2016 Turfgrass Research FIELD DAY

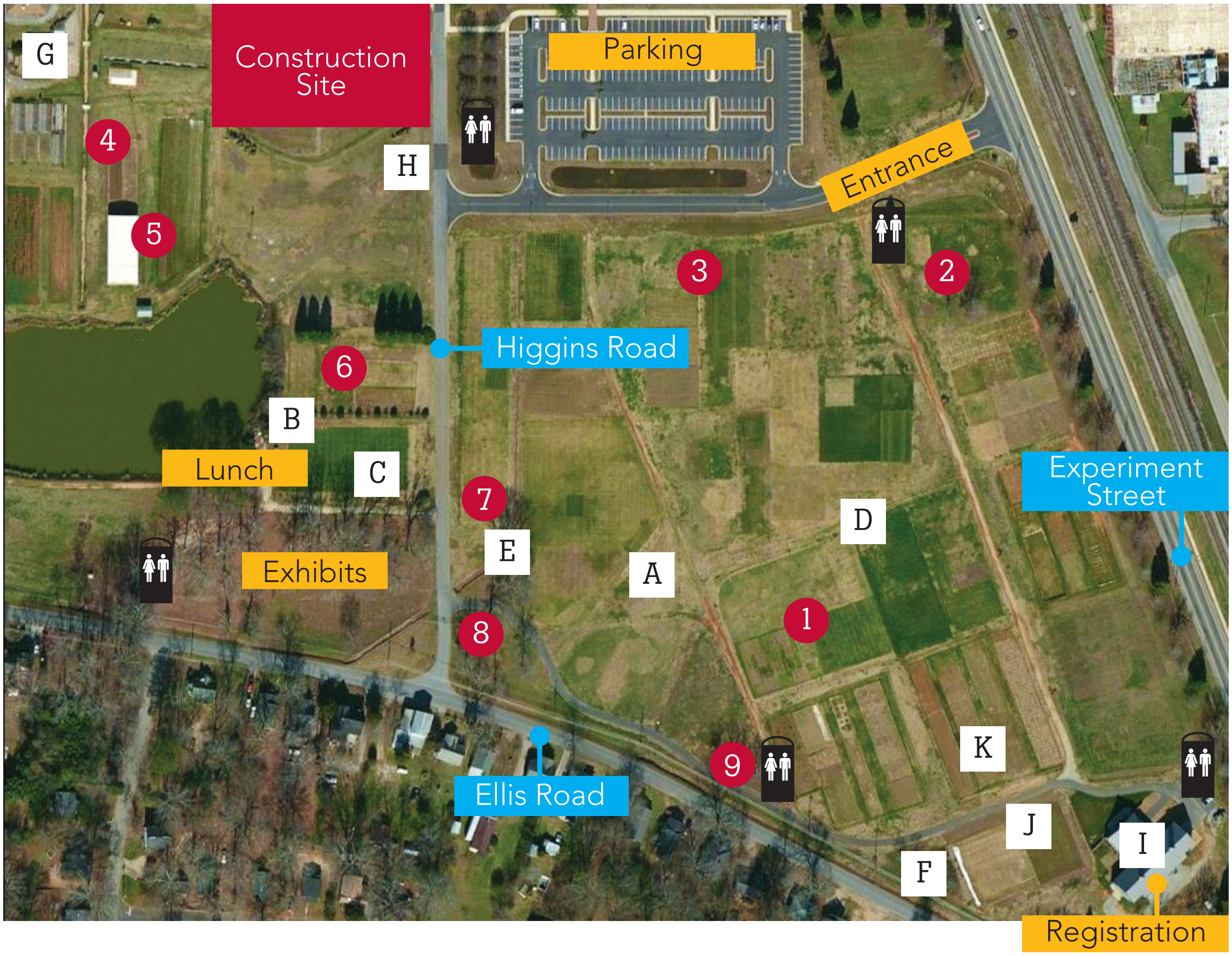
ONE BIG DAY · ACRES OF INFORMATION

THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

Thursday, August 4, 2016
UGA Griffin Campus

Outstanding research tours!
Georgia pesticide recertification credits!
Learn and apply the most current research!
Meet and interact with UGA turfgrass faculty!
Get answers to your questions!
Equipment, product displays, and more!

Map and Field Day tour stops



Guided morning tour stops: 1-9

Self-guided afternoon tour venues: A-K

Porta-potty Restrooms

UGA 2016 Turfgrass Field Day Program Guide editors:
Dr. Alfredo Martinez-Espinoza, UGA CAES Plant Pathology Dept.
Dr. Paul Raymer, Dr. Clint Waltz, and Mary Flynn, UGA CAES Crop & Soil Sciences Dept.

2016 UGA Turfgrass Research Field Day Program

THURSDAY, AUGUST 4

8-8:45 a.m.	REGISTRATION
8:50-9:15 a.m.	INTRODUCTION Welcome – Dr. Clint Waltz Griffin Campus Welcome – Dr. Lew Hunnicutt CAES Welcome – Dr. Bob Shulstad
9:15-11:30 a.m.	GUIDED RESEARCH TOUR* 1. Evaluation of Season-Long Annual Bluegrass Control from Herbicides Applied at an Early-Postemergence Timing – *P. McCullough* 2. Turfgrass Breeding – A Team Approach – *A. Webb, J. Fox, L. Swayzer, & B. Schwartz* 3. Tall Fescue Breeding and Management – *P. Raymer* 4. Understanding Drought Tolerance for Breeding Warm-season Grasses – *D. Jespersen* 5. Using Sensor Technology to Improve Fertility Practices – *B. Grubbs & G. Henry* 6. Latest Research on Turfgrass Diseases with Emphasis on Lawncare and Golf – *A. Martinez* 7. Diagnosing Common and Not So Common Problems in Turf – *C. Waltz* 8. Cultivar Development in Little Bluestem – *M. Harrison & C. Robacker* 9. Pesticide Application and Pollinator Spaces – *G. Huber & B. Griffin*
11:30 a.m.-1:00 p.m.	TURFGRASS EQUIPMENT AND PRODUCT EXHIBITS
11:30-1:15 p.m.	BARBECUE LUNCH (ribs and chicken)
1:15-2:30 p.m.	SELF-GUIDED RESEARCH TOUR† A. Turf: Is it a Source or Sink of Carbon Dioxide? – *M. Leclerc* B. Fungicides for Control of Diseases in Bentgrass and Bermudagrass – *A. Martinez* C. Nitrogen Needs of the Newer Bentgrasses – *B. Guertal & C. Waltz* D. Managing Turfgrass Weeds – *P. McCullough* E. Common Pests in Ornamental Grasses – *M. Harrison, C. Robacker & S. Hawkins* F. New Approaches for Understanding Turfgrass Physiology – *D. Jespersen* G. Demonstration: Pesticide Storage and Handling – *Rick Hayes* H. New Turfgrass Research and Education Facilities – *P. Raymer & C. Waltz* I. Poster Session – Turfgrass Graduate Programs at UGA – *Turfgrass Graduate Students* J. Demonstration: Update on Seashore Paspalum Breeding – *P. Raymer* K. Demonstration: Subsurface Irrigation of Turf – *V. Tishchenko*

** A special Spanish translation will be made available for the Guided Research Tour*
† Other research plots will be marked and labeled for individual observation.

Pesticide recertification credits will be available at registration no earlier than 2:15 p.m.

2016 UGA Turfgrass Research Field Day Program

RESEARCH AND EDUCATION CONTRIBUTORS

The turfgrass research and education program at the University of Georgia is supported by two means: (1) state and federal support, and (2) the various entities of the turfgrass industry. Without the active support of the turfgrass industry, our research and education efforts would be severely limited. To show our gratitude, we would like to recognize the contributors who have recently helped to strengthen the turfgrass industry by supporting our research and education programs:

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Georgia Crop Improvement Association
Georgia Golf Course Superintendents Association (GGCSA)
Georgia Golf Environmental Foundation
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Georgia PGA
Georgia Seed Development Commission
Georgia State Golf Association
Georgia Turfgrass Foundation Trust
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The Turner Foundation
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University of Georgia Research Foundation
UGARF– Technology Commercialization Office
Urban Ag. Council
USDA-ARS
U.S. Golf Association (USGA)
Valent U.S.A.
Valley Irrigation
Valmont Irrigation
Wright Turf

Thank you! If we have inadvertently omitted a contributor, we apologize.

University of Georgia Turfgrass Team - 2016

Athens Campus

Kris Braman, Professor & Department Head Entomology Phone (706) 542 – 2816 kbraman@uga.edu	**Will Hudson**, Professor Entomology Phone (229) 386 – 3424 wghudson@uga.edu
Benjamin Campbell, Assistant Professor Ag & Applied Economics (706) 542 – 0852 bencamp@uga.edu	**Elizabeth Little,** Asst. Professor Plant Pathology – Extension Specialist Phone (706) 542 – 4774 elittle@uga.edu
Katrien Devos, Professor Crop & Soil Sciences – Plant Breeding & Genomics Phone (706) 542 – 0925 kdevos@uga.edu	**Andrew H. Paterson**, Professor Crop & Soil Sciences – Plant Geneticist Phone (706) 583 – 0162 paterson@uga.edu
Gerald Henry, Assoc. Professor Crop & Soil Sciences – Env. Turfgrass Science Phone (706) 542 – 0898 gmhenry@uga.edu	

Griffin Campus

Ellen Bauske, Program Coordinator Center for Urban Ag. Phone (770) 233 – 5558 ebauske@uga.edu	**David Jespesen**, Assistant Professor Crop & Soil Sciences Phone (770) 228 – 7357 djesper@uga.edu
Zhenbang Chen, Research Scientist Crop & Soil Sciences – Turfgrass & Small Grains Phone (770) 228 – 7331 zchen@uga.edu	**Monique Leclerc**, Professor Crop & Soil Sciences – Biomicrometeorology Phone (770) 228 – 7279 mleclerc@uga.edu
Wojciech Florkowski, Professor Ag & App. Economics Phone (770) 228 – 7231 mwflorko@uga.edu	**Alfredo Martinez**, Professor Plant Pathology – Turfgrass Phone (770) 228 – 7375 amartine@uga.edu
Becky Griffin, Educational Program Specialist Center for Urban Ag Phone (770) 528 – 4070 beckygri@uga.edu	**Patrick McCullough,** Associate Professor Crop & Soil Sciences – Weed Science Phone (770) 228 – 7300 pmccull@uga.edu
Mussie Habteselassie, Asst. Professor Crop & Soil Sciences – Env. Soil Microbiology Phone (770) 229 – 3336 mussieh@uga.edu	**Paul Raymer**, Professor Crop & Soil Sciences – Turfgrass Breeder Phone (770) 228 – 7234 praymer@uga.edu
Melanie Harrison, Curator USDA – PGRCU Phone (770) 412 – 4097 melanie.harrison@ars.usda.gov	**Viktor Tishchenko**, Research Professional II Crop & Soil Sciences Phone (404) 606 – 0823 viktort@uga.edu
Jack Huang, Assoc. Professor Crop & Soil Sciences – Environmental Sciences Phone (770) 220 – 3302 qhuang@uga.edu	**Clint Waltz**, Professor Crop & Soil Sciences – Turfgrass Management Phone (770) 228 – 7300 cwaltz@uga.edu
Greg Huber, Training Coordinator Center for Urban Ag. Phone (770) 229 – 3251 ghuber@uga.edu	

Tifton Campus

Karen Harris-Shultz, Research Geneticist USDA – Crop Genetics and Breeding Research Phone (229) 386 – 3906 karen.harris@ars.usda.gov	**Brian Schwartz,** Associate Professor Crop & Soil Sciences – Turfgrass Breeder Phone (229) 386 – 3272 tifturf@uga.edu

Evaluation of Season-Long Annual Bluegrass Control from Herbicides Applied at an Early-Postemergence Timing

Patrick McCullough, Associate Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

ABSTRACT

Annual bluegrass is a problematic weed in turfgrass. Postemergence herbicides often provide erratic levels of control or require repeat applications when applied to annual bluegrass after maturity. The objective of this field experiment was to evaluate the efficacy of various sulfonylureas applied at an early postemergence timing (October) for season-long annual bluegrass control. By 23 WAT, Katana controlled annual bluegrass 96 to 100% at rates ranging from 1.5 to 3 oz/acre. Monument and Revolver provided 100 and 90% control, respectively. Plots treated with herbicides had about 3 times more bermudagrass cover than the nontreated at 23 WAT. Overall, early-postemergence treatments of these herbicides at rates evaluated provided season-long annual bluegrass control. It is recommended that turf managers consider tank-mixing sulfonylureas with another mode of action, such as simazine, at this application timing if resistance to ALS-inhibitors is a concern.

INTRODUCTION

Annual bluegrass (Poa annua) is the most problematic winter weed of bermudagrass. Plants have a light green color, coarse leaf texture, and produce unsightly seedheads (Beard 1970). Annual bluegrass germinates in fall, overwinters in a vegetative state, and resumes active growth in spring (Beard 1970; Lush 1989). Competitive growth of populations causes stand thinning of bermudagrass that may predispose turf to invasion by summer annual weeds, such as crabgrass (*Digitaria* spp.). Annual bluegrass typically dies by May in Georgia, but cool temperatures in spring and regular irrigation may extend survival of populations in early summer.

Cultural practices that promote turfgrass density can reduce annual bluegrass infestations. This is particularly important for grasses with limited selective herbicides available for control. Overwatering, especially in shady areas, promotes annual bluegrass establishment in fall. Withholding irrigation until turfgrasses exhibit initial symptoms of drought stress can reduce annual bluegrass growth and competition. Core aerifications should be conducted during active turfgrass growth and favorable periods for quick recovery. Voids left in turf with exposed soil following aerifications may permit annual bluegrass invasion during periods of peak germination. Warm-season grasses should have enough time to recover from summer aerifications to promote turf density prior to annual bluegrass germination in fall.

Nitrogen fertilization should be reduced during peak annual bluegrass establishment in fall and periods of vigorous growth in spring. High nitrogen at these times encourages annual bluegrass spread and survival in polyculture with turfgrasses. Warm-season grasses do not recover from scalping as quickly in fall compared to summer, which may enhance annual bluegrass establishment. Regular mowing or adjusting the height of cut may help reduce scalping if weather precludes mowing operations in fall. While returning clippings is recommended to recycle nutrients to the soil, removal of clippings in spring can reduce the spread of viable seed. Adjusting these cultural practices can help reduce annual bluegrass populations over time, but herbicides are often needed to provide acceptable levels of control.

Preemergence herbicides applied in early fall can provide effective control of annual bluegrass. Application timing before germination is critical since most preemergence herbicides do not control annual bluegrass after establishment. Sulfonylureas such as flazasulfuron, foramsulfuron, and trifloxysulfuron are postemergence herbicides for annual bluegrass control in warm-season grasses. These herbicides are highly selective for controlling cool-season grasses in bermudagrass, but may require sequential applications for controlling mature annual bluegrass populations. Repeat applications of these herbicides can increase maintenance costs and the injury potential to turfgrasses transitioning out of dormancy in spring. Improving the efficacy of these herbicides by adjusting the application timing could reduce the rates and regimens required for acceptable annual bluegrass control.

Applications of sulfonylurea herbicides after peak germination of annual bluegrass in fall could enhance the efficacy for control compared to later timings. However, the limited soil persistence of these herbicides in winter may limit residual control by spring. The objective of

Table 1. Annual bluegrass control and 'Tifway' bermudagrass cover following herbicide treatments on October 30, 2014. WAT = weeks after treatment.

Herbicide	Rate (oz/acre)	Annual bluegrass control (%)		Bermudagrass cover (%)
		8 WAT	23 WAT	23 WAT
Katana 25%	1.5	91	96	69
	2	90	100	70
	2.5	94	100	75
	3	96	100	64
Revolver 0.19SC	17.4	93	90	61
Monument 75%	0.5	97	100	74
Nontreated				20
	LSD0.05		3	14

this field experiment was to evaluate the efficacy of various sulfonylureas applied at an early postemergence timing for season-long annual bluegrass control.

MATERIALS AND METHODS

The experiment was conducted on a 'Tifway' bermudagrass fairway on the UGA Griffin Campus. Local soil was a Cecil sandy clay loam with a 6.0 pH and 2.5% organic matter. The turf was mowed twice per week at 0.5" with a reel-mower during active growth. The site was irrigated as needed to prevent turf wilting. Annual bluegrass was at a seedling growth stage on the day of treatments.

The herbicides evaluated included Katana 25% (flazasulfuron) at 1.5, 2, 2.5, and 3 oz/acre, Revolver (foramsulfuron) at 17.4 fl oz/acre, and Monument 75% (trifloxysulfuron) at 0.53 oz/acre. Katana treatments included a non-ionic surfactant at 0.25% v/v. A nontreated check was included. The application date was October 30, 2014. Treatments were applied with a CO_2-pressured sprayer equipped with three 8002 flat-fan nozzles calibrated to deliver 25 gallons per acre.

Bermudagrass injury and annual bluegrass control were evaluated on a percent scale every two weeks from November to late April. The experimental design was a randomized complete block with four replications of 5 x 10-ft plots. Data were subjected to the analysis of variance. Means were separated with Fisher's LSD test at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Bermudagrass injury was not detected on any evaluation date (data not shown). Annual bluegrass control was excellent (>90%) from all treatments at 8 weeks after treatment (WAT, Table 1). By 23 WAT, Katana at all rates controlled annual bluegrass 96 to 100%. Control from these treatments was comparable to Monument. Revolver controlled annual bluegrass 90%, but was less effective than Katana and Monument. Plots treated with herbicides had about 3 times more bermudagrass cover than the nontreated at 23 WAT.

