</u>

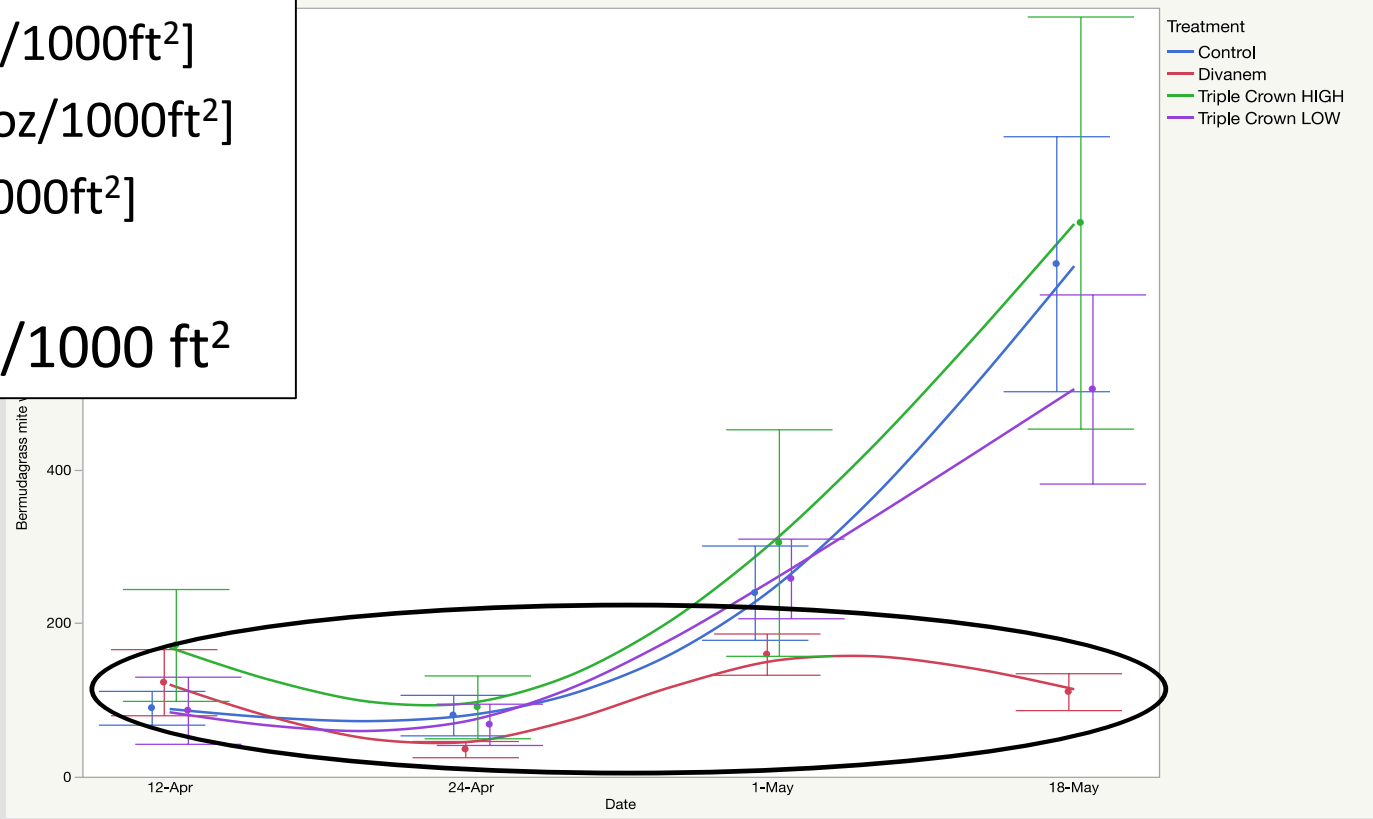
- Abamectin (golf)
- Azadirachtin
- Dursban (sod farms)
- Civitas (golf)
- Pyrethroids

Bermudagrass Mite Control 2018

- Anecdotal success with imidacloprid and/or bifenthrin
- Miticides (like abamectin) effectively control mites

Evaluated:
Triple Crown [0.8floz/1000ft^2]
Triple Crown [0.46 floz/1000ft^2]
Divanem [0.14 floz/1000ft^2]

Applied in 2 gallons/1000 ft^2



Bermudagrass Mite Control

- Us
- No ds
- Mo da
- 0.1 ft^2 sho

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Biology and Management of the Bermudagrass Mite, *Eriophyes cynodoniensis*[1]

Pablo Agustin Boeri, Nicole D. Benda, J. Bryan Unruh, and Adam Dale[2]

Introduction

The bermudagrass mite, *Eriophyes cynodoniensis* (Sayed) (Arthropoda: Arachnida: Eriophyidae), also known as the couch grass mite, can be a serious pest of bermudagrass (*Cynodon dactylon* [L.] Pers.) in multiple high-maintenance turf systems such as sod production, athletic fields, and golf courses (Buss 2008). Like most eriophyid mite species, the bermudagrass mite specializes on one host plant and thus does not attack other plant species. Mites in the family Eriophyidae are commonly known to cause leaf and bud galls on their host plants, which can lead to severe aesthetic damage and plant decline or death in high-maintenance areas with low tolerance for plant damage (Figure 1).

Figure 1. Brown patches of thinning bermudagrass observed from a distance caused by bermudagrass mite on a Florida golf course. Credits: Craig Weyandt, GCS

http://edis.ifas.ufl.edu/in1217

Forms of Intervention in IPM

Incorporate as much of 1-3 as possible and #4 appropriately

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Longer-term solutions

Immediate / short-term solutions

also suffer economic losses if grass being grown from sprigs or plugs becomes damaged during the establishment period because this reduces sod quality and increases the time to harvest. Golf courses afflicted with bermudagrass mite infestations struggle with reduced quality of play, which can negatively affect business. Currently, the most effective and primary method for controlling these pests is chemical control, which can be expensive and, in many cases, cost-prohibitive.

