THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

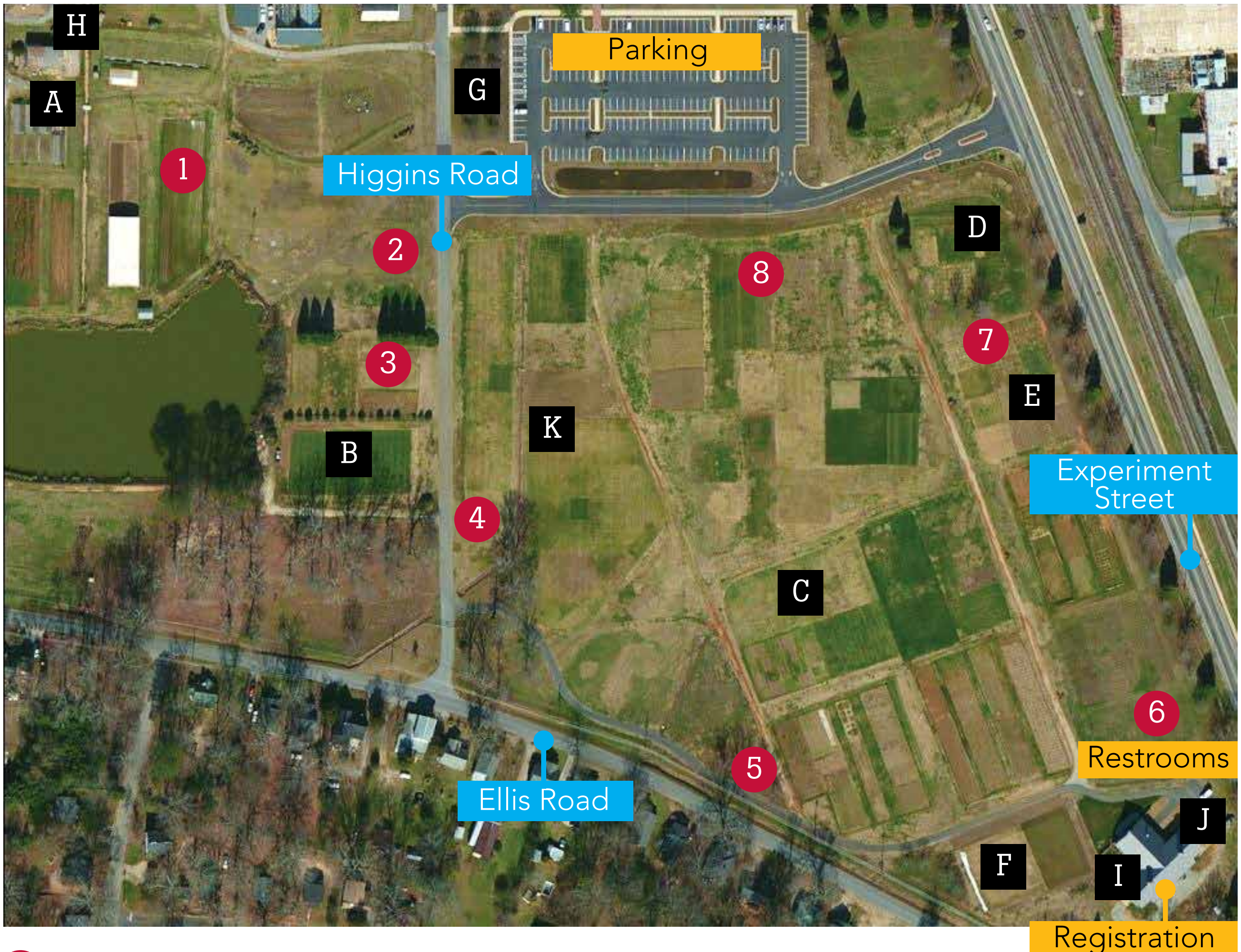
2014 Turfgrass Research Field Day

Wednesday, August 6
UGA Griffin Campus

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

ONE BIG DAY · ACRES OF INFORMATION

Map and
Field Day tour stops



Guided morning tour stops: 1-8

Self-guided afternoon tour venues: A-K

@GeorgiaTurf

2014 UGA Turfgrass Research Field Day Program

WEDNESDAY, AUGUST 6

8-8:45 a.m.	REGISTRATION
8:50-9:15 a.m.	WELCOME
9:15-11:30 a.m.	GUIDED RESEARCH TOUR* 1. Site Specific Turfgrass Management – *G. Henry* 2. Seedhead control on Bermudagrass, Seashore Paspalum, and Zoysiagrass – *P. McCullough* 3. Latest Research on Warm-season Turfgrass Diseases – *A. Martinez* 4. Lunch and Lawn: Can You Have Grass and Eat Too? – *E. Bauske* 5. Latest Research on Turfgrass Insects – *K. Braman & W. Hudson* 6. Herbicide Resistance Systems for Turfgrasses – *P. Raymer* 7. Bermudagrass Breeding at UGA – *B. Schwartz* 8. Zoysiagrass Establishment Timing – *C. Waltz*
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. Heat and Drought Tolerant Bentgrass – *P. Raymer* B. Latest Research on Cool-season Turfgrass Diseases – *A. Martinez* C. Managing Turfgrass Weeds – *P. McCullough and C. Johnston* D. Sustainability of Turfgrass with Soil Incorporation of Organic Matter – *B. Griffin* E. Reduced Input Bermudagrass Management – *M. Hartman* F. Warm-season Putting Green NTEP Trial – *C. Waltz* G. Step into the Shade: Conversations about Urban Agriculture – *Center for Urban Ag.* H. Demonstration: Pesticide Storage and Handling – *Rick Hayes, Ga. Dept. of Ag.* I. Poster Session: Turfgrass Graduate Programs at UGA – *Turfgrass Graduate Students* J. Demonstration: Reel Grinders and Mower Set-up – *Chris Langley, Bernhard and Co* K. Demonstration: Applications for UAVs in Turf – *Ben Worley, Vision Services Group*

* *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.