Katana at all rates tested provided similar or better annual bluegrass control to Revolver and Monument at an early postemergence timing in fall. Treatments at this timing controlled seedling annual bluegrass with enough residual to enhance bermudagrass spring transition compared to the nontreated. Revolver provided excellent annual bluegrass control, but was less effective than Katana in this experiment. Annual bluegrass resistance to sulfonylureas is concerning in bermudagrass throughout Georgia. Resistance could eventually preclude the exclusive use of these herbicides without tank-mix partners for annual bluegrass control. Segregation of annual bluegrass populations after applications of these herbicides should be monitored to determine if resistant biotypes could be present. If resistance is a concern, tank-mixing sulfonylureas, like Katana, with different modes of action will enhance the potential to control annual bluegrass.

REFERENCES

Beard, J.B. (1970). An ecological study of annual bluegrass. USGA Green Sect Rec 8:13–18.

Lush, W.M. (1989). Adaptation and differentiation of golf course populations of annual bluegrass. Weed Sci 37:54–59.

ACKNOWLEDGEMENTS

We would like to thank Seth Williams and Bob Perry from the University of Georgia and Alan Estes from PBI Gordon for supporting this work.

Turfgrass Breeding – A Team Approach

A Bermudagrass Greens for the Future

Amanda Webb, Graduate Student, Crop and Soil Sciences
Brian Schwartz, Associate Professor, Crop and Soil Sciences
The University of Georgia, Tifton Campus

ABSTRACT
'Tifgreen' bermudagrass is a cultivar released from the USDA and the University of Georgia that is reported to be seed-sterile, but its propensity to mutate has led to genetic instability over the past 60 years. Some 'Tifgreen' mutants have differing leaf, root, and growth habits. Those mutants with superior characteristics, such as 'Tifdwarf,' 'TifEagle,' 'MiniVerde,' and 'Champion,' have had significant value to the turf industry. A new study of 'Tifgreen' mutants has shown a wide variety of different morphological changes from 'Tifgreen.' Future studies of this collection of mutants will be conducted to see if these genetic changes have affected the sterility of these triploid grasses.

INTRODUCTION
In 1956, Dr. Glenn Burton released 'Tifgreen' bermudagrass (Burton 1964). 'Tifgreen' was an improved triploid hybrid from a cross between a very low growing common bermudagrass (tetraploid) and African bermudagrass (diploid). The popularity of 'Tifgreen' as a greens grass grew in the 1960's because of its tolerance to low mowing heights, color, sterility, and leaf density. Mutations began to accumulate in 'Tifgreen' over time, and some of these off-types were isolated, studied, and released as new cultivars.

MATERIALS AND METHODS
In 2012, Patrick O'Brien (USGA) was informed that one of the oldest known plantings of Tifgreen was going to be renovated at Taylors Creek Golf Course at Fort Stewart, GA (O'Brien, 2012). For nearly 50 years these greens had been mutating while being maintained under standard golf course putting green's management practices. A collection trip was planned and 140 of these grasses were selected because of their ability to survive under high nematode pressure, heavy shade, or their aggressive nature. These plugs were brought back to Tifton where each grass was isolated down to a single sprig for genetic purity. The single sprigs were allowed to grow in the greenhouse until the plants expanded to fill a 6-inch nursery pot, and in 2013 t, all of the 140 mutants were taken to the field and planted into two separate 3x3 plots.

The mutants were compared to the cultivars 'Champion,' 'Floradwarf,' 'Jones Dwarf,' 'MiniVerde,' 'MS-Supreme,' 'Tifdwarf,' 'TifEagle,' and 'Tifgreen' by measuring different morphological traits such as percent turf cover, color, canopy height, internode length, leaf width, and leaf length. Percent turf cover (Richardson et al., 2001) and color (Karcher and Richardson, 2003) were measured using a light box and digital camera. Other measurements where done by hand with a digital caliper. In 2015, 100 seedheads were collected off of each of the 140 different mutants and cultivars. These seedheads were x-rayed in small groups in an attempt to find mature seed. Seedheads will be collected and screened by x-ray again in 2016.

RESULTS
Off-types from 'Tifgreen' bermudagrass putting greens originally planted in 1961 at Taylor's Creek Golf Course displayed a wide range of phenotypic variability (Figures 1 and 2). Compared to commercial cultivars, the off-types from Taylor's Creek typically had longer internode and leaf lengths as well as higher canopy height. Additionally, off-types expressed more aggressive lateral growth during the duration of this study.

The x-rays of the 14,000 seedheads collected in 2015 possibly show a few mature seed. These seed will be treated and planted in the summer of 2016 to see if they germinate and produce viable plants.

CONCLUSIONS
Off-types with more aggressive, upright growth than commercial cultivars can negatively affect functional and aesthetic putting green quality. The problems associated with off-type grasses in bermudagrass putting greens will likely continue as the use of bermudagrass cultivars within the 'Tifgreen' family increases throughout the transition zone and southern United States.

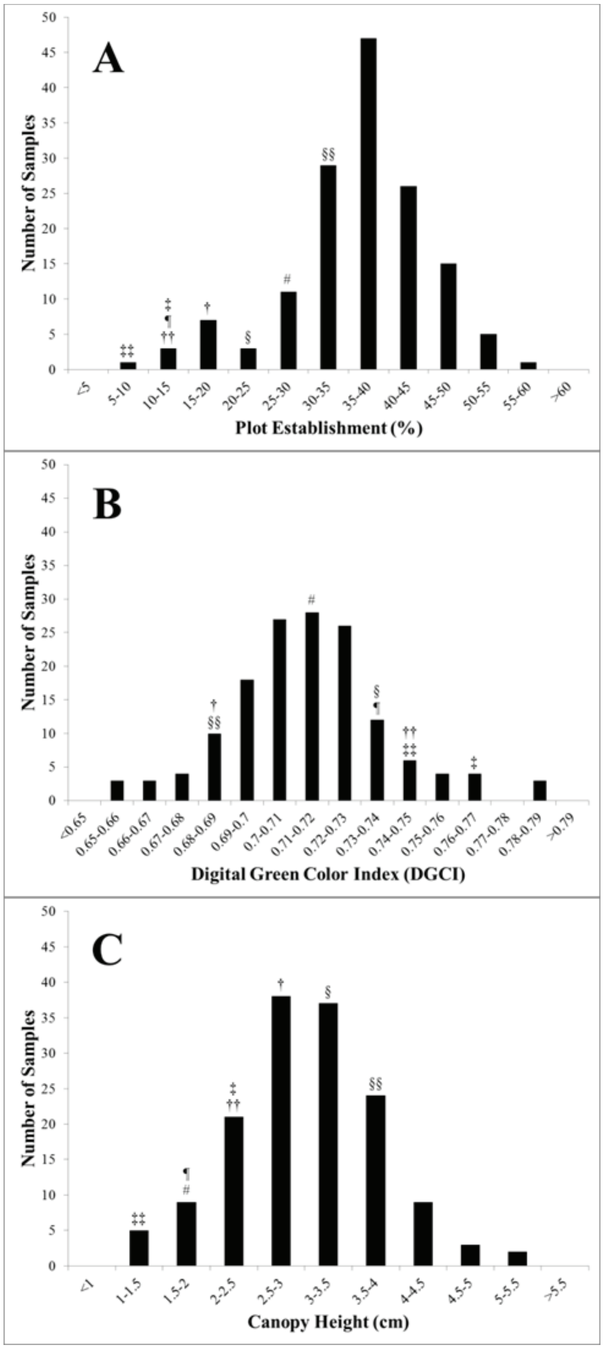

Figure 1. Frequency distribution histograms for mean turfgrass percent cover (A), digital green color index (B), and canopy height (C) for 140 off-type bermudagrasses and the cultivars Champion (†), Floradwarf (‡), Jones Dwarf (§), MiniVerde (¶), MS-Supreme (#), Tifdwarf (††), TifEagle (‡‡), and 'Tifgreen' (§§) in two field trials conducted in Tifton, GA, during 2013 and 2014. Genotypic groupings that include cultivars are designated by each respective symbol defined above.

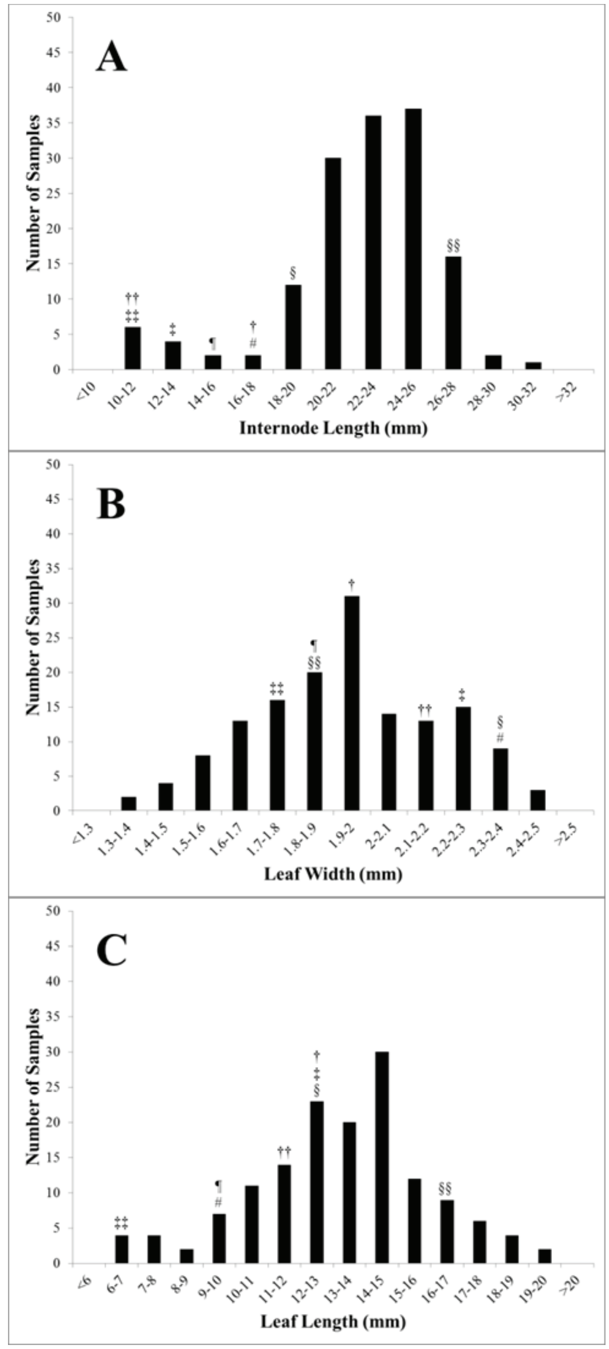

Figure 2. Frequency distribution histograms for mean internode length (A), leaf width (B), and leaf length (C) for 140 off-type bermudagrasses and the cultivars Champion (†), Floradwarf (‡), Jones Dwarf (§), MiniVerde (¶), MS-Supreme (#), Tifdwarf (††), TifEagle (‡‡), and 'Tifgreen' (§§) in two field trials conducted in Tifton, GA, during 2013 and 2014. Genotypic groupings that include cultivars are designated by each respective symbol defined above.

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Turfgrass Breeding – A Team Approach, *continued*

A Bermudagrass Greens for the Future

Five selections have been made out of the original 140 different mutants and have been advanced to more rigorous studies. These five selections were planted in 2015 on three different golf courses. Each grass is being subjected to standard industry putting green management practices and their performance is being evaluated in comparison to TifEagle that was planted at the same time. Two preliminary stimp measurements conducted since the greens were established indicate that their putting performance will be comparable to that of TifEagle.

If viable seed can be formed in the 'Tifgreen' mutants, it could possibly provide a way to stabilize the genetics of 'Tifgreen.' Further research will be necessary to determine if the desirable traits of 'Tifgreen' are heritable, and if the sexually-derived progeny are genetically stable.

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Turfgrass Breeding – A Team Approach

B Screening Centipedegrass populations for Morphological Variation and Seed Yield Component Variation

Luellen Swayzer, Graduate Student, Crop and Soil Sciences
Brian M. Schwartz, Associate Professor, Crop and Soil Sciences
Gerald Henry, Associate Professor, Crop and Soil Sciences
The University of Georgia, Athens and Tifton Campuses

ABSTRACT

Centipedegrass (*Eremochloa ophiuroides*) is a low maintenance turfgrass species that is well adapted to the southeastern and south central regions of the United States. The most widely used cultivars, 'TifBlair' and 'Common,' have similar backgrounds, which increases the chances of genetic vulnerability within the species. Morphological variation can be seen on an individual plant basis in this species, but the phenotypic and genotypic variation is typically small at the population level. In efforts to add diversity to the centipedegrass germplasm, collection trips were conducted around the United States and to the center of origin in China. To quantify the variability from the collected germplasm, individual centipede plants will be screened for morphological characteristics, such as leaf length, leaf color, canopy density, and turf quality. Broad sense heritability estimates will be calculated on a single-plant (Hsp) basis for all characteristics to determine whether centipedegrass can be effectively improved through plant breeding.

INTRODUCTION

Centipedegrass was introduced into the United States in 1916, and was originally used as a forage grass in Florida and southern Georgia because of its ability to withstand low fertility (Hanna, 2000). Now, centipedegrass is cultivated as a turf and is known as the "the lazy man's grass" because of its ability to thrive in low fertility and reduced management in comparison with other turfgrasses (Hook and Hanna, 1994; Brosnan and Deputy, 2008). In order to broaden the variation of the United States germplasm, a collection trip was conducted in 1999 in central and southern China collecting germplasm from many geographical regions. Morphological variation was assessed in 31 accessions and seed set variation was measured in 58 accessions from the six regions of China, and then compared to 'Common' and 'TifBlair' (Liu et al., 2003). The resulting data showed that 'TifBlair' and 'Common' had similar morphological characteristics, and that there was variation in stolon number, internode length, leaf length, and width in the Chinese accessions that could

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Figure 1. Centipedegrass experiment planted at the University of Georgia's Athens Turfgrass Research and Education Center on June 9, 2016.

Turfgrass Breeding – A Team Approach, *continued*

B Screening Centipedegrass populations for Morphological Variation and Seed Yield Component Variation

provide new sources of genetic variation for centipedegrass breeding (Liu et al., 2003). Differences have also been found in centipedegrass accessions tested for adaptation to varying soil pH and survival in subfreezing temperatures (Henry and Schwartz, 2010).

MATERIALS AND METHODS

Five University of Georgia centipedegrass breeding populations (TC-196, TC-427, TC-428, TC-434, and TC-437) are currently being compared to 'TifBlair.' The experiment is arranged as a randomized complete block design with six replications (nine sub-samples within each replication) at the University of Georgia's Athens Turfgrass Research and Education Center. Plants were germinated in the greenhouse during 2015 and were irrigated daily and fertilized bimonthly to sustain plant growth. Fifty-four plants from each population were randomly selected in the greenhouse before they were transplanted to the field in June of 2016 (Figure 1). Morphological traits being assessed are internode length (between third and fourth terminal node, leaf width, leaf length, leaf color, canopy density, canopy height, and turf quality. Data for these traits is being collected as described by Liu et al. (2003). Measurements were initiated one month after plots were planted. Visual turf cover and color are being assessed using digital image analysis (DIA), photosynthetic capacity is being measured using normalized difference vegetation index (NDVI), and turf quality is being rated using National Turfgrass Evaluation Program guidelines, with 1 being dead brown grass and 9 being outstanding quality and color (Morris and Shearman, 2007).

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Turfgrass Breeding – A Team Approach

C Shade Tolerance of Bermudagrass, Zoysiagrass, St. Augustinegrass and Seashore Paspalum

Jonathon Fox, Graduate Student, Crop and Soil Sciences
Brian Schwartz, Associate Professor, Crop and Soil Sciences
The University of Georgia, Tifton Campus

ABSTRACT

Most warm-season turfgrasses grow better with full sunlight than under higher levels of shade, as long as soil moisture is not limiting. In coordination with a USDA grant to develop drought tolerant turfgrasses, we have begun testing the shade tolerance of the most drought tolerant bermudagrasses, zoysiagrasses, St. Augustinegrasses, and seashore paspalums from the University of Georgia, the University of Florida, North Carolina State University, Oklahoma State University, and Texas A&M University. Currently, we are comparing the turf coverage and canopy heights of experimental genotypes versus cultivars of these species under 73% shade. By the end of the experiment we hope to find dense and vigorous turfgrass cultivars that are less prone to scalping.

INTRODUCTION

The University of Georgia, Texas A&M University, the University of Florida, Oklahoma State University, and North Carolina State University have jointly been awarded two USDA-NIFA-SCRI grants to develop drought and salinity tolerant turfgrasses. Researching the shade tolerance of the most drought tolerant bermudagrass, zoysiagrass, St. Augustinegrass, and seashore paspalum experimental lines has become a priority because shade stress can often limit the performance of many turfgrasses. All experimental bermudagrasses were compared to the standards T'Tifway,' 'TifGrand,' and 'Celebration.' 'TifGrand' and 'Celebration' were chosen because of their improved shade tolerance over 'Tifway.' 'Floratam,' 'Raleigh,' and 'Palmetto' were cultivars selected as the checks for the St. Augustinegrass shade study. 'Palmetto' and 'Raleigh' were included because of the exceptional shade tolerance they have shown in the past. 'Floratam' was chosen as a control since it typically is the poorest performing St. Augustinegrass in shady conditions. The zoysiagrass cultivars that were chosen are 'Empire,' 'Zeon,' and 'Palisades.' 'Zeon' was selected because of its ability to be grown in heavy shade in previous studies and in real-world scenarios. 'Palisades' and 'Empire' were also chosen as control grasses for comparison since they both have moderate shade tolerance. 'SeaStar' and 'SeaIsle 1' were the standard seashore paspalum cultivars included in the study. Shade performance has typically been a weakness for many turfgrasses. The development of new shade and drought tolerant turfgrass cultivars in each of these species would allow turf managers to perform their job at a higher level.