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1. Cultural Control Tactics

Long-term, sustainable pest management strategies for reducing pests and promoting plant / ecosystem health

Habitat manipulation through:

a. Site preparation
b. Host plant resistance
c. Plant selection and landscape design

Rangasamy et al. 2006. *Journal of Economic Entomology*

Soil mitigation strategies following residential development

Rapid Site Development

Disturbed soils

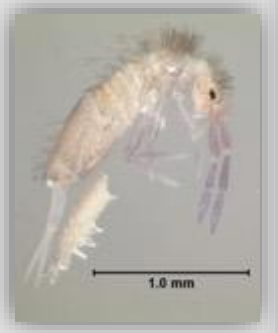
Disturbed soils can reduce plant growth and establishment

- Poor drainage
- Restricted soil aeration & root growth
- Reduced root growth
- Increased pest pressure

How does this soil disturbance affect arthropods?

Arthropod populations may also be negatively affected

- Loss of organic matter and topsoil affects decomposers
- Loss of natural enemy complex



Does a new residential landscape start as a blank slate?

Beneficial organisms in the lawn

- Predatory and parasitic insects = pest control
- Insect-parasitic nematodes = pest control
- Decomposers = thatch decomposition and improved lawn health

- A biodiverse lawn should have fewer pest problems and management challenges

Lawn Invertebrates

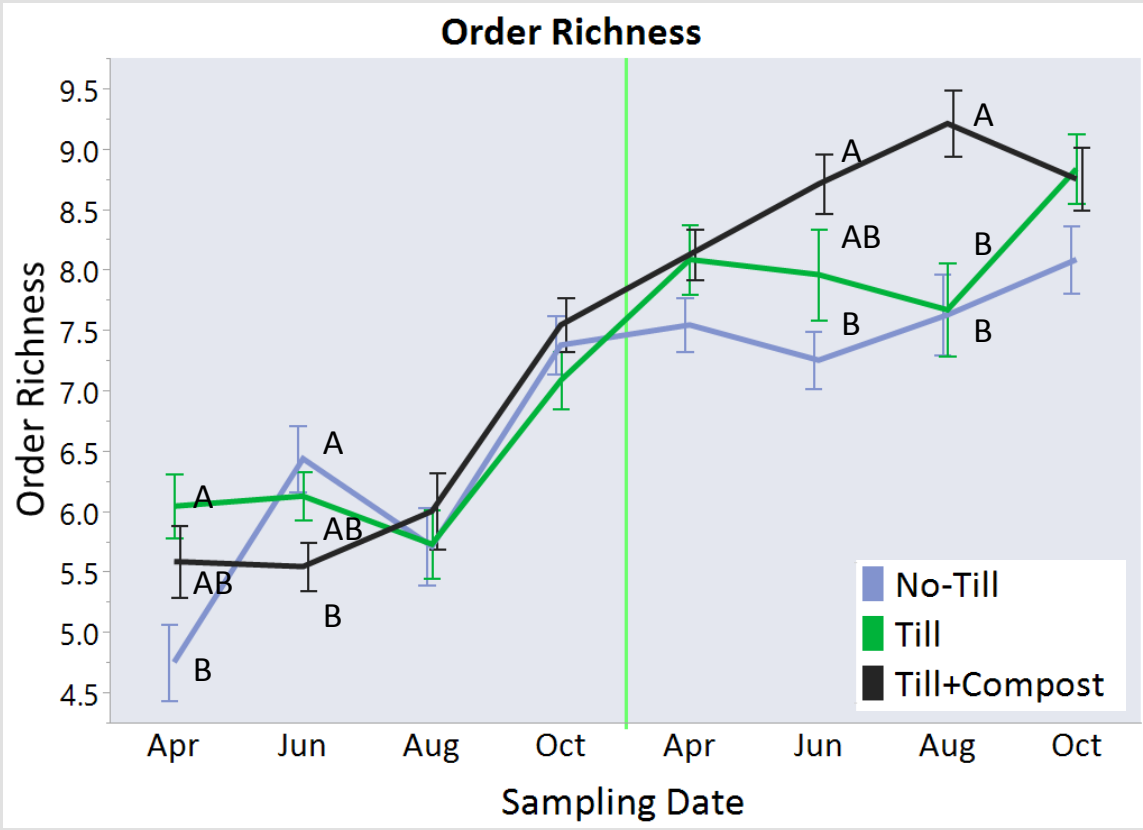
- Surveyed soil and turf-dwelling invertebrates every two months for two years:

- Key decomposers:
  Springtails & Oribatid mites

- Key predators:
  Spiders, ants, earwigs, beetles

Invertebrate biodiversity

- Lawn-dwelling organisms become more abundant and diverse over time post-development
- Compost-amended soils supported most diverse community in year 2



($F_{25,547} = 19.31$, $p < 0.0001$*)