2014 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: (a) state and federal support, and (b) the various entities of the turfgrass industry. Without the active direct and indirect support of the turfgrass industry, our research and education efforts would be severely curtailed. Thus, we wish to thank the various contributors who in recent years have helped the turfgrass industry by supporting our research and education programs:

Agriguard Company
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Georgia Certified Landscape Professionals
Georgia Crop Improvement Association
Georgia Golf Course Superintendents Assn.
Georgia Golf Environmental Foundation
Georgia Master Gardeners
Georgia PGA
Georgia Seed Development Commission
Georgia State Golf Association
Georgia Turfgrass Foundation Trust
Golf Course Superintendents Assn. of America
Golf Ventures West
Gowan
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NG Turf
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Sugarloaf TPC
Super Sod
Syngenta
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The Turner Foundation
TriEst Ag. Group
Turfgrass Producers International
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Turf Seed
University of Georgia Golf Course
University of Georgia Research Foundation
UGARF – Technology Commercialization Office
Urban Ag. Council
U.S. Golf Association
Valent U.S.A.
Valley Irrigation
Wright Turf

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

University of Georgia Turfgrass Team - 2014

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Site Specific Turfgrass Management

Gerald Henry – Associate Professor, Crop and Soil Sciences
The University of Georgia, Athens Campus

This field day presentation is aimed to teach attendees how to operate current site assessment equipment/sensors and integrate their use into daily turfgrass management practices. Turfgrass managers will learn that the concept of site-specific management simply involves applying inputs to areas where needed, when needed, and in the amount needed, resulting in management on a smaller scale, reducing overall inputs, and increasing turfgrass uniformity/performance.