MATERIALS AND METHODS

The shade trial was planted during 2014 at the Coastal Plain Experiment Station in Tifton, GA. It included genotypes of four turfgrass species (bermudagrass, zoysiagrass, St. Augustinegrass, and seashore paspalum) that were planted as a single plug in five replications on 3 ft centers under 73% shade structures (Figure 1). The bermudagrasses included were 'Tifway,' 'Celebration,' 'Latitude 36,' 'TifGrand,' 'TifTuf,' 10 experimental grasses from Oklahoma State University, and 15 experimental grasses from the University of Georgia. The zoysiagrasses included Empire, Palisades, Zeon, 10 experimental grasses from Texas A&M University, 10 experimental grasses from the University of Florida, and 13 experimental grasses from the University of Georgia. The St.Augustinegrass trial contained 'Floratam,' 'Palmetto,' 'Raleigh,' 10 experimental grasses from Texas A&M University, and 10 experimental grasses from North Carolina State University. The seashore paspalum trial included SeaStar, SeaIsle 1, and 10 experimental grasses from UGA.

The shade structures were taken off every two weeks for routine mowing, and once a month for measuring canopy height and taking pictures for digital image analysis to determine percent turf coverage (Richardson et al., 2001) and color (Karcher and Richardson, 2003). The plots were maintained with a zero-turn Grasshopper lawn mower with a bagging system to collect clippings. The height of cut was 3.5 in for the St. Augustinegrass and 2.5 in for the other three species. Pictures were taken with a digital camera mounted on a rolling light box to allow consistency in illumination and distance from the turf.

RESULTS

Digital images are being analyzed using Sigma Scan. The study is not yet complete, so all results are preliminary.

continued on the next page

Turfgrass Breeding – A Team Approach, *continued*

C Shade Tolerance of Bermudagrass, Zoysiagrass, St. Augustinegrass and Seashore Paspalum

Figure 1. Rolling shade structures with 73% shade cloth and zoysiagrass plots mowed at 2.5in.

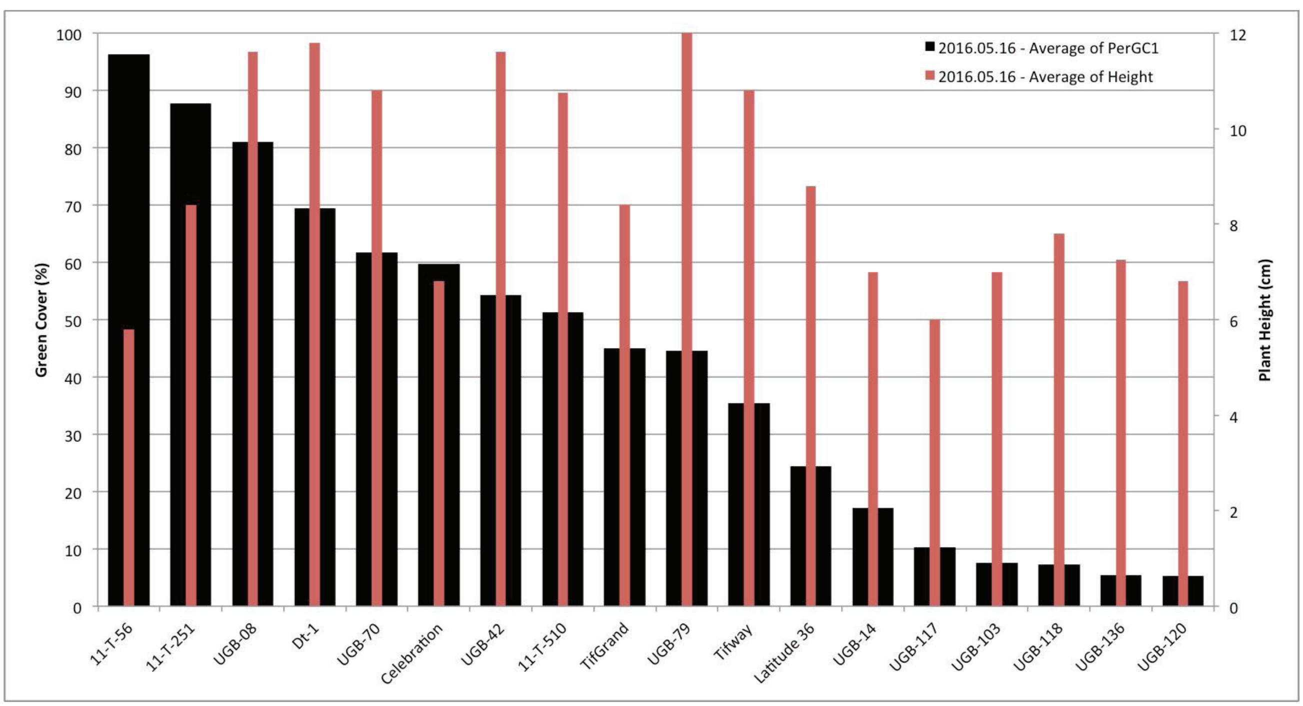

Figure 2. Turf cover (black bars) and canopy height (gray bars) of bermudagrasses grown under 73% shade in Tifton, GA, during May of 2016.

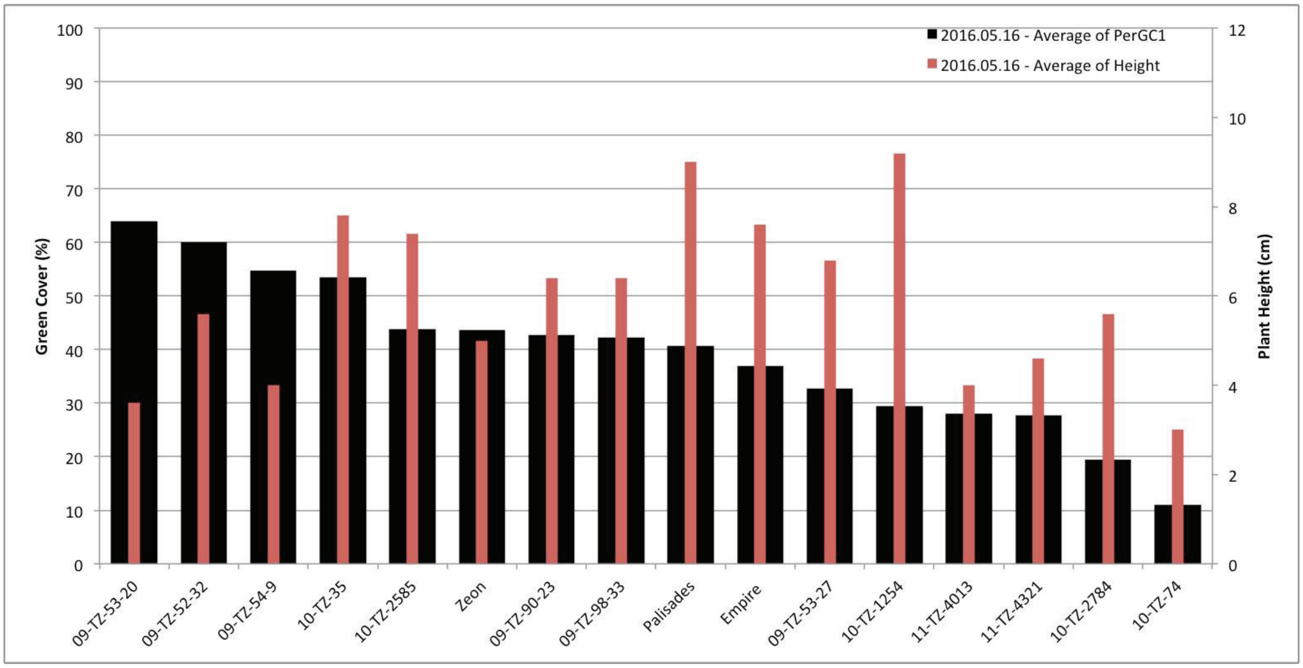

Figure 3. Turf cover (black bars) and canopy height (gray bars) of zoysiagrasses grown under 73% shade in Tifton, GA, during May of 2016.

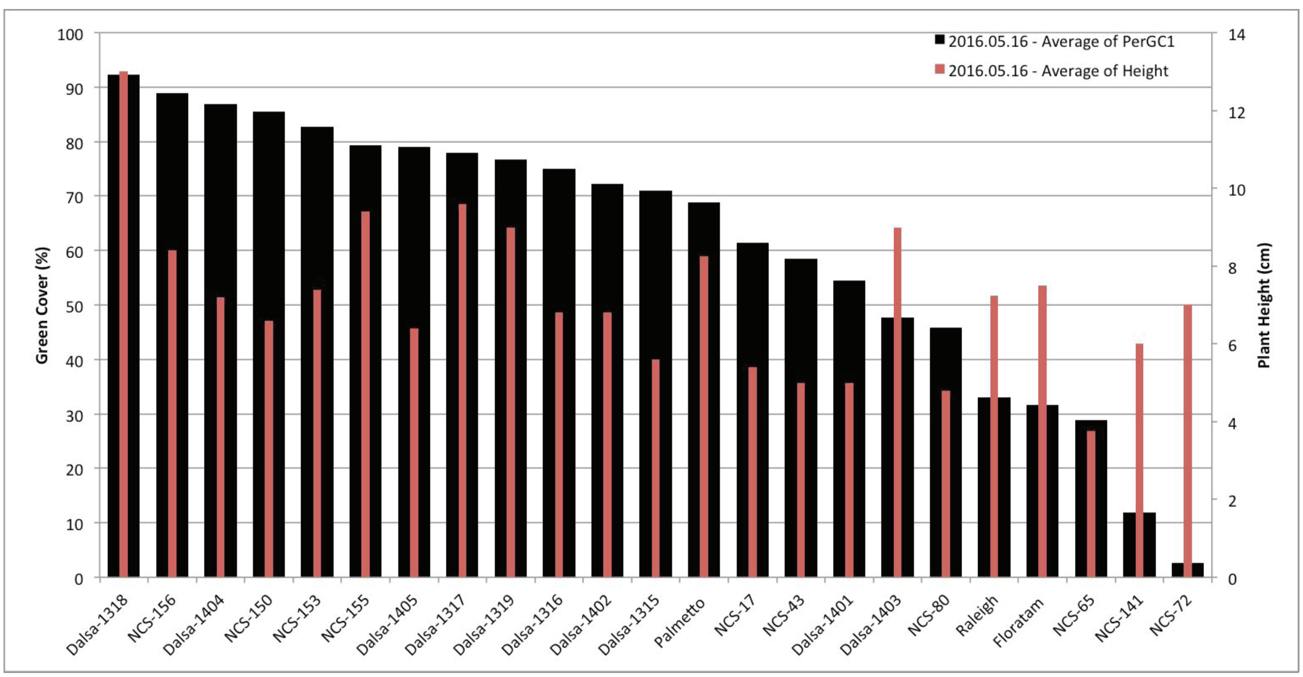

Figure 4. Turf cover (black bars) and canopy height (gray bars) of St. Augustinegrasses grown under 73% shade in Tifton, GA, during May of 2016.

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Turfgrass Breeding – A Team Approach, *continued*

C Shade Tolerance of Bermudagrass, Zoysiagrass, St. Augustinegrass and Seashore Paspalum

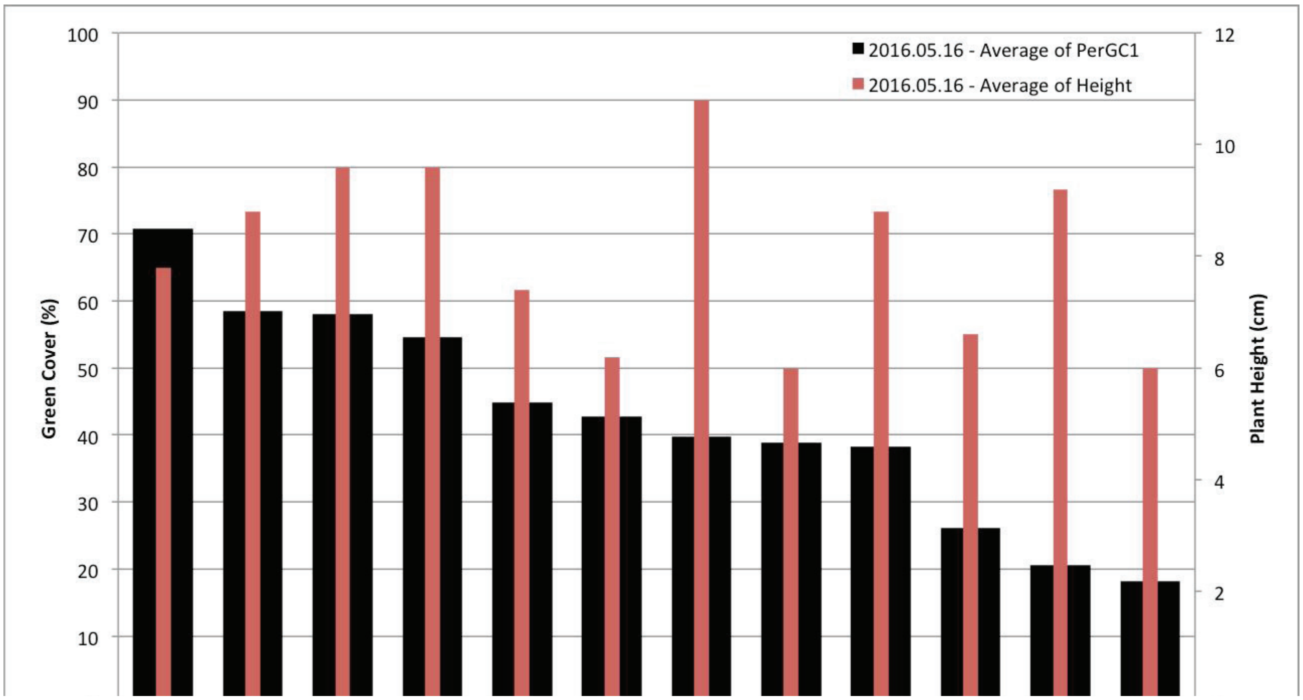

Figure 5. Turf cover (black bars) and canopy height (red bars) of seashore paspalum grown under 73% shade in Tifton, GA, during May of 2016.

CONCLUSIONS

To date, there have been experimental grasses outperforming released cultivars in all four species. At the minimum, we have identified germplasm that can be used to make new hybrids that have the potential to be more shade tolerant. Our hope is that these shade tolerant grasses are also very drought tolerant and widely adapted across the United States and will possibly make an impact on home owners, landscape professionals, golf course superintendents, and sports field managers in the future.

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ACKNOWLEDGEMENTS

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Tall Fescue Breeding and Management

Paul Raymer, Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

ABSTRACT

Turf managers and Georgia citizens need grasses that resist drought, require low water use, and are adapted to stresses associated with our climate, soil, and spectrum of pests. Tall fescue is a cool-season turfgrass commonly used for home lawns, general grounds, roadsides, golf course roughs, sports fields, and land stabilization sites. While many tall fescue cultivars are widely used in the northern half of Georgia, stands and appearance often deteriorate after only a few years largely due to the extreme climatic conditions of our typical Georgia summers. The UGA tall fescue breeding program seeks to develop new cultivars with outstanding performance even in our challenging environment.

INTRODUCTION

A National Turfgrass Evaluation Program (NTEP) trial for tall fescue was established at the Griffin Campus in 2012 (www.ntep.org). The objectives of this trial and similar trials conducted throughout the United States and Canada were to compare the performance of the 116 released or experimental tall fescue lines included and to determine regions of adaptation. Unfortunately, most lines entered in this trial have a similar and sub-par performance in our challenging environment of central Georgia.

Unless a grass can develop and maintain a deep and viable root system in the hard, red clay soils and the sandy coastal plain soils common in the Southeast, the grass will not be drought resistant and will not persist. Soil stresses associated with our red clay soils that limit rooting are high soil strength and low pH that results in a combination of Al/Mn toxicity and nutrient deficiencies. A primary means of overcoming these problems without costly management is to develop turfgrasses that have genetic-based tolerance to these stresses. Turfgrasses that have improved rooting and low water use can better survive periodic droughts and more efficiently use rainfall.

Three tall fescue cultivars, 'Southeast,' 'Tenacity,' and 'Bulldog 51,' were released from the Griffin Campus tall fescue breeding program more than a decade ago. These cultivars did demonstrate excellent long-term persistence under Georgia conditions and with proper management made a reasonably attractive turf. Because these cultivars generally lacked the deep green color and fine leaf texture common to many commercially marketed turf-type fescue cultivars, they were not accepted as lawn grasses and were most often used in low-maintenance turf applications or for reclamation uses where persistence and stress tolerance traits are most important.

MATERIALS AND METHODS

The tall fescue breeding program at Griffin now places increased emphasis on improving turf quality but remains focused on the development of new cultivars with better performance and persistence for use in Georgia and similar climates of the southern transition zone. Specific breeding objectives are to improve drought tolerance, stand persistence, disease resistance, and tolerance to acid soils. The breeding program utilizes a rigorous screening protocol under low pH, induced drought, and high-stress conditions to identify superior parental lines. Our current breeding goals are to continue to develop stress tolerant and persistent tall fescue cultivars but with improved color, leaf texture, and overall turf quality.

RESULTS

In the fall of 2015 ten tall fescue populations from our breeding program with improved turf quality characteristics were sent to Oregon for evaluation of seed yield potential and resistance to seed production diseases. This is a major step in the process of developing the next generation of tall fescue cultivars adapted to our tough Georgia conditions.

CONCLUSIONS

Future UGA developed tall fescue cultivars will not only have improved drought tolerance and persistence but also acceptable turf quality characteristics. However, until these new cultivars are available, you may improve the persistence of current tall fescue cultivars during our stressful summer months by using deep and infrequent irrigation, raising mowing heights to 3-4 in., and limiting fertilization until active growth returns in the fall (Reeves, et al. 2003).