Decomposers

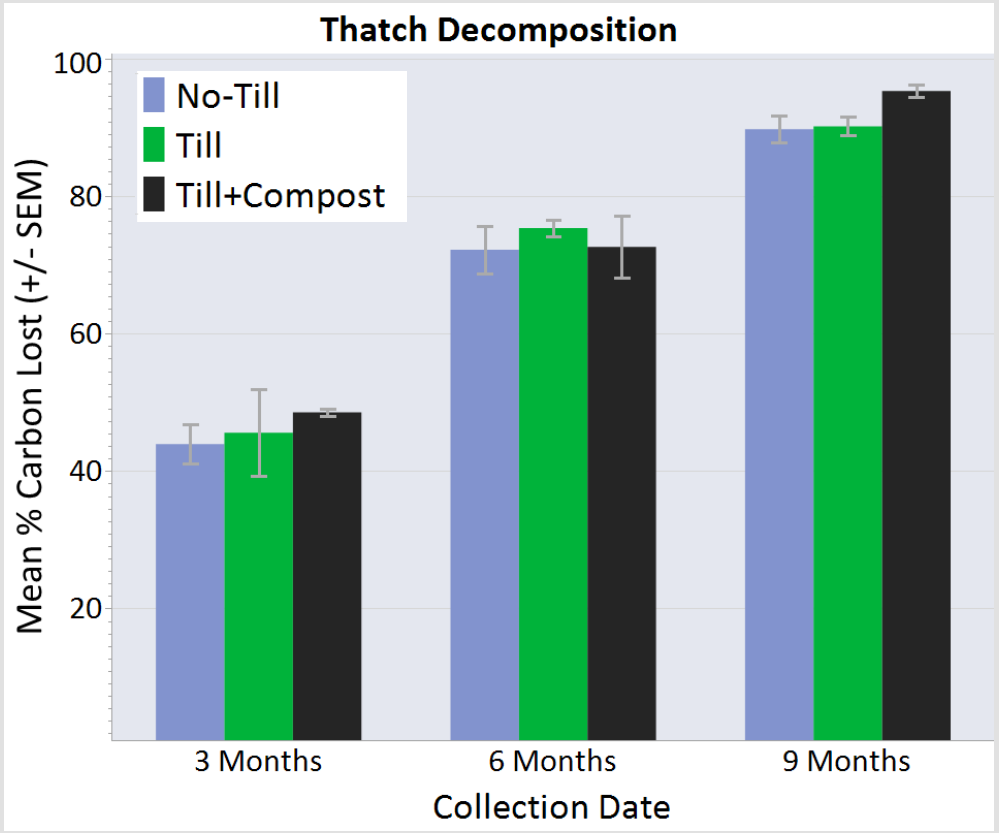
- Collembola and Oribatid mites were quantified from pitfall samples.
- Important for thatch decomposition
- Highly variable throughout the survey period

Measuring thatch decomposition

- Dried turfgrass clippings
- Placed 20 g in wire mesh cages
- 6 cages per plot
- Retrieve 2 cages at 3, 6, and 10 months

Thatch Decomposition

- Measured thatch decomposition after 3, 6, and 9 months
- No effect of soil mitigation treatment



Treatment ($F_{2,2} = 1.157$, $p = 0.339$)

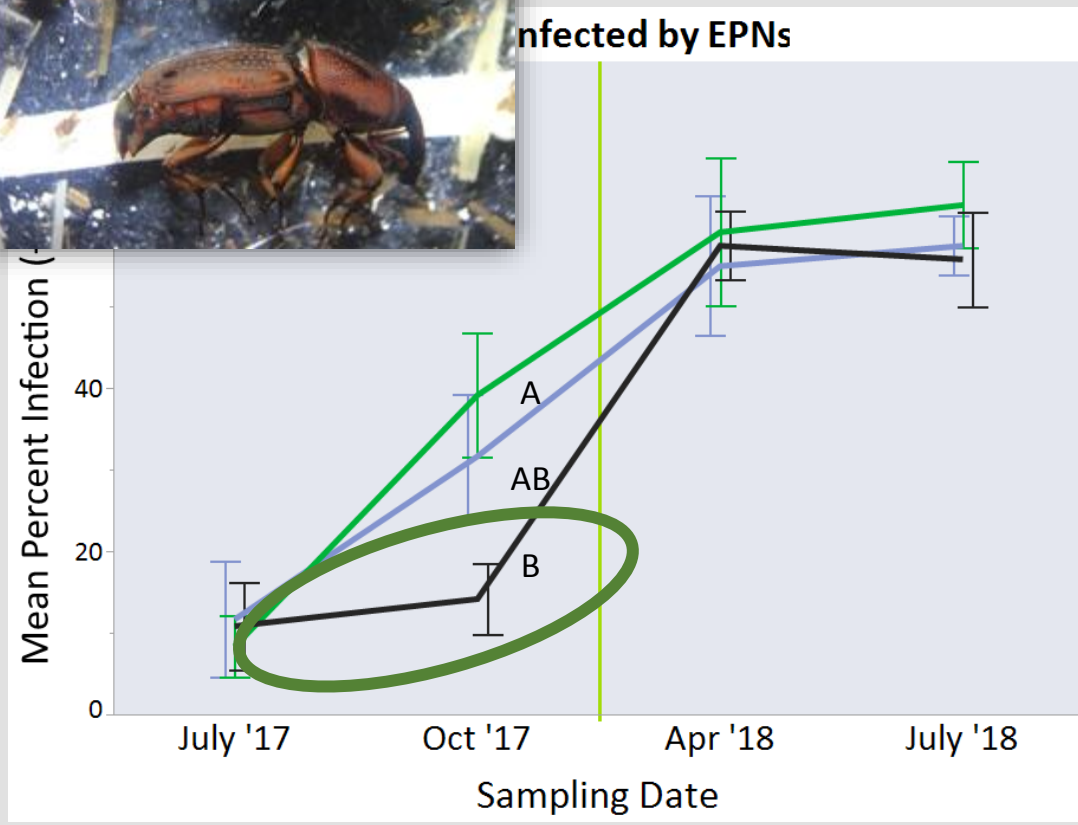
Insect-parasitic nematodes

- NOT ALL NEMATODES IN THE SOIL ARE BAD
- Presence of insect-parasitic nematodes can reduce turf pest abundance and damage, particularly white grubs and billbugs

Heterorhabditis bacteriophora emerging from a wax moth cadaver. Photo by Peggy Greb, USDA Agricultural Research Service, Bugwood.org