INTRODUCTION

Golf course superintendents and athletic field managers are often accused of exhibiting luxury consumption of several turfgrass inputs such as fertility, irrigation, cultivation, etc. Recent research has attempted to change this perception by enhancing sustainability through the development and implementation of efficient, site specific turfgrass management. The spatial variability (differences) of soil and plant parameters common to golf courses and athletic fields makes it very difficult to manage the entire turfgrass site under the same management plan. Therefore, the primary goal of site specific management is to define boundaries of site specific management units (SSMUs) (i.e. management zones) through the use of precision agriculture concepts, technologies and products.

Our program's previous research at UGA has focused on the impact of sample size on the prediction accuracy of several soil and plant parameters. For example, assessment methods for athletic field performance testing (American Society for Testing and Material) employs hand-held sensors to collect data from only 6-8 locations across a field. This small sample size may make it very difficult to completely and accurately evaluate the entire field. Although increasing the number of samples is necessary to enhance precision, little research has been conducted to investigate map accuracy in response to sample size. The introduction of mobile data acquisition units allow for quick and intense data collection, while the use of GPS compatible mobile and hand-held devices provide the ability to manipulate sample spacing and overall sample number.

MATERIALS AND METHODS

Research was conducted at the Grimes Bridge Soccer Complex in Roswell, Ga., and Oconee Veterans Park in Watkinsville, Ga. A total of six community level sports fields were used between the two locations. The Roswell location included three 'Tifway 419' hybrid bermudagrass (*Cynodon dactylon x C. transvaalensis*) fields mowed two times a week at 2.54 cm with a reel mower. The Watkinsville location included three 'TifSport' hybrid bermudagrass fields also mowed two times a week at 2.54 cm with a reel mower.

All fields evaluated had sandy loam soils and field size ranged from 60-64 m x 95-104 m. Soccer was the primary sport played on all fields at both locations. Fields in Roswell were constructed in tiers, with field 1 being at the top, field 2 in the 35 middle, and field 3 below. Two concrete walls approximately 9.1 m and 3.0 m high separates fields 1 and 2, and fields 2 and 3, respectively. Field 1 is open to the public while fields 2 and 3 remain gated throughout the day and are solely used for scheduled practice and games. Fields in Watkinsville were designed in a flat open area (4.2 ha) and laid in close proximity to one another. Field 1 is directly north of field 3 with the south end zone of 1 being approximately 22.9 m from the north end zone of 3. Field 2 is centered approximately 22.9 m east of 1 and 3. All fields in Watkinsville are open to the public.

Data collection in Roswell followed one day after significant rainfall, thus each field was semi-saturated. In Watkinsville, data was collected two days after rainfall, thus percent volumetric water content (VWC) was lower than at Roswell, but still near field capacity. The distribution of VWC does not resemble manual irrigation patterns at either location. VWC data was collected in Roswell on 9 May, 2013 and in Watkinsville on 10 May, 2013. A mobile, multi-sensor, data acquisition unit was used to measure VWC on all six fields.

The mobile device was attached to the hitch of a utility vehicle. Measurements were made approximately every 2.4 m while traversing the field at a speed of 2.7 to 3.3 km h^{-1}. Passes downfield were made 2.4 m apart; therefore measurements were collected using an approximate 2.4 m x 2.4 m sample grid, which resulted in 997 to 1,189 readings per field. Data was recorded using an on-board computer and displayed in a spreadsheet format. Soil moisture measurements were based on a capacitance sensor (The Toro Company, Bloomington, MN) that measured VWC at a 0-10 cm depth. A NovAtel GPS (NovAtel Inc., Alberta, Canada), attached to the unit, was used to gather latitude and longitude information for the data.