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Understanding Drought Tolerance for Breeding Warm-Season Grasses

David Jespersen, Assistant Professor, Crop and Soil Sciences
Paul L. Raymer. Professor, Crop and Soil Sciences
Monique Leclerc, Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

ABSTRACT

Drought stress is a major environmental stress which damages and limits the growth of warm-season grasses. A collaborative project among several universities in the southern United States, including the University of Georgia, was formed to evaluate the drought performance of several warm-season grasses including bermudagrass, zoysia, St. Augustine grass, and seashore paspalum. In addition to characterizing drought tolerance of a wide selection of experimental varieties, important physiological responses to drought were further detailed in select varieties of bermudagrass and seashore paspalum to better understand potential mechanisms for drought tolerance. This project will ultimately advance the ability of turf breeders to develop improved varieties which can withstand severe levels of drought.

INTRODUCTION

Drought stress is a major environmental stress which damages and limits the growth of warm-season grasses (Beard, 1989). These damages include leaf wilting, the production of reactive oxygen species, and altered carbon metabolism (Fry and Huang, 2004). Frequently during periods of prolonged drought, restrictions will be placed on outdoor water usage, particularly for turf areas, which can further the problem of drought induced damages. Screening and identifying warm-season grasses which can better withstand this abiotic stress is of key importance for the development of elite cultivars. A collaborative project between the University of Georgia and partners at the University of Florida, North Carolina State University, Oklahoma State University, and Texas A&M University has been undertaken to develop improved warm-season turfgrasses. By screening plant materials in several locations in a joint project, the selection and improvement of warm-season grasses in the southern United States will be accelerated and lead to the development of cultivars adapted to a wide range of environments. Understanding differences in physiological responses to drought stress in this wide collection of germplasm — in addition to identifying key drought olerance mechanisms — will be of great importance in the development of cultivars with the ability to thrive under reduced water usage.

MATERIALS AND METHODS

A field trial containing bermudagrass (*Cynadon dactylon*), zoysia (*Zoysia* spp.) St. Augustine grass (*Stenotaphrum secundatum*), and seashore paspalum (*Paspalum vaginatum*) was planted in Griffin, GA. Four replications were included for each of 13 bermudagrass, 13 zoysia, 13 St. Augustine grass, and 7 seashore paspalum varieties. These materials included both commercially available cultivars as well as experimental varieties from the University of Georgia, University of Florida, University of Oklahoma, and Texas A&M University. To induce drought stress, all irrigation was turned off and the field was equipped with a rainout shelter capable of preventing rain events from adding moisture to the plots. Drought stress was induced on August 25th in 2015 and June 20th in 2016. Measurements during drought stress included visual quality ratings, normalized difference vegetation index (NDVI) which estimates green leaf biomass, as well as digital image analysis to assess turf color and density. On bermudagrass cultivars 'Celebration,' 'TifTuf ,' and 'Tifway,' and seashore paspalum cultivars 'SeaIsle 1,' 'SeaStar,' and 'UGA1743,' more detailed analysis was performed. Analysis included respiration rates measured by CO^2 flux to quantify energy usage, relative water content to assess leaf hydration status, electrolyte leakage to assess membrane damage, and osmotic adjustment to assess the accumulation of compatible solutes affecting leaf osmotic potential.

RESULTS

In 2015, drought stress led to a number of declines in all four of the tested turfgrass species with the average turf quality dropping to below 6, the minimally acceptable turf quality rating, in all four species. In addition to the declines in visually rated turf quality, NDVI also decreased with progressing levels of drought stress. After 4 weeks without irrigation, NDVI had decreased by 26% compared to pre-drought levels across all species. Within this population, each species exhibited different ranges of drought tolerance. The greatest range of variation in turf performance was

Table 1: Responses to drought stress in experimental germplasm for four warm-season grasses

	Control						Drought					
	TQ			NDVI			TQ			NDVI		
Species	Mean	Range	St. Dev.	Mean	Range	St. Dev.	Mean	Range	St. Dev.	Mean	Range	St. Dev.
Bermudagrass	7.9	8.4-7.5	0.24	62.8	60.0-65.8	1.57	5.9	6.4-5.1	0.32	47.2	51.3-43.3	2.81
Zoysia	7.5	8.4-6.8	0.46	66.2	72.0-61.8	3.10	5.3	6.8-3.4	0.92	51.2	61.5-45.3	5.12
St. Augustine	7.3	8.1-6.0	0.65	60.3	70.5-47.0	7.07	5.7	7.2-3.4	1.2	44.7	59.3-30.0	9.64
Seashore paspalum	7.5	7.8-7.0	0.26	63.5	67.3-57.5	3.26	5.9	6.4-4.7	0.51	43.1	47.5-39.0	3.36

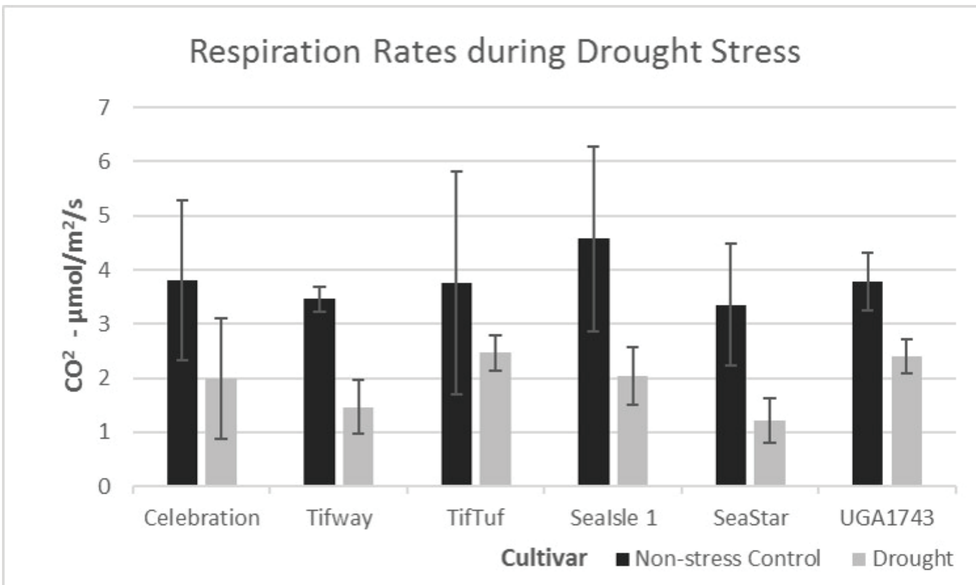

Figure 1: Respiration rates for selected lines of bermudagrass ('Celebration,' 'Tifway,' 'TifTuf') and seashore paspalum ('SeaIsle 1,' 'SeaStar,' 'UGA 1743') under non-stress control conditions, and at 24 days of drought stress. Bars represent standard errors.

found between St. Augustine genotypes which had TQ ratings of 3.4 to 7.2, and NDVI scores of 30.0 to 59.3 during the drought stress period. The narrowest range of responses was found in bermudagrasses, in which TQ ratings ranged from 5.1 to 6.4, and NDVI scores ranged from 43.3 to 51.3, indicating fewer differences in drought tolerance among bermudagrass varieties used in this study. However, a range of drought tolerance was found within each species studied (Table 1). Respiration rates were also measured in a select subset of plants. Within the three bermudagrass lines selected for more detailed analysis, respiration rates were found to decrease as drought stress progressed (Figure 1). Similar results were found for the three seashore paspalums which were subjected to more detailed analysis in which respiration rates also declined over the course of drought stress. These decreases in respiration rate indicate altered energy metabolism which will affect plant's ability to grow and survive during drought. The rate at which respiration declined differed within the individuals studied with the bermudagrass 'TifTuf' and the seashore paspalum 'UGA1743' experiencing slower declines in respiration compared to other genotypes such as 'Tifway' or 'Seastar.' Further understanding the physiological mechanisms which are responsible for regulating respiration is an important strategy for improving drought tolerance in warm-season grasses.

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Understanding Drought Tolerance for Breeding Warm-Season Grasses, *continued*

CONCLUSIONS

A range of responses was found between the different warm-season turfgrass species, as well as within each species. However, it should be noted that the trends observed in this study may not necessarily be completely representative of a species response to drought, but may be more specific to the collection of germplasm used in this study. Differences in both overall visual quality and NDVI measurements highlight the differences in drought tolerance in this population. Respiration rates measured in a subset of plants further highlights the damage to plants caused by drought with decreasing respiration levels demonstrating altered energy metabolism and a decrease in potential for plant growth. Maintained respiration rates may indicate that plants are able to maintain their normal metabolic activities and experience less drought induced damage. The differences in drought tolerance in these plants show that there is a range of genetic variability which can be harnessed for use in the development of new cultivars which may have improved abiotic stress tolerance. Understanding mechanisms for drought tolerance is a key step to integrating stress defense mechanisms into new cultivars which can thrive under reduced water usage.

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Using Sensor Technology to Improve Fertility Practices

Becky Grubbs, Graduate Research Assistant, Crop and Soil Sciences
Gerald M. Henry, Associate Professor, Crop and Soil Sciences
The University of Georgia, Athens Campus

ABSTRACT

Six fairways (three per location) were sampled at the University of Georgia golf course in Athens, GA, and the Georgia Club golf course in Statham, GA, during the summer of 2015. Soil cores were collected on a 6-m grid generated in ArcMap and geo-referenced using a hand-held GPS unit. Approximately 6 to 8 cores were collected and consolidated for each point using a 2.54-cm soil sampler to a depth of 8 to 10 cm. Samples were analyzed for soil texture (% clay), CEC, and OM (%). Interpolated point values for each parameter were modeled using Gaussian process regression and enhanced by Jenks natural breaks optimization to produce maps that showed significant spatial variability: UGA golf course [% clay (min: 0.4%, max: 25.1%), pH (min: 4.6, max: 6.1), OM (min: 3.2%, max: 19.5%)] and Georgia Club [% clay (min: 2%, max: 29.1%), pH (min: 5.7, max: 7.3), OM (min: 0.1%, max: 17%)]. Maps can be used to implement variable rate fertility, further increasing application efficiency and reducing overall inputs.

INTRODUCTION

Variable rate fertility (VRF) is the application of fertilizers based on measured spatial variability across an area and delineation of smaller zones referred to as site-specific management units (SSMUs). Variable rate applications have the potential to improve resource-use efficiency thereby reducing overall inputs and cost to the end user (Lawes and Robertson, 2011). VRF practices have been implemented across many agronomic systems, but remain underdeveloped in turfgrass environments (Carrow et al., 2010). Turfgrass systems are typically smaller, continuous areas with minimal cultivation and disturbance compared to most agronomic fields. In conjunction with management practices that further contribute to spatial variability, these characteristics present unique challenges for VRF implementation on turfgrass environments such as golf courses.

Golf course fairways are routinely fertilized using blanket applications based on recommendations derived from consolidated soil sampling practices. These sampling techniques fail to account for soil spatial heterogeneity and may lead to costly and inefficient application practices (Carrow et al., 2010). Modern sensor technology, including hand-held and mobile devices, can be used in conjunction with conventional diagnostic methods to evaluate turfgrass areas and implement VRF practices. These sensors measure a number of parameters including, but not limited to, normalized difference vegetation index (NDVI), volumetric water content (VWC), electrical conductivity (EC), soil compaction and surface hardness.

Determining the extent of spatial variability present on golf courses is important in order to develop assessment protocols and identify associated sensor technology. Researchers along with turfgrass professionals will be able to select hand-held vs mobile sensor technology and the degree to which they should be operated. Therefore, the objective of this research was to assess the degree of soil spatial variability across six individual golf course fairways in North Georgia.

MATERIALS AND METHODS

Research was conducted at the University of Georgia golf course in Athens, GA, and the Georgia Club golf course in Statham, GA, during the summer of 2015. Three fairways were selected at each location based on size and topographic features. Soil cores were collected from each fairway using a 6-m grid generated in ArcMap [ArcGIS Desktop 10.3.1. Software – Environmental Systems Research Institute (ESRI), Redlands, CA 92373] and geo-referenced using a hand-held GPS unit (GeoExplorer 6000 hand-held GPS unit – Trimble Navigation, Ltd., Sunnyvale, CA 94085). Approximately six to eight cores were collected and consolidated for each point to produce sufficient material for analysis and conduct a thorough and comprehensive assessment of each area. Individual soil cores were collected from a depth of approximately 8-10 cm using a soil probe with a diameter of 2.54 cm. The number of samples collected varied according to area, but ranged from 156 to 302 per fairway.

Samples were subsequently analyzed by an independent laboratory (Waypoint Analytical Laboratories, Richmond, VA 23237) for particle size distribution (texture), pH, OM (%), and cation exchange capacity (CEC). Mean, minimum values, maximum values, and standard deviation were calculated for

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Using Sensor Technology to Improve Fertility Practices, *continued*

each soil property by Microsoft Excel (Table 1).

Point data for each soil property was interpolated in ArcMap using Gaussian process regression to generate individual fairway maps for each measured variable. Each interpolated map was classified using Jenks natural breaks optimization in order to delineate zones of concentrated values that will be used to define site-specific management units for the implementation of variable rate fertility applications in future research.

RESULTS

Soil analysis data revealed extensive variability within and between individual fairways for all measured parameters (Table 1). Seven soil texture classes were identified across both golf courses including loam, loamy sand, sand, sandy clay loam, sandy loam, silt, and silty loam, with sandy loam being the most prominent soil texture. Range values for sand, silt, and clay percentages at the University of Georgia (UGA) and Georgia Club (GC) golf courses were 44, 28.9, 24.7 and 59.9, 56, 27.1, respectively. Spatial distribution of clay (%) is depicted for the UGA 14 fairway in Figure 1.

Average CEC was calculated at approximately 6.1 milliequivalents per 100 g of soil (meq/100g) for UGA and 8.1 (meq/100g) at GC with ranges of 5 and 12.1, respectively. For most North Georgia soils, CEC is often most strongly correlated to organic matter which ranged from 0.8 to 19.5% at UGA and 0.1 to 17% GC. Similar interpolated maps were generated for each of these values (Figure 2 and 3). Average pH for each course was measured at approximately 5.4 (UGA) and 6.6 (GC), with less spatial variability than that observed for other soil properties.

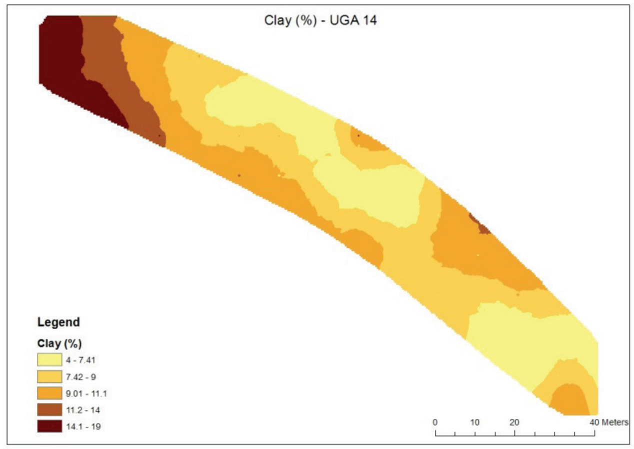

Figure 1. Interpolated values for clay (%) on the 14th fairway of the University of Georgia golf course in Athens, GA. Classes were delineated using Jenks natural breaks optimization.

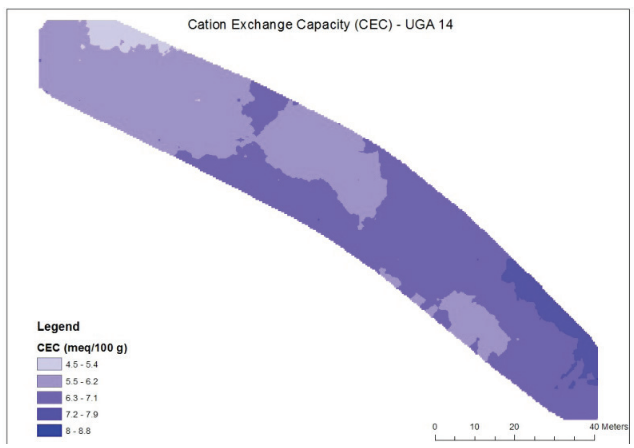

Figure 2. Interpolated values for CEC (meq/100 g of soil) on the 14th fairway of the University of Georgia golf course in Athens, GA. Classes were delineated using Jenks natural breaks optimization.

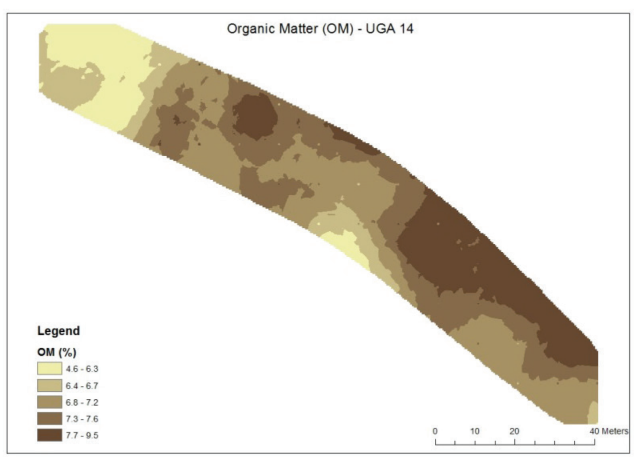

Figure 3. Interpolated values for organic matter (%) on the 14th fairway of the University of Georgia golf course in Athens, GA. Classes were delineated using Jenks natural breaks optimization.