Insect parasitic nematode activity

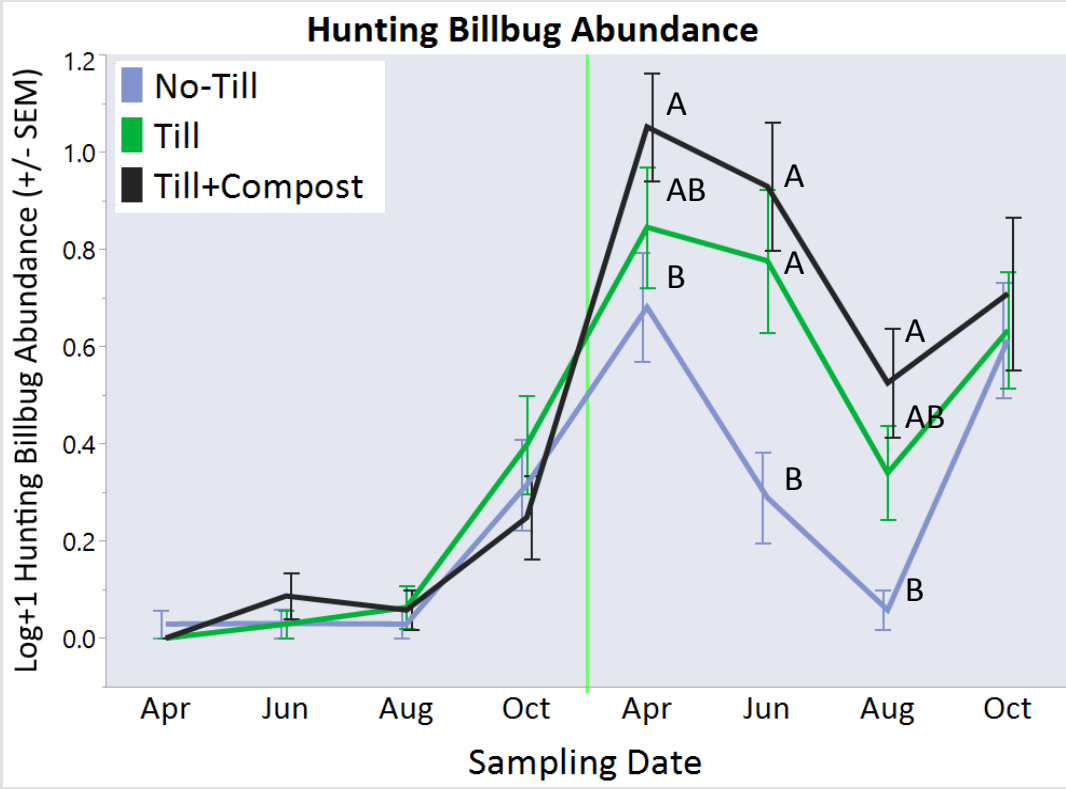
- Present in all lawn soils
- Infection rates increased over time
- Compost-amended soils had the lowest parasitism in Fall Year 1



($F_{13,58}$ = 10.64, p <0.0001*)

Hunting billbug abundance

- Year 1: Low numbers overall
- Year 2: Most abundant in compost-amended soils where nematode activity was lowest



($F_{25,547} = 14.80$, $p < 0.0001$*)

Summary

- Soil mitigation treatments affect lawn and soil-dwelling organisms
- Effects depend on time after mitigation
- Overall a positive effect on biodiversity and the lawn ecosystem (but be mindful in year 2)

- Also drastic observed effects on soil water-holding capacity, turf irrigation needs, and lawn quality

Cultivar Development

er this year:

grass

nce

gray leaf spot, large patch, &

ce

ar

- Moderate **chinch bug tole**

CitraBlue™ St. Augustine

Lawns are frequently attacked by insect pests…

- The evidence
  - Southern chinch bug, *Blissus insularis*
  - Southern & tawny mole crickets, *Neoscapteriscus spp*.
  - Tropical sod webworm, *Herpetogramma phaeopteralis*
  - Tuttle mealybug, *Brevennia rehi*
  - Fall armyworm, *Spodoptera frugiperda*
  - Several more…

What factors of landscapes affect insect pest pressure?

- Plant stress
- Plant selection
- Habitat disturbance
- Microclimate conditions
- Presence/absence of natural enemies
- Plant diversity & the abundance of host plants

Lawn Diversity

- Warm season turf is produced, planted, and maintained as cultivar monocultures to preserve desirable aesthetic and maintenance traits
- Within a warm season turfgrass lawn, each plant is a clone of the other

- Insect herbivores often colonize and become more abundant in monoculture crop plantings

What if we increase lawn diversity?

- **Mixing turf species** may not be a viable approach (production & maintenance differences, aesthetic differences, plant competition, etc)
- **Mixing turf cultivars** eliminates aesthetic & maintenance differences, but provides genetic diversity