The ArcGIS version 10.1 GIS and mapping software (ArcMap) was used to develop, display, analyze, and interpret maps of the VWC data (ESRI, Redlands, CA). Using the editor tool in ArcMap, samples were removed from the initial 2.4 m x 2.4 m sampling grid to create the various sample sizes evaluated in this study. For each field, a total of 8 sample sizes were manipulated including 7 sampling grids and a sampling pattern that resembles test procedures from previous non-spatial performance testing research. Visual assessment of VWC was done using kriging, with the Geostatistical Analyst extension of ArcMap, to create prediction surface maps (ESRI, Redlands, Ca.).

RESULTS

Sampling patterns and associated spatial maps for 1,189, 308, 77, and 7 samples are presented (Fig. 1, 2, 3, and 4). Cross validation was performed to determine the effect of sample size on the accuracy of each prediction model (data not shown). Both the 1,189 and 308 sample sizes accurately depict the spatial variability of VWC within the athletic field (Fig. 1 and 2). Although the 77 sample size map does show similar trends in VWC spatial distribution, certain map areas lose significant detail (Fig. 3). The 7 sample size map does not show any spatial variability with respect to VWC (Fig. 4). Based on observations from this work, turfgrass managers must sample > 77 times to accurately depict the spatial variability of VWC in a typical athletic field. In fact, approximately 100 samples must be obtained to retain accuracy (data not shown). Results from this research can be used to determine a standard method for data collection using both hand-held and mobile technology.

ACKNOWLEDGEMENTS

This research represents a portion of Mr. Chase Straw's MS thesis. This research, along with countless other projects, would not be possible without the help of Chase Straw, Rebecca Grubbs, Kevin Tucker, Josh Andrews, Tommie Burch, Erick Begitschke, Jennifer Murphy, Chris Bergwall, Dr. Van Cline, and Dr. Bob Carrow.

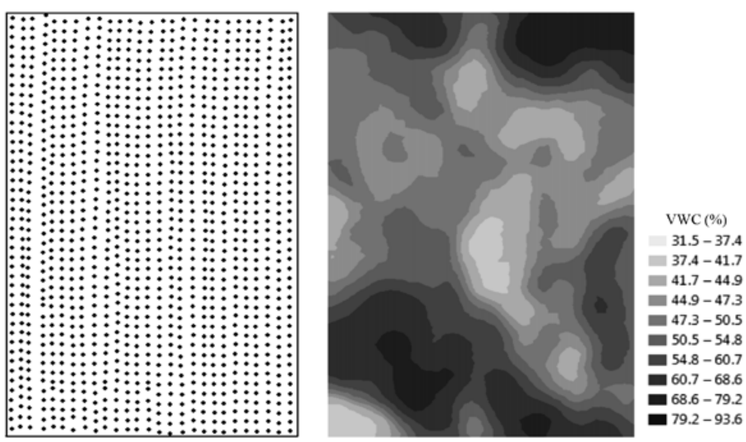

Figure 1: Sampling pattern and resulting spatial map of VWC using 1,189 samples.

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Site Specific Turfgrass Management, *continued*

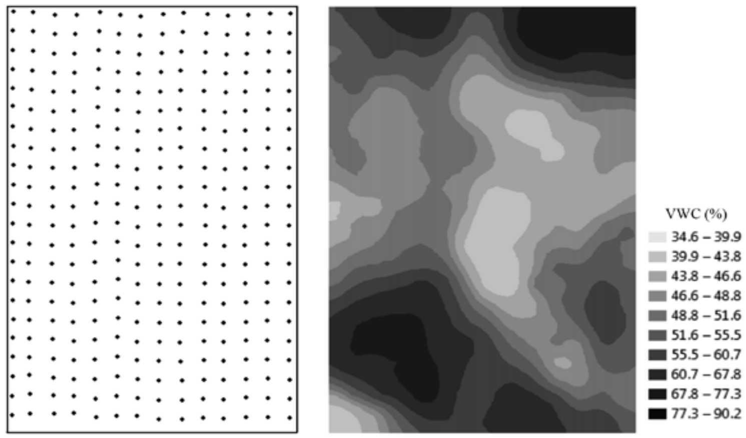

Figure 2: Sampling pattern and resulting spatial map of VWC using 308 samples.