CONCLUSIONS

Soil spatial heterogeneity within and between golf course fairways can be extensive. Therefore, the implementation of variable rate fertility practices could be both economically and environmentally beneficial to the end user. Soil texture, CEC, organic matter, and pH can all greatly contribute to nutrient adsorption and retention in the soil profile, which could have implications for turfgrass nutrient requirements (Havlin et al., 2005). Given the scope of the variability and size of golf course fairways, additional research should be conducted to explore the use of mobile sensor technology in order to obtain large-scale assessments of soil variability that correlate to different soil properties. The development of such technology and protocols for use in turfgrass could have significant impact on fertility management efficiency and turfgrass sustainability.

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Table 1. Descriptive statistics for measured soil properties of fairways at the University of Georgia (UGA) and Georgia Club (GC) golf courses.

	Sand (%)	Silt (%)	Clay (%)	OM (%)	CEC (meq/100g)	pH
UGA – 11						
Min	51.6	3.7	6.6	3.2	4.1	4.8
Max	82.6	32.6	25.1	19.5	9.0	6.1
Mean	67.7	17.2	15.0	6.4	6.3	5.4
Std Dev	5.5	5.1	3.6	1.8	0.9	0.2
UGA – 14						
Min	58.0	11.3	3.2	3.4	4.2	4.6
Max	82.8	27.0	22.4	12.2	8.8	5.9
Mean	72.0	18.6	9.3	7.1	6.3	5.3
Std Dev	5.0	3.3	3.8	1.3	0.8	0.3
UGA – 15						
Min	59.4	4.0	0.4	3.4	4.1	4.9
Max	95.6	28.0	22.6	8.2	9.1	6.1
Mean	72.4	17.6	9.9	5.3	5.8	5.6
Std Dev	7.4	4.7	4.5	0.8	0.7	0.2
GC 1						
Min	40.3	9.3	6.1	3.1	5.6	5.9
Max	84.4	45.3	24.0	10.3	9.8	7.3
Mean	63.0	22.4	14.6	6.6	7.2	6.6
Std Dev	6.0	5.2	3.4	0.9	0.9	0.2
GC 2						
Min	54.4	2.0	2.0	0.1	5.8	6.0
Max	95.9	29.0	25.7	17.0	17.3	7.3
Mean	64.7	19.5	15.7	8.0	9.3	6.7
Std Dev	4.4	3.8	2.9	2.1	1.2	0.2
GC 3						
Min	36.0	7.3	3.5	4.1	5.2	5.7
Max	85.9	58.0	29.1	10.2	10.1	7.1
Mean	71.1	20.3	8.6	6.6	7.2	6.6
Std Dev	9.7	9.8	2.9	1.0	1.0	0.2

Latest Research on Turfgrass Diseases with Emphasis on Lawncare and Golf

A Control of Rhizoctonia Large Patch on Zoysiagrass Using New Fungicide Chemistries, Rates and Fungicide Timings

Alfredo Martinez-Espinoza, Professor and Extension Plant Pathologist, Plant Pathology
The University of Georgia, Griffin Campus

ABSTRACT

Zoysiagrass (*Zoysia* spp.) tolerates a broad range of environmental conditions, and it is used throughout Georgia as residential lawn, commercial landscape, golf tees, and fairways. Rhizoctonia Large Patch (LP) caused by the soilborne fungus *Rhizoctonia solani* AG 2-2 LP is the most common and severe disease of zoysiagrass across the state of Georgia. Large patch spring infections and re-infections are common. Supportive and conclusive evidence for post-epidemic fungicide treatments in spring is limited. Additionally, new turfgrass fungicide chemistries are now available. Therefore, the objectives of these investigations were to determine the effect of these new(er) fungicides and different rates on LP control as well as the determine pre and post epidemic control of LP. Fungicide trials were conducted on an area of 'El Toro' zoysiagrass at the University of Georgia Griffin campus. Flutalonil (Prostar) at 2.2 oz/1000 ft^2, tebuconazole (Mirage) either at 1 or 2 fl oz/1000 ft^2, fluoxapyroxad (Xzemplar) at 0. 26 fl oz/1000 ft^2, fluoxapyroxad + pyraclostrobin (Lexicon) 0.47 fl oz/1000 ft^2, and triticonazole (Trinity) at 1.5 fl oz/1000 ft^2 provided significant ($\alpha<0.05$) disease suppression. Combination of fall and spring applications provided the highest disease suppression while spring applications applied post-epidemically curtail further advance of the disease while accelerating turfgrass recovery to an acceptable quality (foliar canopy was uniform in color and density) for up to 5 weeks. Results obtained in these investigations provide turfgrass managers with new disease management tools, improved disease control, and better turf quality.

INTRODUCTION

Zoysiagrass (*Zoysia* spp.) tolerates a broad range of environmental conditions, and it is used throughout Georgia as residential lawn, commercial landscape, golf tees, and fairways. Rhizoctonia Large Patch (LP) caused by the soilborne fungus *Rhizoctonia solani* Kuhn AG 2-2 LP is the most common and severe disease of zoysiagrass across the state of Georgia. Symptoms of the disease appear in fall and spring disease as the grass is entering or coming out of dormancy. There are several fungicides labeled for LP control. Preventive fungicide applications in early to mid-fall applied before disease development is evident have shown to be efficacious in controlling the disease. Large patch spring infections and re-infections are common. Supportive and conclusive evidence for post-epidemic fungicide treatments in spring is limited and how these spring applications impact LP disease progression and turfgrass recovery. Additionally, new turfgrass fungicide chemistries are now available. Therefore, the objectives of these investigations were to determine the effect of these new(er) fungicides and different rates on LP control as well as to determine pre- and post-epidemic control of LP.

MATERIALS AND METHODS

The efficacy of several new fungicide chemistries and application timings against *R. solani* on *Zoysia* spp. was evaluated. Fungicide trials were conducted on an area of 'El Toro' zoysiagrass at the University of Georgia Griffin campus. The site was selected due to a history of fall and spring LP epidemics that had resulted in >80% incidence and severity. Treatments were arranged as plots (5 ft x 5 ft) in a randomized, complete block design with four replications. Active ingredients included: flutolanil, tebuconazole, fluxapyroxad, fluxapyroxad + pyraclostrobin, and triticonazole. Timing of application included 2 applications in the fall, 2 applications in the fall and one in spring, and/or 2 applications in spring of the different modes of action. Fungicide products were mixed with water and sprayed in 2.0 gal water per 1000 ft^2 with a hand-held, CO^2-pressured boom sprayer at 30 psi using XR TeeJet 800 2vs nozzles. To accentuate disease incidence, experimental plots were inoculated with a zoysiagrass isolate of *R. solani* grown on a tall fescue/barley/wheat seed mixture previously soaked in water overnight and then double sterilized in Erlenmeyer flasks. The infected seed was manually placed into the center of the plot and into crowns of plants by pulling the stolons apart with a soil probe. Visual ratings were performed from 7- to 20-day intervals from the initial application date and depending on disease activity. Visual estimates of large patch disease severity were made using a modified Horsfall-Barratt rating scale (0 to 11), and then transformed to percent disease severity (0=1.17%, 5=37.5%, 11=98.82%). Turf quality was also rated using a percent (0=bad, unsightly quality; 100=excellent quality). Percent of disease severity and turf quality data were subjected to analysis of variance and means were separated using Fisher's LSD=0.05.

RESULTS

The disease severity in the nontreated control progressed steadily, reaching 50%. While LP incidence was high on the trial, symptom distribution was not uniform among replications. This behavior coincides with the nature of Rhizoctonia Large Patch infections and distribution. Despite this variation, data from the trial provided conclusive results. Flutolanil (Prostar) at 2.2 oz/1000 ft^2, tebuconazole (Mirage) either at 1 or 2 fl oz/1000 ft^2, fluxapyroxad (Xzemplar) at o. 26 fl oz/1000 ft^2, fluxapyroxad + pyraclostrobin (Lexicon) 0.47 fl oz/1000 ft^2, and triticonazole (Trinity) at 1.5 fl oz/1000 ft^2 provided significant ($\alpha<0.05$) disease suppression compared to the nontreated check. Preventive applications of these active ingredients in the fall were shown to be to be efficacious in controlling the disease. Combination of fall and spring applications provided the highest disease suppression, while spring applications applied post-epidemically curtail further advance of the disease while accelerating turfgrass recovery to an acceptable quality (foliar canopy was uniform in color and density) for up to 5 weeks. No phytotoxicity was observed in any of the treatments. An added benefit of spring fungicide applications is the control and/or prevention of other diseases, especially dollar spot and Drechslera/Bipolaris leaf spot. Results obtained in these investigations provide turfgrass managers with new disease management tools, improved disease control, and better turf quality.

Latest Research on Turfgrass Diseases with Emphasis on Lawncare and Golf

B Temporal, Cultural, Biological, and Chemical Practices to Enhance Spring Dead Spot (SDS) Control of Bermudagrass in Georgia.

Research supported by the Georgia Golf Environmental Foundation (GGEF)

Alfredo Martinez-Espinoza, Professor and Extension Plant Pathologist, Plant Pathology
The University of Georgia, Griffin Campus

ABSTRACT

Spring dead spot (SDS) caused by *Ophiosphaerella* spp. is a persistent and destructive disease of bermudagrass (*Cynodon* sp.) in Georgia. Cultural practices that result in disturbance of the upper root zone have been reported to reduce SDS damage. However, these practices alone have proven erratic and ineffective at reducing disease pressure below acceptable levels. K_{oc} (soil sorption coefficient) values of several fungicides may limit their movement into the root zone following application. Cultivation practices aimed at increasing infiltration and reducing thatch accumulation may increase penetration and enhance fungicide efficacy. Traditionally, fungicides have been applied in the fall. Applying fungicides earlier in the year (spring) may increase SDS control. Additionally, several new chemistries have been introduced that may be effective at controlling SDS. Therefore, the objectives of our research were to evaluate the combination of temporal (spring and fall) and cultural (aerification) and chemical practices to re-evaluate SDS-labeled fungicides and examine several new fungicides. Field experiments were conducted on a 'TifSport' bermudagrass swards with SDS history, which are located at the University of Georgia Griffin campus and at Towne Lake Hills Golf Course. Preliminary results are discussed in the next paragraphs.

INTRODUCTION

Spring dead spot (SDS) (caused by *Ophiosphaerella korrae, O. narmari* and *O. herpotricha*) is a persistent and destructive disease of bermudagrass (*Cynodon* sp.) in Georgia. The disease can be devastating on bermudagrass greens, tees, and fairways (Martinez et al., 2011; Tredway et al, 2008). Tisserat and Fry (1997) reported that cultural practices that result in severe disturbance of the upper root zone could reduce SDS damage of bermudagrass turf. However, these practices alone were intermittent at best. Although several fungicides are labeled for the control of SDS, the inability to identify *Ophiosphaerella* infection timing has led to erratic control, varying from golf course to golf course and from year to year. Nitrogen sources appear to be of impact in the development of spring dead spot in bermudagrass. Additionally, environmental stewardship, overreliance on chemical control, and increasing concerns about pesticide resistance have led turfgrass managers to examine alternative practices to reduce plant disease. Therefore, the objectives of our research were to evaluate the combination of temporal, cultural, biological, and chemical practices to determine optimal fungicide application timing, and to examine several new fungicides for the control of SDS disease in bermudagrass.

MATERIALS AND METHODS

Field experiments were conducted on 'TifSport' bermudagrass swards with SDS history, which are located at the University of Georgia Griffin campus and Towne Lake Hills Golf Course, during 2014-2016. Plots measuring 4 ft x 6 ft were arranged in a 2 x 2 x 9 factorial within a split/split plot experimental design. Fungicide application timing (spring or fall) was the main factor, cultural treatment (core-aeration or no core-aereation) was the subfactor, and fungicide chemistry was the subsubfactor. Aerification (to a depth of 3 in.) was conducted prior to initial fungicide applications (spring or fall) using a green/tee aerifier. Liquid fungicides were applied using 2.5 gal of water per 1,000 ft^2 with a hand-held, CO_2-pressured boom sprayer at 30 psi using XR TeeJet 8002VS nozzles. Granular formulations were weighed and mixed with sterilized sand prior to application. The fungicide/sand mixture was distributed equally in each replicated plot using a canister with perforated lid. Spring applications were timed when average soil temperatures in the primary root zone were consistently above 60° F. In the fall, applications were performed when average soil temperature in the primary root zone reached 70°F. Fungicide treatments consisted of tebuconazole at 0.6 fl oz/1000 ft^2, metconazole at 0.37 oz/1000 ft^2, azoxystrobin + propiconazole at 3 fl oz/1000 ft^2, azoxystrobin + difenconazole at 0.75 fl oz/1000 ft^2, pyraclostrobin + triticonazole at 3 lb/1000 ft^2, fluxapyroxad at 0.26 fl oz/1000 ft^2, tebuconazole + wetting agent, and fenarimol at 6 fl oz/1000 ft^2. A nontreated control was added for comparison. All treatments received a sequential fungicide application 30 days after initial treatment. Irrigation (0.25 in.) was applied immediately following fungicide applications. Percent SDS disease cover ratings (using a modified Horsfall-Barratt scale) and number of disease patches were recorded visually monthly and/or every two weeks starting summer 2014 to 2016. Digital photography (DP) was taken monthly with a Canon (Rebel XT EOS) camera. Digital images were analyzed using Adobe Photoshop software and/or SigmaScan Pro software (v. 5.0, SPSS Inc., Chicago, IL) to determine differences on SDS severity and/or turf quality. At Towne Lake Hills Golf Course, research trials were exactly replicated and disease evaluations were followed as they were at the Griffin location.

PRELIMINARY RESULTS

1. Core aeration (solid tine) cultural practice before fungicide application was statistically similar to non-core aeration in both fall and spring. Thus, core aeration did not increase fungicide efficacy in spring or fall applications in any of the sites. Solid tine did not negatively impact fungicide efficacy either, nor promoted disease severity.
2. 2014-2015 data indicates that all fungicide treatments provided statistically significant Spring Dead Spot suppression when compared to the untreated control at both locations and times.
3. There were statistically significant differences in disease suppression among fungicide treatments both in fall and in spring.
4. Based on preliminary data analysis of disease suppression and disease suppression consistency in fall and in spring, fungicides were divided in three TIERS:
5. TIER 1. Fluxapyroxad (Xzemplar) at 0.26 fl oz/1000 ft^2, fenarimol (Rubigan) at 6 fl oz/1000 ft^2, and azoxystrobin + difenoconazole (Briskway) at 0.75 fl oz/1000 ft^2 provided the most significant and consistent control.
6. TIER 2. Tebuconazole (Torque) at 0.6 fl oz/1000 ft^2 + wetting agent (Revolution) at 6 fl oz/1000 ft^2, metconazole (Tourney) at 0.6 fl oz/1000 ft^2 formed the second most efficacious group of fungicides.
7. TIER 3. Tebuconazole (Torque) at 0.6 fl oz/1000 ft^2, azoxystrobin + propiconazole (Headway) at 3 fl oz/1000 ft^2, and pyraclostrobin + triticonazole (Pillar) at 3 lb/1000 ft^2 formed the third most efficacious group of fungicides.
8. Preventive management of SDS using two fall fungicide applications provided significant disease suppression with the use of new(er) chemistries as well as with previously proven efficacious chemistries.
9. Spring fungicide applications proved to suppress SDS severity up to 60% compared to the untreated control, resulting in the acceleration of turfgrass recovery up to 47-77 days (days to acceptable quality=foliar canopy was uniform in color and density).
10. An unforeseen benefit of spring fungicide applications is the control and/or prevention of other diseases, especially dollar spot and large patch.

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Diagnosing Common and Not-So-Common Problems

Clint Waltz, Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

ABSTRACT

When mistakes happen and environmental conditions change, grass may go off-color, the canopy may thin or die. Diagnosing a problem begins with recognizing the difference between "normal" and "not normal." With grass, diagnosing problems can be difficult because the same symptoms can be expressed from multiple stresses. For example, "brown grass" is a common symptom. Observing the problem and investigating what occurred prior to its appearance is where the diagnostic process begins. Quickly determining if the problem is manmade or pest-related can help in arresting the problem and getting the grass back into active growth. Manmade symptoms typically have recognizable patterns like straight lines, stripes, streaks, and some degree of consistency. Pest -problems are more variable and irregular or patchy. Take the time to learn the symptomology of common pests and from self-induced mistakes. Then, put in place corrective measures to ensure problems are less likely to happen again, and take the time to teach others about the problem and how to properly correct it.

INTRODUCTION

Mistakes happen! Environmental conditions change! When mistakes happen and environmental conditions change, grass may go off-color, the canopy may thin or die (Cavanaugh 2014). Many turfgrass managers have, at some time in their career, killed some grass. It may have been a learning experience, one that taught them more about growing grass than they learned in a classroom, book, or seminar. The challenge becomes learning from those mistakes, preventing them from occurring again, and comprehending how the environment affects turf growth and pest occurrence. Essential in the learning process is understanding how the mistake occurred or what environmental influence was altered to elicit a growth response.

Diagnosing a problem begins with recognizing the difference between "normal" and "not normal" (White and McCarty, 2012). Having a fundamental understanding of how grass grows and what it supposed to look like should be the baseline for "normal." A turfgrass plant is constantly changing, and its health can be affected by various stresses like heat, cold, drought, wetness, maintenance, and pests. These stresses can affect the turfgrass plant differently at different times of the year. Additionally, not all turfgrass species respond to the same stress the same way.

With grass, diagnosing problems can be difficult because the same symptoms can be expressed from multiple stresses. For example, "brown grass" is a common symptom of drought, localized dry spot, high temperatures, scalping, fertilizer burn, herbicide misapplication, or pests (e.g., diseases, insects, and nematodes). Having an appreciation of the nuances associated with these stresses takes continual observation, learning, and experience.