St. Augustinegrass Diversity

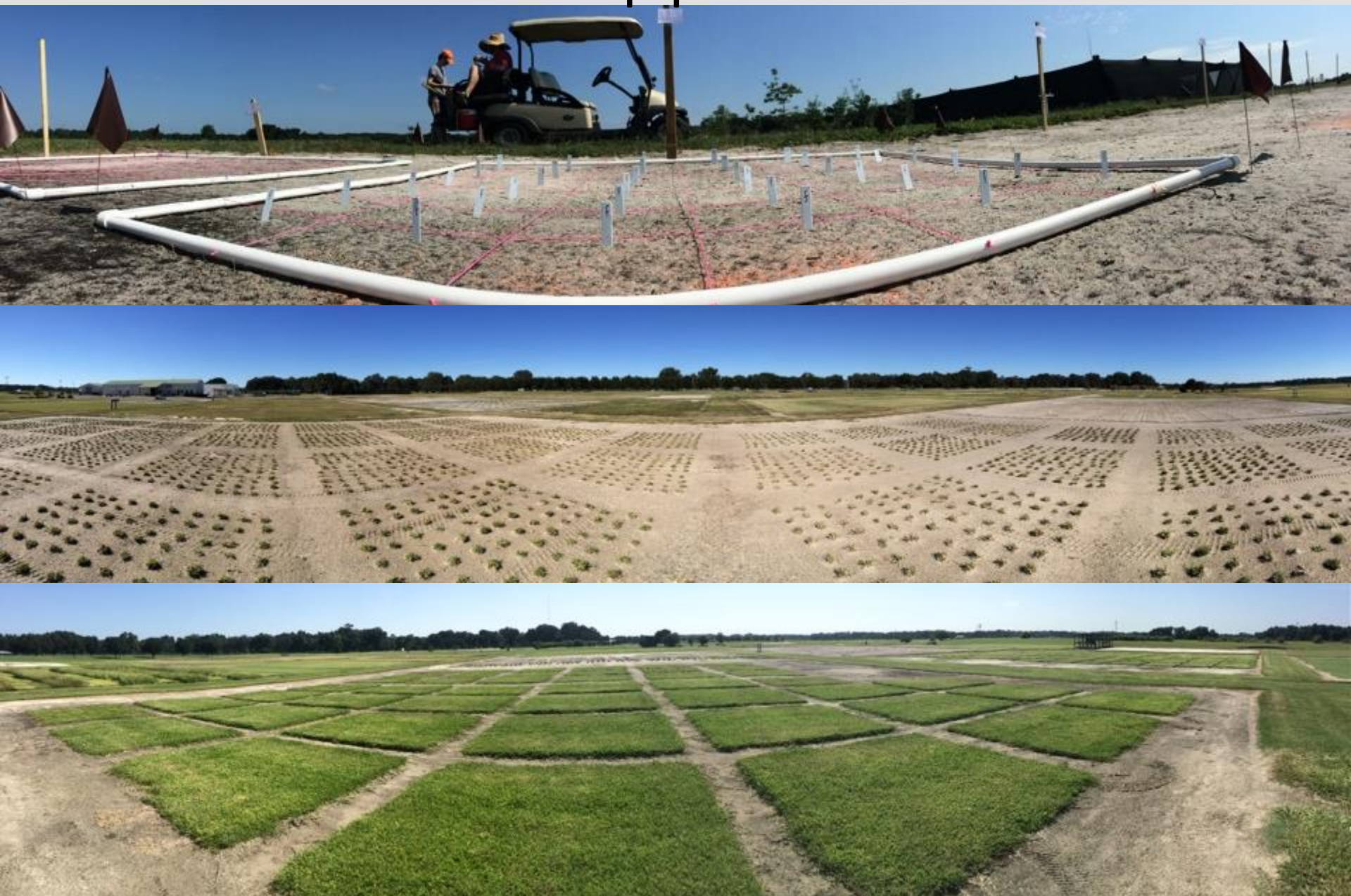
Six St. Augustinegrass cultivars

- Floratam
- Palmetto
- Bitterblue
- Classic
- Seville
- Captiva

3 Treatments
- Monoculture (M1)
- Mixture of 2 cultivars (M2)
- Mixture of 4 cultivars (M4)

M1 M2 M4

Field Application




2ft
A
A
A
A
A
B
B
A
A
B
D
C
M1
M2
M4
Joseph Giuliano

Effects on an herbivore

- Fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae)
- Reared on each cultivar diversity level: M1, M2, M4
  - Tracked development rate, body size, survival, and more

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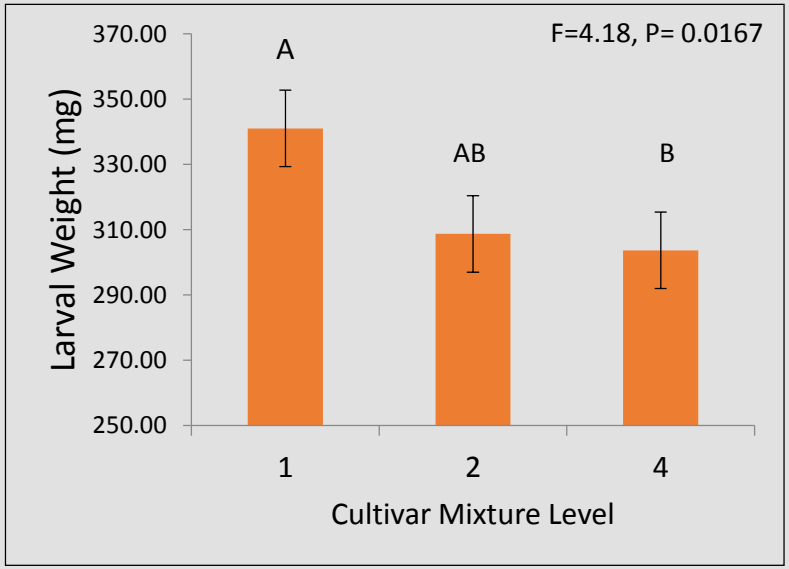
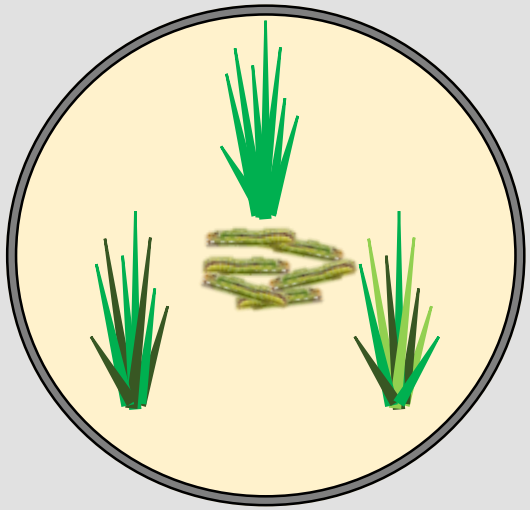
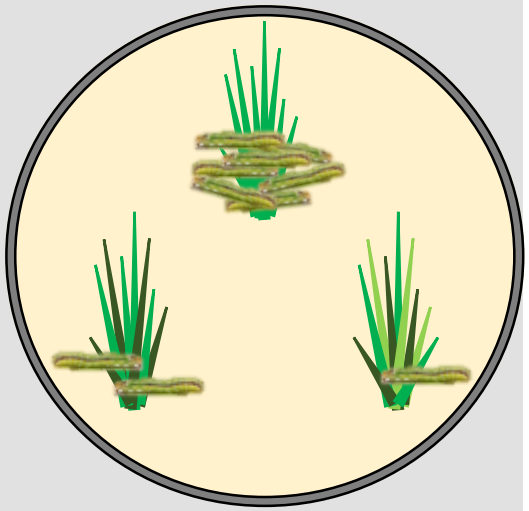