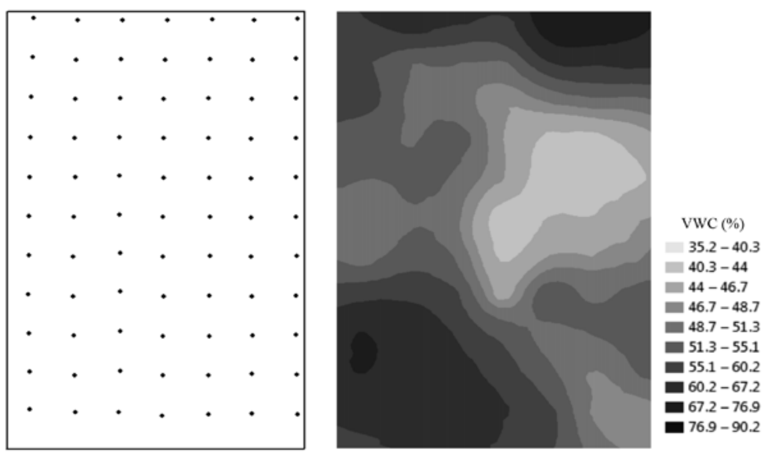

Figure 3: Sampling pattern and resulting spatial map of VWC using 77 samples.

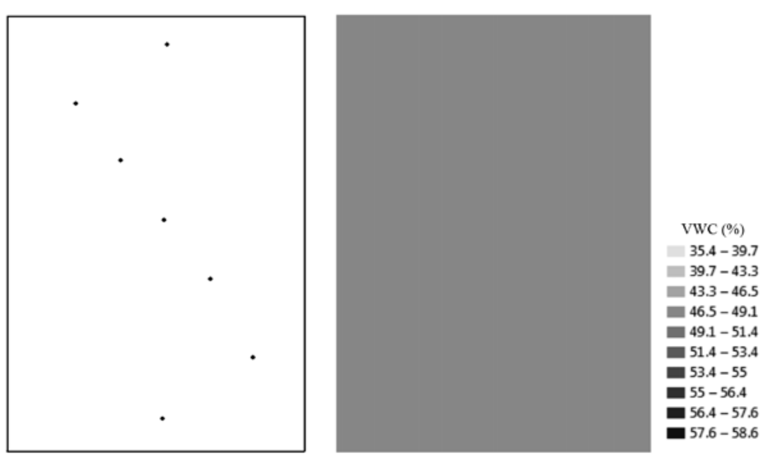

Figure 4: Sampling pattern and resulting spatial map.

Seedhead Control on Bermudagrass, Seashore Paspalum and Zoysiagrass

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

A three-year experiment is being conducted on the University of Georgia Griffin Campus to evaluate effects of mowing regimens on seedhead emergence of TifGrand bermudagrass, Sea Isle 1 seashore paspalum, and Diamond zoysiagrass. These three grasses were chosen because of prolific seedhead emergence issues reported by superintendents.

Experiments are also being conducted to evaluate five application timings of Embark and Proxy + Primo for controlling seedheads on these grasses in spring. For mowing experiments, bermudagrass, seashore paspalum, and zoysiagrass maintenance was modified in the fall 2012 in one of four regimens including mowing at 0.25" 2 d wk^{-1}, 0.5" 2 d wk^{-1}, 1.5" weekly, or no mowing. All three species were mowed under these four programs until dormancy, and mowing resumed upon active growth in the spring of 2013. Beginning in January 2013 and 2014, seedhead cover of plots was visually measured weekly. For each rating date, growing-degree days (heating units) and photoperiod were determined to help provide relative emergence timing for seedheads on the three grasses, rather than calendar dates.