Observing the problem and investigating what occurred prior to its appearance is where the diagnostic process begins. There are a multitude of questions to ask, for example:

- When was the grass last mowed?
- When was it last fertilized?
- What has been applied to the turf?
- Has the weather changed in the last few days?

These basic questions are just a place to start and typically generate additional questions that ultimately get to the root cause of the problem. Sometimes it is related to the weather or environment, other times the problem is self-induced. Sometimes, the problem could not have been anticipated, other times it was avoidable. Quickly determining if the problem is manmade or pest-related can help in arresting the problem and getting the grass back into active growth. Manmade symptoms typically have recognizable patterns like straight lines, stripes, streaks, and some degree of consistency. An example is misapplication of fertilizer where regular light and dark streaks all run in the same direction. Pest-related problems are more variable and irregular or patchy.

It can be particularly frustrating when a pest-related problem becomes a manmade problem. An example is when a turfgrass manager is trying to resolve a pest-related problem and makes a mistake with a pesticide. Prior to using any pesticide, check and double-check the product label.

- Know how the product is to affect the turfgrass species to which it is being applied.
- Check the calibration of the spreader or sprayer.
- Use the appropriate rate and delivery volume for effective control.

If in doubt, read, read, and re-read the label. All the information needed for safe and effective use is typically contained in the label.

Mistakes with products can happen for many reasons and include: not understanding the product; reading the label incorrectly, incompatibleness with other tank mixed products, retreatment intervals, application rates, etc.; incorrect calculations, including putting the decimal point in the wrong place; thinking more will be better; and improper storage of products (i.e., freezing or heat).

Accept that mistakes happen. But take the time to learn from those mistakes, put in place corrective measures to ensure they are less likely to happen again, and take the time to teach others about the problem and how to properly correct it. Common and not-so-common turfgrass problems are regularly posted on Twitter @GeorgiaTurf.

MATERIALS AND METHODS

At this stop there are several abnormal plots of grass that participants will be given the opportunity to diagnose. From this list of problems, can you identify?

1. Fuel spill
2. Over application of iron
3. Fertilizer burn
4. Aerosol damage
5. Disease
6. Herbicide tracking
7. Hydraulic fluid leak
8. Scalping
9. Shade
10. ??????

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Cultivar Development in Little Bluestem

Melanie Harrison, Agronomist
United States Department of Agriculture, Griffin Campus

Carol Robacker, Associate Professor, Horticulture
The University of Georgia, Griffin Campus

ABSTRACT

Little bluestem, *Schizachyrium scoparium*, is a warm-season perennial grass native to North America with a range extending from Canada to Mexico. It is a predominant species of the tallgrass prairie and can be found growing in USDA plant hardiness zones 3 to 9. There is a large amount of variation within this species, which can be readily exploited to develop cultivars with unique ornamental characteristics. Little bluestem typically grows to a height of 1 to 3 feet and produces green to blue-green foliage. Through a modified recurrent selection scheme, three little bluestem cultivars that have unique foliage color and growth habit were developed by a joint project between the USDA and the University of Georgia. These three cultivars are licensed by EuroAmerican and are being marketed as 'Cinnamon Girl,' 'Seasons in the Sun,' and 'Good Vibrations' as the series 'Hit Parade.' The cultivar 'Cinnamon Girl' has an upright, rounded form featuring colorful red, purple, and green cascading foliage throughout the growing season. 'Seasons in the Sun' has purple cascading foliage mixed with silvery blue that gives the plant an overall iridescent lavender glow. 'Good Vibrations' has blue-green foliage tipped with burgundy, creating a striking color display.

INTRODUCTION

Little bluestem, *Schizachyrium scoparium*, is a warm-season perennial grass native to North America with a range extending from Canada to Mexico. It is a predominant species of the tallgrass prairie and can be found growing in USDA plant hardiness zones 3 to 9. Initial interest in the species focused on its forage quality, but increased interest in using perennial grasses in the landscape has led to the development of little bluestem as a valuable ornamental grass. It is beneficial to wildlife, providing seed for feeding and nesting habitat in its tufted basal foliage. It is drought tolerant, has low fertility requirements, and encounters few pest problems. These characteristics make it an ideal species for providing ornamental vegetation in large areas where high maintenance is not feasible. Little bluestem typically grows to a height of 1 to 3 feet and produces green to blue-green foliage. There is a large amount of variation within this species, which can be readily exploited to develop cultivars with unique ornamental characteristics. The plant industry has expressed a desire for little bluestem cultivars with foliage color variation, compact form, and reduced lodging. The intent of our little bluestem breeding program is to develop cultivars with these desired characteristics and bring them to the marketplace.

MATERIALS AND METHODS

Three little bluestems were developed as part of a cooperative breeding project between Dr. Carol Robacker of the University of Georgia and Dr. Melanie Harrison of the USDA. Thirty-seven accessions of *S. scoparium* obtained from the USDA National Plant Germplasm System (number of plants per accession ranged from one to 51 depending upon the germination of individual accessions) were germinated and transplanted into field plots in Griffin, Georgia, in 2006. Accessions were planted in individual plots surrounded by a barrier crop (pearl millet) to reduce cross-pollination among accessions. These plants were evaluated in the field for two years. Seeds from open pollination within accessions were collected. After two seasons of growth, 28 plants representing 11 accessions were identified as having ornamental potential. These were labeled as B1 through B28, and served as the parent plants. These were dug from the field and placed in pots in the screen house. Seeds were collected from each of these 28 plants and labeled according to the mother plant. The seeds were from open pollination within each of the 11 accessions. The seeds were sown the spring of 2008. The 368 seedlings that germinated were evaluated in containers in a screen house on the Griffin campus. Evaluation criteria included reduced lodging; blue, purple, or burgundy foliage color; rounded form; compact form; reduced height; and attractive fall color. Selections were continued and three candidate cultivars were selected for replicated trial testing. In March 2011, rooted liners were sent to EuroAmerican under a Restricted Testing Agreement and underwent multiyear, multilocation evaluation. Replicated plantings were also established in Griffin, Georgia, and Blairsville, Georgia, for evaluation.

RESULTS

Three little bluestem cultivars were developed that showed unique and valuable ornamental characteristics compared to the current cultivars with foliage color and plant form being particularly distinctive. Foliage colors vary during the growing season among these three cultivars. In early summer, the distal portion of the foliage of 'Good Vibrations' is violet-blue, 'Seasons in the Sun' is purple, and 'Cinnamon Girl' is purple and grey-purple. In midsummer, while all three cultivars have various shades of grey-purple, 'Good Vibrations' also has purple leaves. In late summer, both 'Cinnamon Girl' and 'Good Vibrations' have some yellow-green leaves, and 'Cinnamon Girl' also has some red-purple foliage. These colors are evident in both Griffin, GA and Blairsville, Georgia, Blue Heaven™, 'Carousel,' 'Blaze,' 'The Blues' and 'Prairie Blues' grown in Griffin and Blairsville have mostly green or green-blue foliage during the summer, though reproductive culms turn red in the fall in Blairsville. The overall habit or form in early summer (before flowering) of 'Cinnamon Girl,' 'Good Vibrations' and 'Seasons in the Sun' is upright rounded, appearing to be as tall as they are wide. Blue Heaven™ and 'Carousel' are more broadly rounded, with width greater than foliage height. Furthermore, the foliage of 'Cinnamon Girl' and 'Seasons in the Sun' gently cascades or arches throughout the growing season, while foliage of 'Good Vibrations' is upright in early summer, changing to cascading in midsummer. Blue Heaven™ and 'Carousel' have upright foliage throughout the growing season.

CONCLUSIONS

The little bluestem series 'Hit Parade,' which includes the cultivars 'Seasons in the Sun,' 'Cinnamon Girl,' and 'Good Vibrations' provides superior foliage color and form, adding a burst of color and pizzazz to the landscape. To best showcase these highly ornamental little bluestems, mass groupings work particularly well in the landscape, making them ideal for a variety of settings, including community entryways and common areas, parks, commercial landscapes, golf courses, and home gardens. All three cultivars have been officially released jointly by the University of Georgia and the U.S. Department of Agriculture and plant patent protection has been applied for. All three cultivars are licensed by EuroAmerican, and plant material is being commercially propagated by Aris Green Leaf Plants (http://www.glplants.com/plants/4071-Schizachyrium-scoparium-Seasons-In-The-Sun; http://www.glplants.com/plants/4072-Schizachyrium-scoparium-Cinnamon-Girl; http://www.glplants.com/plants/4070-Schizachyrium-scoparium-Good-Vibrations).

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Pesticide Application and Pollinator Spaces

A Turfgrass: Getting into the Weeds of Pollinator Health

Greg Huber, Training Coordinator, Georgia Center for Urban Agriculture
The University of Georgia, Griffin Campus

Scientists are concerned that pollinator health worldwide is trending downwards and there is no simple explanation. Pollinators include certain beneficial bees, butterflies, bats, birds, moths, flies, wasps, and beetles. It is estimated that one out of every three bites of food relies on the free services of pollinators, including apples, peaches, blackberries, blueberries, squash, and almonds (USDA, 2016). The United States EPA and USDA are working with researchers to find answers, and scientists generally attribute the decline to many complex, interrelated factors including: 1) pollinator pests and diseases, 2) poor nutrition, 3) pesticide exposure, 4) bee management practices, and 5) lack of genetic diversity (U.S. EPA, 2015).

With agriculture being Georgia's largest industry, the state has taken a proactive step in developing a pollinator protection plan that outlines strategies to help reverse the trend. Entomologists from the University of Georgia and Georgia's Environmental Protection Division worked together to draft a state plan. The draft was sent to stakeholders across the state for their input. The resulting collaborative plan was released in late 2015 and can be found in the booklet, "Protecting Georgia's Pollinators" at http://www.ent.uga.edu.

What do turfgrass professionals need to know and what can be done to help reverse the decline?

Well the answer gets into the weeds, literally.

First, understand that pollinators depend on certain nutritional "weeds," whether desirable or not, and turfgrass areas often provide great forage opportunities in the form of clover, dandelion, henbit, etc. Understandably, these "weeds" (pollinator forage plants) are not considered acceptable additions to any sports field, golf courses, or manicured lawns. However, they may be perfectly acceptable in turfgrass uses such as utility easements, embankments, overflow parking lots, and some residential lawns. Naturally, some spaces will provide better forage for pollinators than others. The bottom line: To promote good pollinator health, include pollinator spaces where it makes sense (either as a separate pollinator habitat or as an integral part of the turfgrass). With concerns over pollinator health making headlines, pollinator spaces are gaining acceptance as part of the solution. Large, open spaces such as the UGA Golf Course are successfully integrating pollinator habitats behind tee boxes and other areas.


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UGA TODAY

UGA Golf Course steps up pollinator protection with its first habitat

INCLUDING POLLINATOR HABITAT IN URBAN LANDSCAPES BECOMING NECESSARY TO HELP PROTECT NATIVE SPECIES

"Including pollinator habitat in urban landscapes is becoming necessary to help protect native species"
(Credit: Merritt Melancon/UGA)

"The first pollinator habitat at the University of Georgia Golf Course features plains coreopsis. The native wildflower seed blend used in the plot will provide blooms for native bees and birds between March and September." (Credit: Merritt Melancon/UGA)

Second, be mindful that pesticides may unintentionally impact pollinator health through drift or when applied over a blooming food source ("weeds"). One solution to reduce pollinator exposure may be to minimize (forage) weeds using a diligent pre-emergence program and by maintaining healthy competitive turfgrass. Otherwise, when pollinators are observed actively foraging, carefully consider the management strategy that is applied. For instance, remove blooms by mowing before using pesticides, apply pesticides that are pollinator-safe, or apply pesticides at dusk when pollinators such as bees have returned to their colonies. Neonicotinoid insecticides such as clothianidin, dinotefuran, imidacloprid, and thiamethoxam are of particular concern to the EPA and special bee labeling has been issued for products containing these chemistries (U.S. EPA, 2013). Look for the "bee hazard icon" on pesticide labeling and carefully follow instructions.

By understanding the natural relationships that exist between pollinators and forage and using best management practices to prevent unintentional exposure, pesticide users and applicators can help to conserve and recover Georgia's pollinator workforce while ensuring the longevity and practice of responsible pest management. Refer to the following list of turfgrass and landscape management "DO's and DON'Ts" to promote pollinator recovery and reduce unintentional pollinator exposure to pesticides:

DO's	DON'Ts
Read and follow the labeling. It's the law! Scout and monitor for pollinator activity to identify active forage areas. Communicate and coordinate with local beekeepers to establish pesticide-free buffers. Apply insecticides late in the day after bees have returned to the colony. Select products in (G) granular formulations versus D, EC, WP, F to reduce foliar exposure (Hooven, L., Sagili, R., & Johansen, E., 2013). Minimize spray drift by using coarse droplets. Set aside designated pollinator forage areas. Participate in the UGA Extension "Pollinator Spaces" project. For more information, contact Becky Griffin at beckygri@uga.edu or visit https://ugaurbanag.com/gardens/pollinators. Find pollinator workshops and events available in your area.	Do not apply pesticides without a specific target in mind. Do not apply pesticides while bees and other pollinators are actively foraging. Do not apply pesticides to flowering plants without first removing blooms. Do not apply pesticides when dew is expected (residual effects may be extended and are more likely to be ingested by pollinators). (Hooven, L., Sagili, R., & Johansen, E., 2013). Do not use pesticides with extended residual toxicity (ERT) of more than 8 hours where pollinators are foraging (Hooven, L., Sagili, R., & Johansen, E., 2013). Do not use tank mixtures of multiple pesticides that may result in synergistic effects. Do not apply pesticides using fine mist spray nozzles or during windy conditions.

Pesticide Application and Pollinator Spaces

B Pollinator Spaces Project

Becky Griffin, Community and School Gardens Coordinator
The University of Georgia, Griffin Campus

To further support pollinator health, Becky Griffin, University of Georgia Cooperative Extension, developed the Pollinator Spaces Project. This project encourages gardeners to add pollinator habitats to their gardens. Resources for this are provided through a website (https://ugaurbanag.com/gardens/pollinators) and through local UGA Extension county agents.

For this project, the pollinator habitat is created in three steps. First, gardeners LEARN about pollinators and pollinator plants through the website and through local UGA programming. Next, gardeners CREATE their pollinator gardens. The gardens can be a large space dedicated only to pollinator health or a smaller space, like a plot in a community garden or the corner of a larger lawn. Gardeners use annuals, perennials, or a combination of both. Teachers are encouraged to create pollinator habitats at their schools and curriculum is provided for lessons in the classroom.

Finally, the gardeners SHARE photographs of their new habitats with UGA Extension for promotion on the project website and supporting Facebook page ("UGA Community and School Gardens"). Participants receive a certificate for being part of this special initiative. During late 2016 a map of new pollinator spaces will be created.

Pollinators and pollinator health are a popular current issue. Landscape clients may be interested in adding pollinator habitats to their home landscapes. The project website would be a resource for landscapers interested in adding pollinator plantings to their services.

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NOTES

NOTES

Turf: Is it a source or sink of carbon dioxide?

Monique Leclerc, Regents Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

The new study addresses some of the industry's concerns related to the environmentally friendly/unfriendly nature of turf, particularly in relation to CO_2 emissions and other greenhouse gases it purportedly releases. In this presentation, we will give a demonstration of how UGA quantifies the net CO_2 exchanged by turf and what that means for the environment. The participants will participate in a hands-on demonstration and learn how the climate influences the degree to which the turf removes atmospheric carbon and thus is environmentally friendlier than previously thought.

STOP B Afternoon Self-guided Research Tour

Fungicides for Control of Diseases in Bentgrass and Bermudagrass

Alfredo Martinez-Espinoza, Professor and Extension Plant Pathologist, Plant Pathology
Brian Vermeer, Research Assistant, Plant Pathology
The University of Georgia, Griffin Campus

ABSTRACT
Creeping bentgrass is one of the most popular grasses and it is used extensively in golf course putting greens in the mountains and upper Piedmont areas of Georgia. There are no bentgrass biotypes with reported durable resistance to *Colletotrichum cereale*; therefore, control depends on the use of fungicides. Rotation of several chemical groups distributed in three fungicide programs provided significant ($\alpha<0.05$) anthracnose control compared to the nontreated check. Turf quality inversely correlated to disease severity. New research results for bermudagrass greens will be described as well.

INTRODUCTION
Creeping bentgrass (*Agrostis palustris*) is a widely used, cool-season grass on golf greens in the northern region and transitional zone of the United States (Steir et al., 2013; Turgeon, 2006; Beard, 2002). The optimum growth temperature range for this cool-season grass is 15°C to 24°C for shoots and 10°C to 18°C for roots. Creeping bentgrass is one of the most popular grasses and it is used extensively in golf course putting greens in the mountains and upper Piedmont areas of Georgia. In Georgia the growth and competitive ability of bentgrass declines during times of high heat and humidity. In Georgia bentgrass is highly susceptible to *Colletotrichum cereale,* the causal organisms of anthracnose (Martinez et al., 2012). There are no bentgrass biotypes with reported durable resistance to *Colletotrichum cereale*; therefore, control depends on the use of fungicides (Smiley et al., 2005; Stier et al., 2013; Martinez et al., 2012).