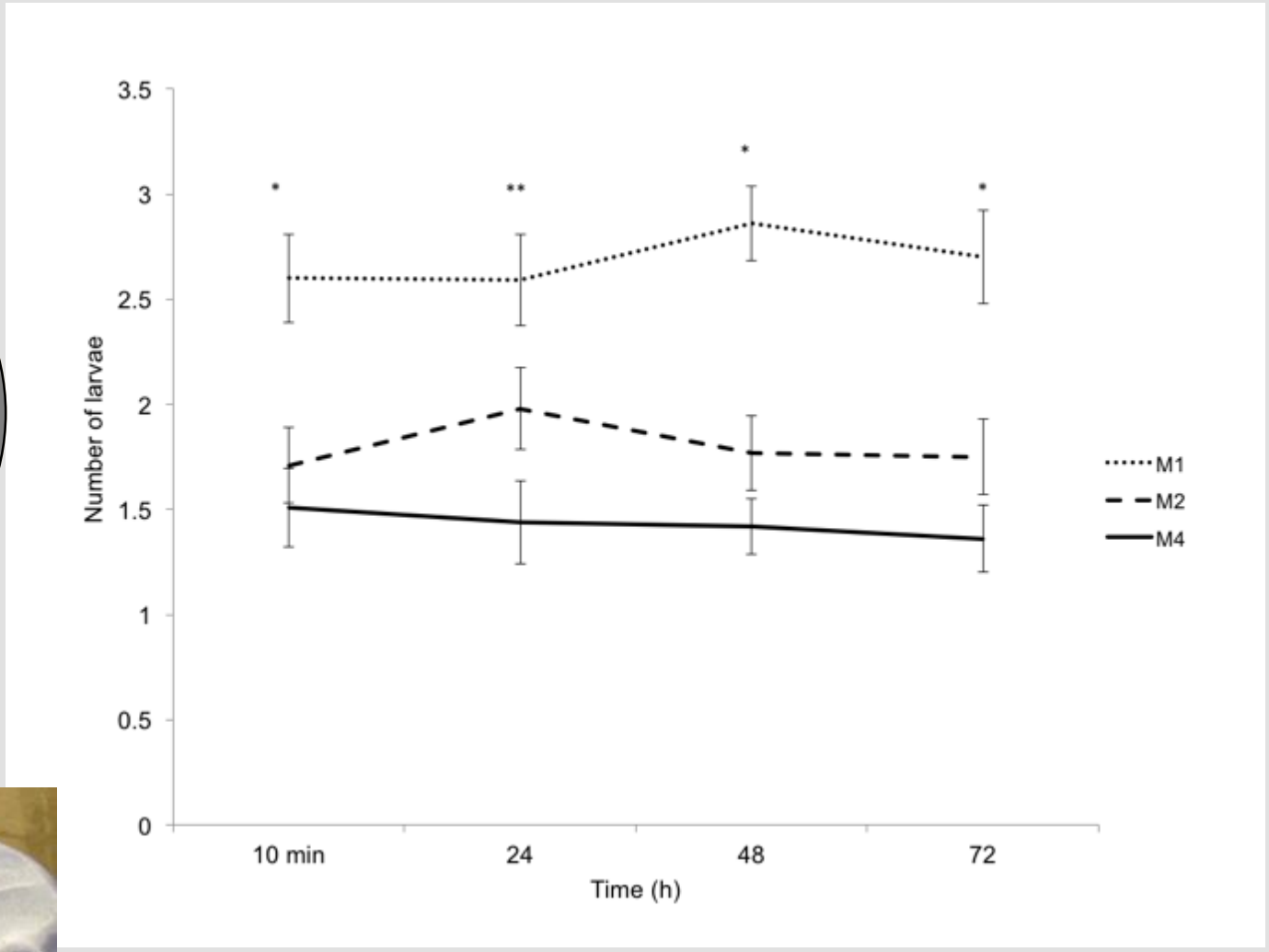
Host Selection

- Inserted pots of each diversity treatment into buckets of pure sand
- Placed 10 armyworms into the center of each
- Recorded their location every 24 hrs for 72 hrs



Preference for Monocultures





Doherty et al. 2019. *Environmental Entomology*

N=60, F=47.81, P<0.0001

Summary

Effects of cultivar mixtures on caterpillars

More diverse cultivar blends:

- Reduce body size and feeding damage
- Are less attractive

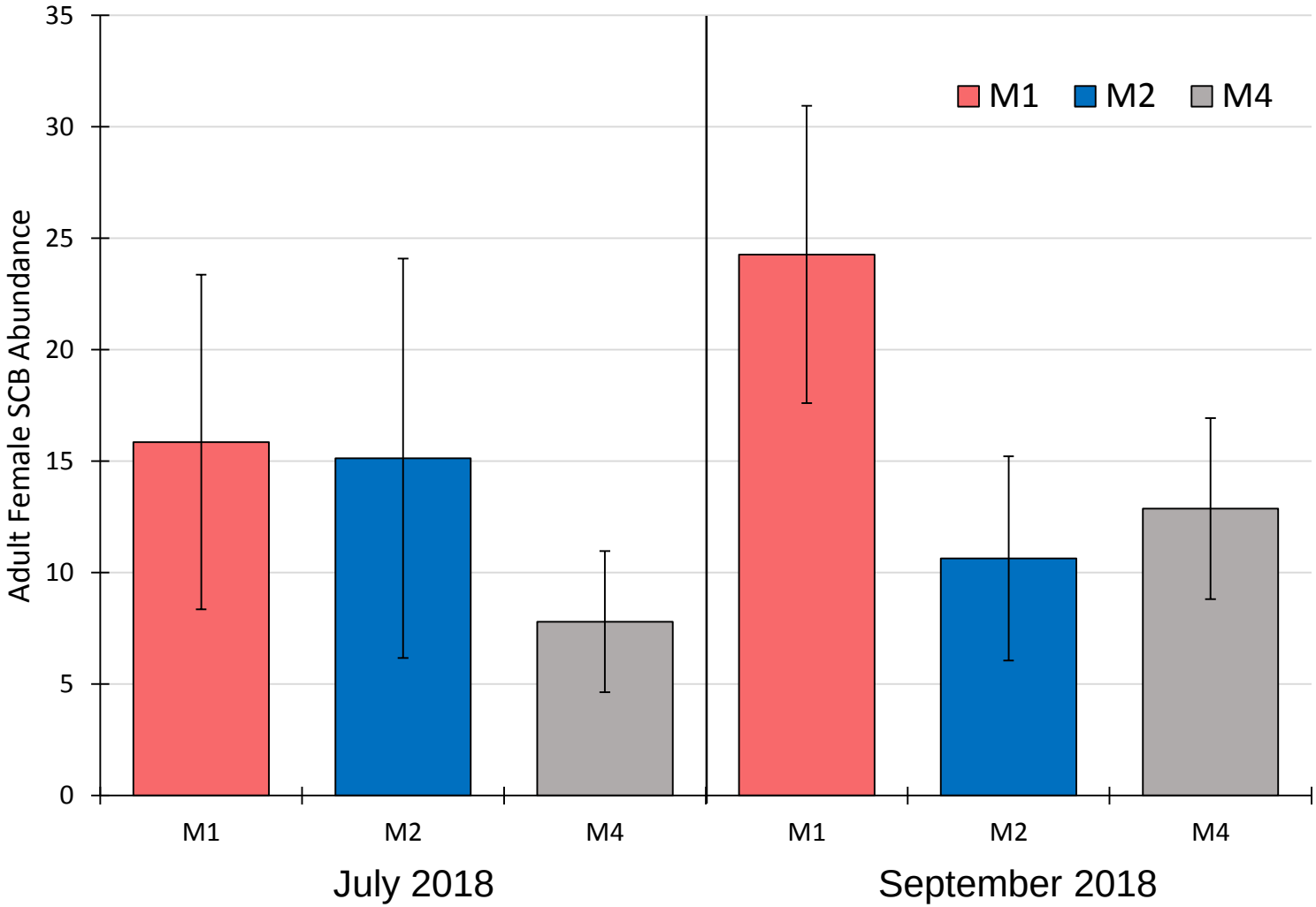
Southern Chinch Bugs

- Surveyed plots for southern chinch bugs in 2018

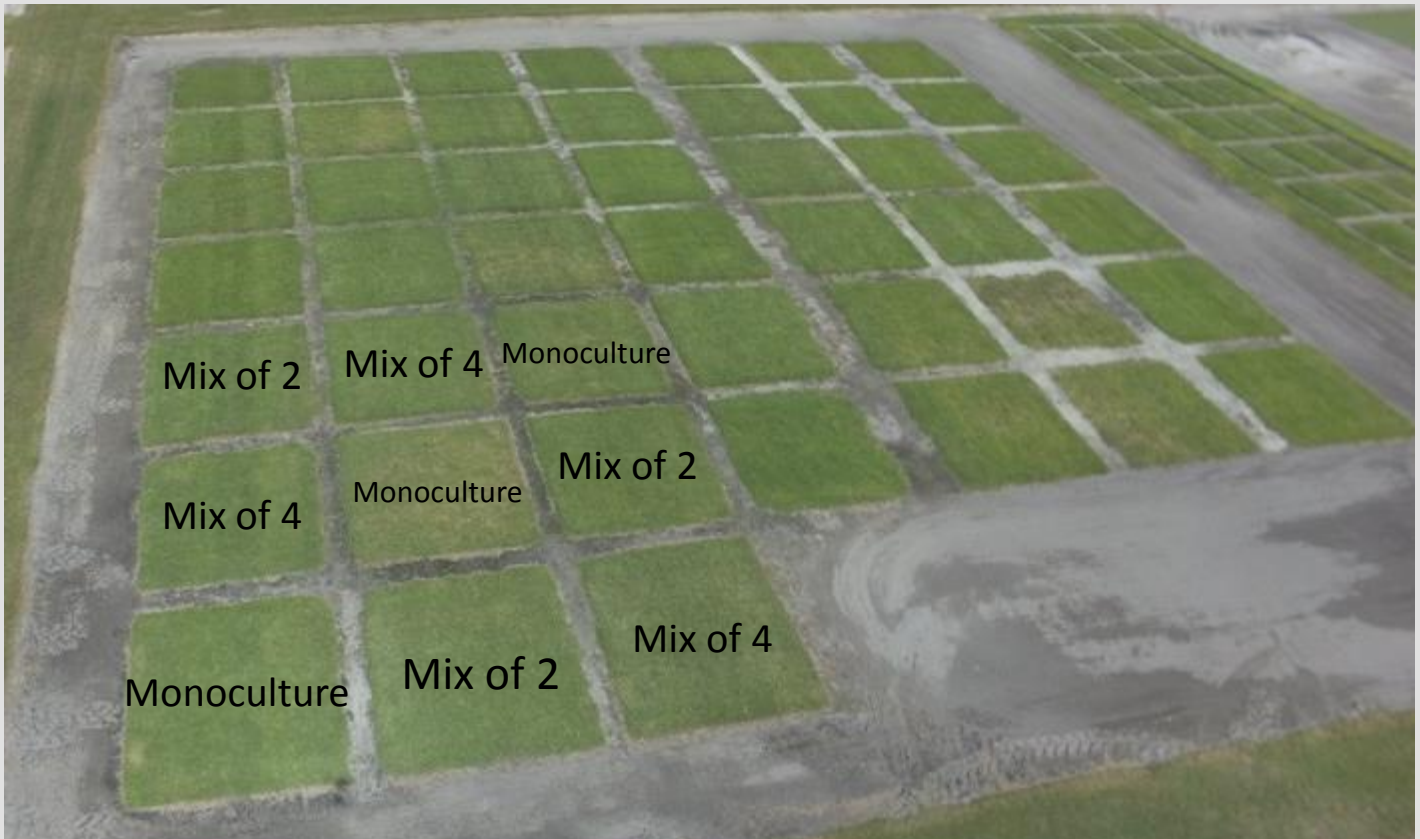
Southern Chinch Bug Abundance

Model: $F_{4,58}$=3.67, P=0.0099
# of Cultivars: F=3.21, **P=0.0475**

TRT	Tukey
M1	A
M2	AB
M4	B



- 83 turfgrass growers and managers *blindly* rated field plots
  - Scale of 1 – 9, how good does each plot look?



Summary

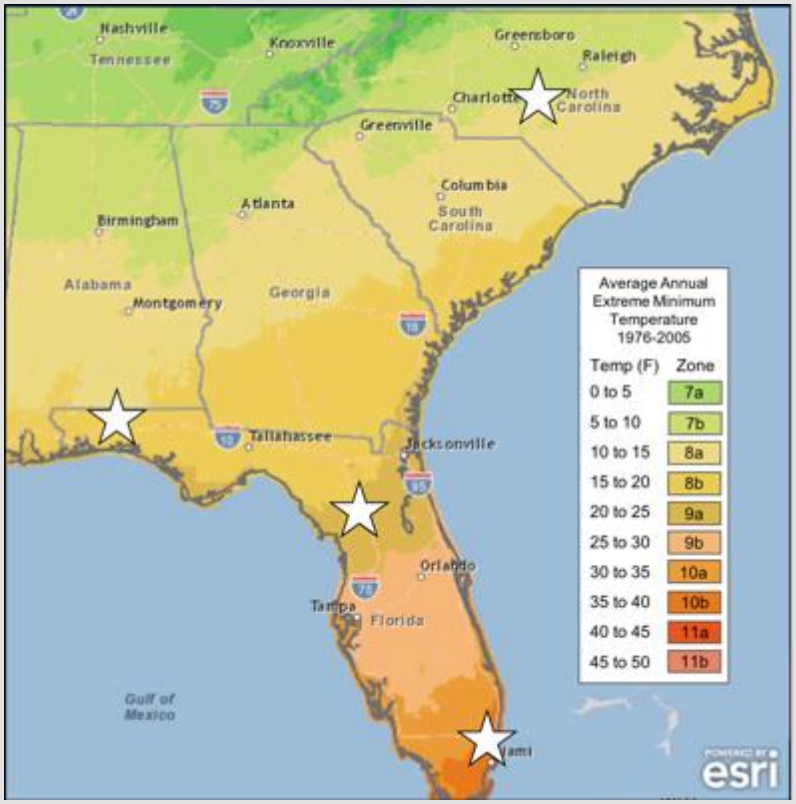
A plausible IPM cultural management strategy

- Indications of insect pest management benefits
- Increased plant density and greenness
- Industry professionals perceive mixtures to be as good or better than monocultures

Implications

- Reduced pest pressure could reduce:
  - Pest damage
  - Insecticide applications
- Effects of diversity on plants could increase:
  - Plant benefits
  - Environmental stress tolerance
  - Weed & disease pressure

Next steps: Ongoing



Developing regional mixture recommendations

Turf IPM Summary

Integrated pest management in lawns is necessary for sustainable development and maintenance

- Pest I.D. & monitoring
- Cultural practices
- Proper insecticide selection & application timing

- Safer for people, beneficial organisms, & environment
- Long-term solutions to creating better landscapes

Thank you!

Recent EDIS publications:

- Natural products for managing insects on landscape plants
- Managing insecticide and miticide resistance on landscape plants
- Managing crapemyrtle bark scale
- Managing southern chinch bugs in Florida lawns
- Stinging and urticating caterpillars of Florida
- Managing bermudagrass mite

Acknowledgements:

- UF/IFAS
- FNGLA
- TPF
- Syngenta
- FMC
- NTEP
- On Top of the World
- USDA-NIFA

- For updates on landscape pest management:
  - @adamGdale
  - http://dalelab.org
  - agdale@ufl.edu

UF/IFAS Extension Bookstore: http://ifasbooks.ifas.ufl.edu/p-153-helpful-harmful-harmless.aspx