For PGR experiments, application timings of Embark or Proxy + Primo were made based on growing degree-days from a base temperature of 50° F on Jan. 1. Applications were made at 250, 500, 1000, 1500, 2000, or 2500 GDD on all three fields, and control, injury, and turf quality were rated weekly. The PGR timing experiments are being conducted on all three species maintained at a 0.5" height with a reel-mower.

Latest Research on Warm-season Turfgrass Diseases

Alfredo Martinez-Espinoza – Professor, Plant Pathology
The University of Georgia, Griffin Campus

ABSTRACT

Seashore paspalum is growing in use and popularity on golf course greens, fairways, sport fields and landscapes due to its tolerance to saline soils and water. Dollar spot caused by *Sclerotinia homoecarpa* is one of the major fungal diseases impacting turf quality of S. paspalum cultivars. There are few chemical options for dollar spot control of S. paspalum. The efficacy of several fungicides against *S. homoeocarpa* on S. paspalum was evaluated with the objective of developing chemical options of control. Boscalid (Emerald), Iprodione (26GT), propiconazole (Banner Maxx), propiconazole + azoxystrobin (Headway), triticonazole (Trinity), triticonazole + pyraclostrobin (Honor), and vinclozolin (Curalan) were evaluated and found to be efficacious against dollar spot in S. paspalum. Recent results indicate that chlorothalonil + acibenzolar (Daconil Action), fluazinam (Secure), fluxapyroxad (Xzemplar), and fluxapyroxad + pyraclostrobin (Lexicon Intrinsic) were also highly efficacious in controlling the disease. Results obtained in these investigations provide turfgrass managers with new disease management tools, improved disease control, and better turf quality. New research results for lawncare settings will be described as well.

INTRODUCTION

Seashore paspalum (*Paspalum vaginatum*) grass is increasingly used on golf course greens, fairways, sport fields and landscapes due to its ability to tolerate saline soils and water (Duncan and Carrow, 2000; Raymer et al., 2008). The grass has an intermediate to fine leaf texture, an attractive dark green color, good density, and good tolerance to low mowing. S. paspalum is considered to be the most salt tolerant, warm-season turfgrass species and also holds promise for reclamation and soil stabilization of unmanaged salt-affected sites (Duncan and Carrow, 2000). The University of Georgia S. paspalum breeding program is now recognized as a major contributor to the recent success of S. paspalum as a turfgrass species. Thus far, this program has released five cultivars: SeaIsle 1, SeaIsle 2000, Supreme, SeaStar and SeaSpray (Raymer et al., 2008). This relatively new turfgrass is best adapted to coastal areas of the tropics and sub-tropics but is now being commonly used in more inland areas. However, in these areas fungal diseases may be a significant problem. Dollar spot caused by *Sclerotinia homoecarpa* is one of the major fungal diseases impacting turf quality of S. paspalum cultivars (Allen et al., 2005; Smiley et al, 2005, Pinto-Perdomo and Martinez-Espinoza, 2011; Garcia-Aroca and Martinez-Espinoza, 2012) (see Fig 1). Chemical disease management options for dollar spot control of S. paspalum have not been well defined.

MATERIALS AND METHODS

The efficacy of several fungicides against *S. homoeocarpa* on S. paspalum was evaluated with the objective of developing chemical control options. Fungicide trials were conducted on a 10-year-old sward of S. paspalum cv. Seaisle 1 grown on a clay loam soil (pH 5.8) at the University of Georgia Griffin Campus in Griffin, Ga. Turfgrass cultural practices were similar to those prescribed for maintenance of fairways and/or sports field in Georgia. All treatments were arranged as plots (3 ft. x 4 ft.) in a randomized complete block design with four replications. Experimental plots were inoculated with a S. paspalum isolate of *S. homoeocarpa* grown on a oats/barley/wheat seed mixture, previously soaked in water overnight and then double sterilized in an Erlenmeyer flask. The plots received approximately 0.24 in. of irrigation water daily at 15:00 and 17:00 hr. to ensure foliar wetness for infection. Dollar spot infection centers was assessed at 7 to 14 day intervals. Data were subjected to statistical analysis.