MATERIALS AND METHODS
A fungicide trial was conducted on a 21-year-old sward of creeping bentgrass grown on a sand/peat root zone (pH 6.2) at the University of Georgia Griffin campus, Griffin, Georgia. Fertilizer was applied at 1.0 and 0.5 lb nitrogen (Lesco 24-4-10) per 1,000 ft^2 on April 14 and September

continued on the next page

Fungicides for Control of Diseases in Bentgrass and Bermudagrass, *continued*

22, respectively. Foliar N using Miracle-Gro was applied at 0.1 lb per 1,000 ft^2 every 14 days during May, June, July, and August. The turfgrass was maintained at a height of 0.2 in. by mowing three times per week. Treatments were arranged as plots (3 ft x 4 ft) in a randomized, complete block design with four replications. The initial fungicide application was made on June 26 and followed by additional fungicide applications at a 14-day interval as per protocol. Fungicides were applied using 2.0 gal of water per 1,000 ft^2 with a hand-held, CO_2-pressured boom sprayer at 30 psi using XR TeeJet 8002VS nozzles. The plots received approximately 0.24 in. of irrigation water twice a day at 1500 and 1700 hr to ensure foliar wetness for infection. Visual ratings were performed at 7- to 14-day intervals from the initial application date. Visual estimates of anthracnose disease severity were made using a modified Horsfall-Barratt rating scale (0 to 11), and then transformed to percent disease severity (0=0%, 5=37.5%, 11=100%) using the ARM statistical package (Agricultural Research Manager, Gylling Data Management, Inc., Brookings, South Dakota, USA). Turf quality was also rated using a percentage scale (0=bad, unsightly quality; 100=excellent quality). Percent disease severity and turf quality data were subjected to analysis of variance and means were separated using Fisher's LSD test at (P=0.05).

Table 1. Effect of fungicides on anthracnose severity.

		Anthracnose severity (%)^z							
Treatment and rate per 1,000 ft^2	Interv (days)	Jun 30	Jul 7	Jul 14	Jul 21	Jul 25	Aug 5	Aug 19	Sep 8
Untreated control	-------	2.3	1.7	5.2 a	11.8 a	11.8 a	14.2 a	23.8 a	39.3 a
Torque 3.6F 0.75 fl oz + Spectro 90WDG 3.6 oz alternating with Affirm 11.3WDG 0.9 oz + Spectro 90WDG 3.6 oz	14	2.9	1.2	1.2 b	1.8 b	1.8 b	2.3 b	0.6 b	0.6 b
Torque 3.6F 0.75 fl oz + Spectro 90WDG 3.6 oz + Anuew 27.5WDG 0.091 oz alternating with Affirm 11.3WDG 0.9 oz + Spectro 90WDG at 3.6 oz + Anuew 27.5WDG 0.091 oz	14	2.9	1.2	3.5 ab	3.5 b	1.2 b	0.0 b	0.0 b	0.0 b
Torque 3.6F 0.75 fl oz + Spectro 90WDG 3.6 oz + Anuew 27.5WDG 0.183 oz alternating with Affirm 11.3WDG 0.9 oz + Spectro 90WDG 3.6 oz + Anuew 27.5WDG 0.183 oz	14	1.8	0.6	0.0 c	0.6 b	0.6 b	0.6 b	0.0 b	0.0 b

^{z} Values followed by the same letter within a column are not significantly different according to Fisher's LSD test at (P=0.05).

Table 2. Effect of fungicides on turf quality.

		Turf quality (%)^z							
Treatment and rate per 1,000 ft^2	Interv (days)	Jun 30	Jul 7	Jul 14	Jul 21	Jul 25	Aug 5	Aug 19	Sep 8
Untreated control	-------	90.0	86.2	83.7	81.2	78.7 b	78.7 b	52.5 b	25.0 b
Torque 3.6F 0.75 fl oz + Spectro 90WDG 3.6 oz alternating with Affirm 11.3WDG 0.9 oz + Spectro 90WDG 3.6 oz	14	85.0	82.5	83.7	82.5	85.0 a	83.7 ab	85.0 a	86.2 a
Torque 3.6F 0.75 fl oz + Spectro 90WDG 3.6 oz + Anuew 27.5WDG 0.091 oz alternating with Affirm 11.3WDG 0.9 oz + Spectro 90WDG at 3.6 oz + Anuew 27.5WDG 0.091 oz	14	82.5	86.2	83.7	85.0	87.5 a	90.0 a	90.0 a	90.0 a
Torque 3.6F 0.75 fl oz + Spectro 90WDG 3.6 oz + Anuew 27.5WDG 0.183 oz alternating with Affirm 11.3WDG 0.9 oz + Spectro 90WDG 3.6 oz + Anuew 27.5WDG 0.183 oz	14	83.7	83.7	86.2	88.7	86.2 a	86.2 a	87.5 a	87.5 a

^{z} Values followed by the same letter within a column are not significantly different according to Fisher's LSD test at (P=0.05).

RESULTS

A natural infection of anthracnose was initiated before the implementation of the trial and continued to increase in severity throughout the duration of the trial. Anthracnose severity reached 39% in the untreated control by September 8. All treatments provided significant disease suppression compared to the untreated control. From July 25 to September 8, turf quality was significantly higher in treated plots compared to the untreated control. No phytotoxicity was observed for any of the treatments.

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Nitrogen Needs for Newer Bentgrasses

Beth Guertal, Professor, Crop, Soil and Environmental Sciences
Auburn University, Auburn, AL

Clint Waltz, Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

ABSTRACT

While there is less bentgrass being grown in the Southeastern U.S., there are golf courses still using bentgrass and converting to the newer cultivars. There is a need ito understand the nitrogen requirements of these newer bentgrasses. In 2016, a two-year trial was initiated at two locations – University of Georgia Griffin campus and the Atlanta Country Club – to investigate nitrogen fertility of six bentgrass cultivars. This data will serve as a baseline for future bentgrass nitrogen fertility programs. Being able to provide research-based fertility programs will help superintendents make more informed decisions on cultivars and nitrogen use and promote environmental stewardship.

INTRODUCTION

Over the past 20 years, new bentgrasses have been released from various turfgrass breeders and seed companies. Compared to Penncross, many of these newer cultivars have characteristics like finer leaf texture, higher canopy density, greater growth rate, disease resistance, improved drought and heat tolerance, and darker green color. These improved bentgrasses have been adopted by golf course superintendents and are widely used. Interestingly, the nitrogen requirements for the newer bentgrasses have not been determined, especially for the Southeastern U.S.. It is not uncommon to see a Penncross fertility program applied to the newer cultivars. Considering many of the improvements, which include a greater growth rate and higher canopy density, these grasses may require an increased fertility program.

Our objective is to determine optimal nitrogen fertility programs for the newer bentgrass cultivars and generate fertility recommendations as golf course superintendents convert from older cultivars to the newer ones.

MATERIALS AND METHODS

In 2016 a two-year trial was initiated at two locations to investigate the effects of six nitrogen rates for six bentgrass cultivars. Plot construction began in 2015, including renovation of a more than 25-year-old Penncross research putting green on the UGA Griffin campus and the construction of aU.S. Golf Association (USGA) research putting green at the Atlanta Country Club (ACC) in Marietta, Georgia. On the Griffin site, renovation included 2 applications of glyphosate, excavation of the upper 3 inches of root zone and thatch, and the site was then backfilled and leveled with 85:15 sand:peat greens mix. The ACC site was a new construction and was built to USGA specifications.

Plots in both locations were seeded at 1.0 lb seed/1000 ft^2 in September 2015 and allowed to establish through the fall and winter. This included regular applications of nitrogen (N), phosphorus (P), potassium (K), and micronutrients to ensure a surface canopy consistent with golf course putting green standards. The mowing height was gradually reduced to putting green heights (0.135 inch). Other management (e.g., pests, topdressing, irrigation, etc.) was consistent with practices to maintain a golf course putting green.

The bentgrass cultivars were planted in blocks as main plots. Cultivars were:

- A1+A4 – standard (Tee-2-Green)
- T1 (Jacklin Seed)
- V8 (Jacklin Seed)
- 007 (Seed Research of Oregon)
- AU Victory (Auburn University)
- Pure Distinction (Pure Seed)

In mid-March 2016, onto 3 ft x 3 ft plots and replicated four times, nitrogen applications were initiated at both locations. Nitrogen was applied as a foliar application using a greenhouse grade urea (46-0-0) dissolved in water and applied with a backpack sprayer set to deliver 90 gpa. Other nutrients (i.e., P & K) were applied periodically based on soil test analysis. Nitrogen rates and timing were:

- No nitrogen – control
- 0.05 lb N/1000 ft^2 weekly
- 0.10 lb N/1000 ft^2 biweekly
- 0.20 lb N/1000 ft^2 biweekly
- 0.30 lb N/1000 ft^2 biweekly
- 0.40 lb N/1000 ft^2 biweekly

Data collection began two weeks after nitrogen was first applied and has included or will include:

1. Turfgrass color and quality – biweekly
2. Root length and shoot density determinations – quarterly
3. Surface firmness – quarterly
4. Nitrogen partitioning – August and March
5. Residual soil N (nitrate and ammonium) – August
6. Thatch depth – quarterly

RESULTS

The trial was initiated in March of 2016, data collection is ongoing and results will be available in the future. To follow the progress of this study on Twitter, follow @AUTurfFert, @GeorgiaTurf, and @Turf_Joe32.

ACKNOWLEDGEMENTS

We gratefully acknowledge the cooperation of the Atlanta Country Club membership and golf course maintenance staff: Mark Esoda, Joe Hollis, Nolan Cash, etc. Financial support has been provided by the USGA and in-kind gifts were received from Precision Turf, Howard Fertilizer, Bulk Aggregate, Tee-2-Green, Jacklin Seed, Seed Research of Oregon, and Pure Seed. Technical support has been provided by Clay Bennett, Alan Wise, Bill Smith, and other student workers. Georgia Golf Environmental Foundation and the Alabama Turfgrass Association also have shown interest in supporting this research.

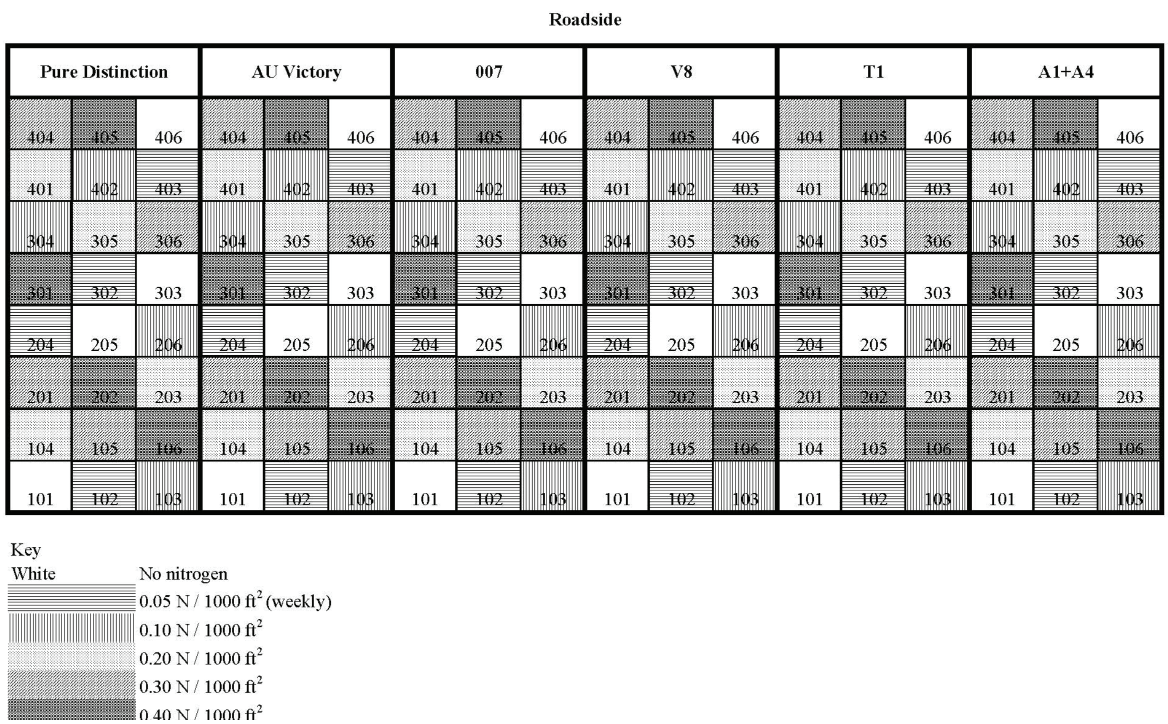

Figure 1. Plot layout of nitrogen rates on six bentgrass cultivars.

STOP D Afternoon Self-guided Research Tour

Managing Turfgrass Weeds

Patrick McCullough, Assistant Professor, Crop and Soil Sciences
Chris Johnston, Graduate Assistant, Crop and Soil Sciences
The University of Georgia, Griffin Campus

This session will cover new herbicides for weed control in turfgrass. We will visit plots with pre- and postemergence crabgrass control in tall fescue, centipedegrass, and bermudagrass. New herbicides for Virginia buttonweed, dallisgrass, and annual bluegrass control will be shown in plots and discussed. The session will be open for discussion with participants about other weed control issues.

STOP E Afternoon Self-guided Research Tour

Common Pests in Ornamental Grasses

Melanie Harrison, Agronomist
U.S. Department of Agriculture, Griffin Campus

Carol Robacker, Associate Professor, Horticulture
Susan Hawkins, Doctoral Student, Horticulture
The University of Georgia, Griffin Campus

ABSTRACT

Ornamental perennial grasses are becoming increasingly popular in the landscape due to their beauty and ease of care. Although few pest problems are encountered in ornamental grasses, they are not immune to insects and disease. Two-lined spittlebugs (*Prosapia bicincta*) can cause damage to ornamental grasses such as little bluestem. One of the best ways to combat these pests is to select cultivars that are resistant to spittlebug damage. Using controlled, no-choice greenhouse tests, little bluestem cultivars were screened to identify resistant plants that can be incorporated in breeding programs to develop improved cultivars. Control of two-lined spittlebugs is also discussed.

INTRODUCTION

Pest problems are not prevalent in ornamental grasses, but there are a few insects that will feed on ornamental grasses including the two-lined spittlebug, or *Prosapia binacta* (Say) (Hemiptera: Cercopidae). Adults aresmall – only 1 cm long – and colored black to dark brown with two red or orange stripes across their wings, while nymphs have a brown head but are cream-colored over the rest of their bodies (Buss and Williams, 2011; Fagan and Kuitert, 1969). Spittlebugs lay eggs most often in debris at the base of grasses, although they may also lay eggs within the leaf itself. The insects overwinter as eggs and the first instar nymphs hatch out in early spring. Once the nymphs hatch, they immediately seek food, inserting their probing mouthparts into the xylem of grass stems, creating a distinctive mass of white, frothy spittle. Spittlebug salivary glands contain a phytotoxic compound that damages the plants upon which they feed (Fagan and Kuitert, 1969). Since the nymphs prefer to feed close to the ground (Fagan and Kuitert, 1969), spittlemasses may also be hard to detect in taller grasses, such as little bluestem.

Infestations of spittlebug are likely to be heavier in rainy years with high humidity and in stands of grass that have heavy thatching (Buss and Williams, 2011). Feeding by spittlebugs immediately causes steaks of purple or white color to appear in turfgrasses (Buss and Williams, 2011). Damage occurs from the actions of both the nymph and adult stages, although nymphs are harder to control by either pesticides or many biocontrols as they are protected by a mass of white, frothy spittle (Fagan and Kuitert, 1969; Nachappa et al., 2006). Heavy feeding causes the grass to wilt, with yellow to brown curling tips. Grass blades might die in as little as a day or as many as three days and stems in three to four days (Fagan and Kuitert, 1969).

Often cultural practices will reduce pest occurrence. Practices that lead to thatch buildup in the basal foliage, such as overwatering and heavy fertilization, will promote the proper moist, humid environment favored by spittlebugs. Placing grasses in shady locations will also lead to increased moisture in the basal foliage and attract spittlebugs. Cultivar selection is an important component of integrated pest management; however, resistance has not been documented in little bluestem. One of the goals of our breeding program is to identify spittlebug resistance in little bluestem and incorporate this trait into our cultivars.

MATERIALS AND METHODS

Spittlebug adults were collected from commercial landscapes and local residential areas in Griffin, Georgia. Five spittlebug adults were placed in caged pots with selected little bluestem lines and commercial cultivars. Four replications of each accession and the commercial cultivars were arranged in a randomized, complete block design. Plants were observed weekly for the presence of nymphs, spittlemass, and adult spittlebugs. After four weeks, total damage was assessed by counting the number of live stems and number of spittlebugs (live\dead). Live bugs were removed from the plants and the plants were trimmed back and allowed to regrow for four weeks in order to assess recovery. After four weeks, leaf tissue was dried and weighed.

RESULTS AND CONCLUSIONS

Preliminary data suggests resistance to spittlebug damage is present in little bluestem. Field observations have revealed little resistance in the commercially available cultivars. It is recommended that breeding efforts in ornamental grasses focus on improving pest resistance in addition to selecting for ornamental value and use.

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STOP F Afternoon Self-guided Research Tour

New Approaches for Understanding Turfgrass Physiology

David Jespersen, Assistant Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

Meet new assistant professor of turfgrass physiology, Dr. David Jespersen. Dr. Jespersen will introduce himself and his research to attendees of the University of Georgia Turf Field Day. His research approach combines whole plant physiology with advanced techniques in molecular biology to better understand turfgrass responses to various stresses. Elucidating the mechanisms that allow turfgrasses to withstand environmental stress will be of key importance for the development of improved varieties, and Dr. Jespersen brings valuable expertise to the Turf Team in Griffin.

David Jespersen is the newest addition to the University of Georgia's Turf Team, starting on April 1, 2016, as an assistant professor of turfgrass physiology. He will be available to discuss his research and roles at the University of Georgia, as well as introduce himself to members of the turfgrass community and learn about their goals and concerns for turfgrasses in Georgia. Dr. Jespersen received his doctoral degree from Rutgers University, studying abiotic stresses in bentgrasses under Dr. Bingru Huang. At the University of Georgia, Dr. Jespersen will continue to explore the effects of abiotic stresses on both warm- and cool-season turf species. His research integrates the study of physiological responses of turfgrasses to stresses in addition to the underlying molecular biology that regulates these responses. This includes the use of advanced techniques such as proteomics to explore how levels of specific proteins are being changed in the plant; metabolomics, which looks at widespread changes to metabolism in the plant caused by environmental stresses and conditions; or through the identification of candidate conditions; which determines differences in key genes involved in stress tolerance. Using these techniques in conjunction with the screening of important physiological traits in turfgrasses will help identify important mechanisms responsible for improved tolerance to stresses in turfgrasses. This information can then be integrated back into breeding programs at the university to help develop improved varieties. By developing his research program and interacting with other researchers at the university in addition to the turfgrass industry, Dr. Jespersen hopes to help improve turfgrasses for use in Georgia and across the Southeast.

STOP G Afternoon Self-guided Research Tour

Demonstration: Pesticide Storage and Handling

Rick Hayes, Pesticide Program Specialist
Georgia Department of Agriculture, Pesticide Division

The Pesticide Division enforces state and federal laws pertaining to the use and application of pesticides. Under the Georgia Pesticide Use and Application Act, this section monitors the use of pesticides in a variety of pest management situations including all areas of the turfgrass industry (e.g., golf courses, sports fields, commercial lawn care, landscaping, sod production, etc.). Proper handling, mixing, and storage ensure the efficacy of pesticides and the safety of applicators and the environment. This demonstration will use an active pesticide storage facility to show the "do's and don'ts" that Georgia pesticide inspectors encounter when visiting green industry companies. This is an opportunity to ask inspectors questions and get information on making sure your business is legal and practicing sound pesticide stewardship.

STOP H Afternoon Self-guided Research Tour

New Turfgrass Research and Education Facilities

Paul Raymer, Professor, Crop and Soil Sciences
Clint Waltz, Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

During the 2014 legislative session, the governor and the Georgia legislature appropriated funds for a statewide turfgrass facilities enhancement project, ensuring a strong future for the Georgia turf industry. The new Turf Science Research and Education Building currently under construction on the Griffin campus will provide modern laboratories, offices, a conferencing area, classroom space, integrated greenhouses, and a headhouse complex to support seven turfgrass scientists, their staff, post-docs, visiting scientists, and graduate students.

At the Tifton campus, antiquated facilities are being replaced with new greenhouses and headhouse facilities to support the expanding warm-season breeding program. At the Athens campus, greenhouses and a combination classroom/headhouse complex are now under construction and will support undergraduate teaching and turf research programs.

These world-class facilities will enhance our undergraduate and graduate education programs, enable our turf scientists to conduct cutting-edge research, and enable our college to retain and recruit top turf scientists needed to ensure a prosperous future for the vital Georgia turf industry.

NOTE: Pictures of these three facilities are on the inside of the back cover.

STOP I Afternoon Self-guided Research Tour

Poster Session

Take time to stop by the Turf Maintenance Building to visit with our turfgrass graduate students and learn about their latest research as they present posters in the breezeway.

Update on Seashore Paspalum Breeding

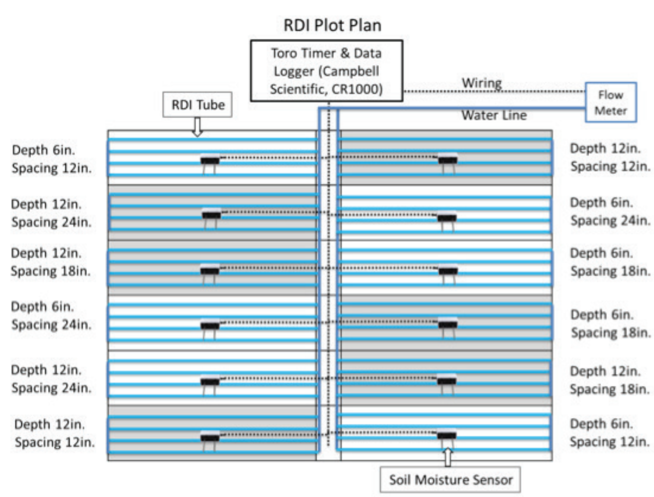
Paul Raymer, Professor, Crop and Soil Sciences
The University of Georgia, Griffin Campus

The University of Georgia seashore paspalum breeding program started more than two decades ago in 1993 at the UGA campus in Griffin. Paul Raymer leads Team UGA, an interdisciplinary program that brings together the full resources of UGA research. Experts in the fields of entomology, plant physiology, weed science, stress physiology, plant pathology, and molecular genetics work together with the goal of developing the finest quality, most environmentally friendly seashore paspalum cultivars on the market today. The seashore paspalum breeding program at UGA has released four of the most widely utilized seashore paspalum cultivars: SeaIsle 1, SeaIsle 2000, SeaIsle Supreme and SeaStar seashore pasaplum. With a more-than-20-year history of innovation and groundbreaking research coupled with the Team UGA approach to cultivar development, UGA is considered the leading seashore paspalum breeding program in the world. Join Paul on the warm-season research green for a brief update on our seashore paspalum breeding efforts, or visit our new website at www.seashorepaspalum.uga.edu.

Application of Root Demand Irrigation for Turf

Viktor Tishchenko, Research Professional II, Crop and Soil Sciences
The University of Georgia, Griffin Campus

Root demand irrigation (RDI) is an innovative, low-pressure, energy-efficient, plant-driven subsurface irrigation system. Porous subsurface tubes are used that serve as water reservoirs, releasing water in response to plant exudates as needed. RDI claims improved water-use efficiency by delivering water and, potentially, nutrients directly to the root zone. It uses low pressure (about 2 psi or less) that requires less energy and allows for the use of natural flow (without pumping) from collected water stored in uplifted containers. RDI requires minimal filtration and can use groundwater, ponds, and canals as well as recycled or treated water without expensive treatment because the water doesn't reach the surface. Here, turfgrass subsoil irrigation is tested and optimized for use on Cecil soils of the Piedmont plateau. RDI tubes are installed at 12-, 18-, and 24-in. intervals and 6- and 12-in. depths (see the graph below). Soil moisture is measured with Decagon soil moisture sensors (GS1) installed between lines at the depth of 3 in. A water flow meter, solenoid valves, and sensors are connected to a timer (Toro) and a data logger (Campbell Scientific, CR1000) to continuously track water use and plant response. Different subsurface irrigation timing and pressure modes together with installation spacing and depth are compared to conventional sprinkle irrigation.



Key Points: Georgia's Turfgrass Industry and UGA's Turfgrass Program

INDUSTRY

- Estimates suggest that, at 1.8 million acres, turfgrass is one of the largest agricultural commodities in the state.
- This includes home lawns, sports fields, golf courses, sod farms, and other managed landscape areas.
- Georgia turfgrass and related industries contribute a total of $7.8 billion annually to the economy.
- In terms of earnings and value added, turfgrass and related industries contribute $4.6 billion each year.
- The federal, state, and local tax impact is more than $1 billion dollars annually.
- This industry accounts for 87,000 full- and part-time jobs.
- The majority of these jobs are related to landscape maintenance of buildings and households.
- The landscape industry has a history of professional development and use of research-based information.
- Through drought periods, the golf and landscape segments have demonstrated exceptional environmental stewardship with their best management practices (BMP) approach to water use efficiency and conservation.
- This industry has strived to be a part of the solution to Georgia's environmental issues.

UGA TURFGRASS PROGRAM

- UGA is the research, development, and education arm of Georgia's turfgrass industry.
- UGA has a 60-plus year history of providing scientifically based information to the turfgrass industry.
- UGA is known for its renowned scientists and specialists developing practices, pest management strategies and grasses that are best adapted to Georgia.
- Turfgrass breeding for warm-season species dates back to the 1950s and continues today with two productive programs focused on sustainable bermudagrass, centipedegrass, seashore paspalum (pronounced pass-pal-um) and zoysiagrass cultivars.
- These scientists are continuing to stretch the scientific boundaries with novel approaches and strategies to solve the most challenging management and environmental issues that face this industry.
- UGA scientists continue to be involved with water conservation and have demonstrated effective methods of achieving sustainability of natural resources (i.e., water) while maintaining industry viability.
- Extension and professional development of Georgia's turfgrass practitioners is also of strong emphasis. Without a well-educated workforce, economic development of the turfgrass industry would not be where it is today.
- Opportunities exist with continued support of strong academic programs along with industry partnerships to increase economic development, further scientific exploration and enhance the environment.

Georgia Farm Gate Information

2014 Georgia Agricultural Commodity Rankings

Rank	Commodity	Farm Gate	% of GA Total
1	Broilers	$4,543,256,669	32.28%
2	Beef	$1,089,490,794	7.74%
3	Cotton	$964,678,523	6.85%
4	Eggs	$822,870,998	5.85%
5	Timber	$601,805,142	4.28%
6	Peanuts	$563,933,740	4.01%
7	Dairy	$438,112,611	3.11%
8	Blueberries	$335,250,992	2.38%
9	Horses	$333,328,738	2.37%
10	Pecans	$313,313,250	2.23%
11	Pork	$269,040,986	1.91%
12	Greenhouse	$265,397,311	1.89%
13	Corn	$264,768,473	1.88%
14	Ag-based Tourism	$156,092,226	1.11%
15	Hay	$152,922,872	1.09%
16	Container Nursery	$146,818,855	1.04%
17	Breeder Pullet Unit	$142,877,184	1.02%
18	Onions	$138,255,865	0.98%
19	Watermelon	$134,206,241	0.95%
20	Soybeans	$125,066,896	0.89%
21	Bell Peppers	$121,547,501	0.86%
22	Sweet Corn	$117,373,539	0.83%
23	Misc. Vegetables	$115,054,523	0.82%
24	Turfgrass	$104,304,869	0.74%
25	Wheat	$86,714,104	0.62%
26	Pine Straw	$79,532,675	0.57%
27	Tobacco	$79,348,361	0.56%
28	Field Nursery	$77,986,787	0.55%
29	Hunting Lease - Deer	$77,167,524	0.55%
30	Cabbage	$74,219,966	0.53%
31	Silage	$67,883,244	0.48%
32	Cucumbers	$60,916,220	0.43%
33	Greens (collards, kale, lettuce, mustard, spinach, turnip greens)	$54,295,497	0.39%
34	Tomato	$53,892,514	0.38%
35	Peaches	$53,511,847	0.38%
36	Quail	$39,755,596	0.28%
37	Eggplant	$30,233,977	0.21%
38	Honeybees	$28,561,487	0.20%
39	Squash (Yellow and Winter)	$27,918,277	0.20%
40	Snap Beans	$27,353,793	0.19%
41	Catfish	$26,637,425	0.19%
42	Zucchini	$25,447,880	0.18%
43	Straw	$23,454,825	0.17%
44	Goats	$21,241,483	0.15%
45	Cantaloupe	$19,794,025	0.14%
46	Strawberries	$15,823,867	0.11%
47	Apples	$12,597,616	0.09%
48	Grapes	$12,472,830	0.09%
49	Rye	$11,893,369	0.08%
50	Oats	$11,026,891	0.08%
51	Christmas Trees	$9,917,140	0.07%
52	Other Peppers (banana and hot)	$9,198,937	0.07%
53	Sorghum	$8,435,847	0.06%
54	Hunting Leases - Turkey	$8,112,969	0.06%
55	Blackberries	$5,461,119	0.04%
56	Southern Peas	$5,170,111	0.04%
57	Sheep	$4,573,688	0.03%
58	Okra	$2,996,996	0.02%
59	Hunting Leases - Duck	$1,612,395	0.01%
60	Barley	$804,608	0.01%
	Crop Insurance	$137,795,578	0.98%
	Government Payments	$304,726,327	2.16%
	All Other Miscellaneous	$218,060,061	1.55%
	2014 Total Farm Gate Value	**$14,076,316,652**	

Georgia Turfgrass Farm Gate Information

2014 Turfgrass Farm Gate Value

Rank	County	Acres	Harvest	$/Acre	Farm gate
41	Appling	50	0.700	$6,050.00	$211,750
-	Atkinson		0.000		$0
-	Bacon		0.000		$0
41	Baker	50	0.700	$6,050.00	$211,750
-	Baldwin		0.000		$0
42	Banks	45	0.700	$6,050.00	$190,575
-	Barrow		0.000		$0
7	Bartow	1,005	0.700	$6,050.00	$4,256,175
-	Ben Hill		0.000		$0
24	Berrien	210	0.700	$6,050.00	$889,350
-	Bibb		0.000		$0
-	Bleckley		0.000		$0
52	Brantley	2	0.700	$6,050.00	$8,470
-	Brooks		0.000		$0
-	Bryan		0.000		$0
4	Bulloch	1,400	0.700	$6,050.00	$5,929,000
44	Burke	30	0.700	$6,050.00	$127,050
-	Butts		0.000		$0
-	Calhoun		0.000		$0
-	Camden		0.000		$0
33	Candler	100	0.700	$6,050.00	$423,500
14	Carroll	500	0.700	$6,050.00	$2,117,500
20	Catoosa	280	0.700	$6,050.00	$1,185,800
-	Charlton		0.000		$0
-	Chatham		0.000		$0
-	Chattahoochee		0.000		$0
47	Chattooga	10	0.700	$6,050.00	$42,350
-	Cherokee		0.000		$0
50	Clarke	5	0.700	$6,050.00	$19,058
-	Clay		0.000		$0
-	Clayton		0.000		$0
-	Clinch		0.000		$0
-	Cobb		0.000		$0
-	Coffee		0.000		$0
41	Colquitt	50	0.700	$6,050.00	$211,750
48	Columbia	7	0.700	$7,500.00	$36,750
2	Cook	1,800	0.700	$6,050.00	$7,623,000
-	Coweta		0.000		$0
-	Crawford		0.000		$0
33	Crisp	100	0.700	$6,050.00	$423,500
-	Dade		0.000		$0
-	Dawson		0.000		$0
10	Decatur	672	0.700	$6,050.00	$2,845,920
-	DeKalb		0.000		$0
-	Dodge		0.000		$0
12	Dooly	550	0.700	$6,050.00	$2,329,250
9	Dougherty	950	0.700	$6,050.00	$4,023,250
-	Douglas		0.000		$0
17	Early	370	0.700	$6,050.00	$1,566,950
-	Echols		0.000		$0
19	Effingham	300	0.700	$6,050.00	$1,270,500
-	Elbert		0.000		$0
40	Emanuel	26	0.700	$12,000.00	$218,400
-	Evans		0.000		$0
-	Fannin		0.000		$0
-	Fayette		0.000		$0
46	Floyd	17	0.700	$6,050.00	$71,995
-	Forsyth		0.000		$0
43	Franklin	40	0.700	$6,050.00	$169,400
26	Fulton	150	0.700	$7,550.00	$792,750
-	Gilmer		0.000		$0
-	Glascock		0.000		$0
-	Glynn		0.000		$0
5	Gordon	1,300	0.700	$6,050.00	$5,505,500
39	Grady	55	0.700	$6,050.00	$232,925
-	Greene		0.000		$0
-	Gwinnett		0.000		$0
18	Habersham	350	0.700	$6,050.00	$1,482,250
51	Hall	4	0.700	$5,772.00	$16,162
30	Hancock	150	0.700	$6,000.00	$630,000
-	Haralson		0.000		$0
43	Harris	40	0.700	$6,050.00	$169,400
36	Hart	74	0.700	$6,050.00	$313,390
27	Heard	175	0.700	$6,050.00	$741,125
-	Henry		0.000		$0
19	Houston	300	0.700	$6,050.00	$1,270,500
11	Irwin	600	0.700	$6,050.00	$2,541,000
19	Jackson	300	0.700	$6,050.00	$1,270,500
-	Jasper		0.000		$0
-	Jeff Davis		0.000		$0
32	Jefferson	120	0.700	$6,050.00	$508,200
-	Jenkins		0.000		$0
-	Johnson		0.000		$0
-	Jones		0.000		$0
-	Lamar		0.000		$0
6	Lanier	1,100	0.700	$6,050.00	$4,658,500
31	Laurens	146	0.700	$6,050.00	$617,675
25	Lee	200	0.700	$6,050.00	$847,000
-	Liberty		0.000		$0
-	Lincoln		0.000		$0
-	Long		0.000		$0
52	Lowndes	2	0.700	$6,050.00	$8,470
-	Lumpkin		0.000		$0
1	Macon	4,500	0.700	$6,050.00	$19,057,500
-	Madison		0.000		$0
-	Marion		0.000		$0
37	McDuffie	70	0.700	$6,050.00	$296,450
-	McIntosh		0.000		$0
38	Meriwether	65	0.700	$6,050.00	$275,275
23	Miller	240	0.700	$6,200.00	$1,041,600
15	Mitchell	400	0.700	$6,050.00	$1,694,000
-	Monroe		0.000		$0
-	Montgomery		0.000		$0
28	Morgan	160	0.700	$6,050.00	$677,600
-	Murray		0.000		$0
-	Muscogee		0.000		$0
-	Newton		0.000		$0
45	Oconee	25	0.700	$6,050.00	$105,875
-	Oglethorpe		0.000		$0
-	Paulding		0.000		$0
3	Peach	1,500	0.700	$6,050.00	$6,352,500
-	Pickens		0.000		$0
-	Pierce		0.000		$0
-	Pike		0.000		$0
-	Polk		0.000		$0
15	Pulaski	400	0.700	$6,050.00	$1,694,000
-	Putnam		0.000		$0
-	Quitman		0.000		$0
-	Rabun		0.000		$0
-	Randolph		0.000		$0

Thanks to our exhibitors

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New Turfgrass Research and Education Facilities

The University of Georgia Turfgrass Team extends their gratitude and thanks to Governor Deal, the 2014 Georgia State Legislature, The Urban Ag Council, and leaders of the Georgia turfgrass industry for their support in securing funds to improve our research and education facilities.

THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

2016 Turfgrass Research FIELD DAY

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