Fig. 1. Dollar spot symptoms caused by Sclerotinia homoecarpa on Seashore paspalum.

RESULTS

Boscalid (Emerald), iprodione (26GT), propiconazole (Banner Maxx), propiconazole + azoxystrobin (Headway), triticonazole (Trinity), triticonazole + pyraclostrobin (Honor), and vinclozolin (Curalan) were found to be efficacious against dollar spot in S. paspalum. The results were corroborated over three years of trials. More recently, results indicate that chlorothalonil + acibenzolar (Daconil Action), fluazinam (Secure), fluxapyroxad (Xzemplar), and fluxapyroxad + pyraclostrobin (Lexicon Intrinsic) were also highly efficacious in controlling the disease. Results obtained in these investigations provide turfgrass managers with new disease management tools, improved disease control, and better turf quality

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Pinto-Perdomo and Martinez-Espinoza, A. D. 2012. Crecimiento, patogenicidad y manejo del hongo *sclerotinia homoeocarpa* en céspedes en el estado de Georgia, U.S.A. Honduras National Agricultural University. B. Sc. Thesis. Catacamas Honduras.

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Lunch and Lawn: Can You Have Grass and Eat Too?

Ellen Bauske – Program Coordinator, Center for Urban Agriculture
Clint Waltz – Professor, Crop and Soil Sciences
Robert Westerfield – Extension Senior Public Service Associate, Horticulture
The University of Georgia, Griffin Campus

ABSTRACT

In order to explore the possibility of using the same space for a fall vegetable garden and a warm-season summer lawn, Top Bunch Hybrid collards, Sweet Surprise cabbage, Kaboko cabbage, Pacman Hybrid broccoli (*Brassica sp.*) and Butter Crunch lettuce, (*Lactuca sativa*) were planted into a hybrid bermudagrass lawn in late September 2013. Strips and plots of varying sizes were cut into the lawn.

Lettuce, collards and cabbage were successfully produced in the 18 cm wide strip or row, 46 cm strip and the 46 x 91 cm plots. Lettuce, collards and cabbage were not successful in the 13 cm row or when directly planted into turfgrass. Broccoli produced edible florets in all treatments. At the first evaluation of the bermudagrass lawn made in mid-March 2014, the lawn covered 95 percent of the bare soil in the direct-planted strip and 40 percent of the bare soil in the 13 cm strip. By June, the lawn covered the 13 cm strip, but a furrow remained, creating a slightly uneven surface. The 18 cm strip was largely covered with turf by early June, but it was both uneven and unsightly. The 46 cm strip and 46 x 91 cm plots did not exceed 75 percent coverage by early June and were very uneven. Crabgrass was present in all but the direct-planted row.

INTRODUCTION

Enthusiasm for local food production and self-sufficiency, as well as concern over food safety, has generated increased interest in home vegetable gardens. However, many urban dwellers have small outdoor spaces and often lawns occupy the only full sun areas of the landscape.

Lawns can be replaced with food gardens. This approach has many supporters (Hadden, 2012 and Haeg, 2010). However, many people enjoy their lawns and the many physical and psychological benefits they provide (Bauske &Waltz, 2013 and Beard & Green, 1994).

If one can tolerate a slightly weedy lawn, several lawn weeds commonly found in Georgia can be eaten (Fern, 2000). These include wild garlic (*Allium oleraceum*), white clover (*Trifolium repens*), dandelions (*Taraxacum officinale*), yarrow (*Achillea millefolium*), lawn daisies (*Bellis perennis*), chicory (*Cichorium intybus*), cat's ear *(Hypochoeris radicata*), plantains (*Plantago sp.*) and coltsf*oot (Tussilago farfara*).

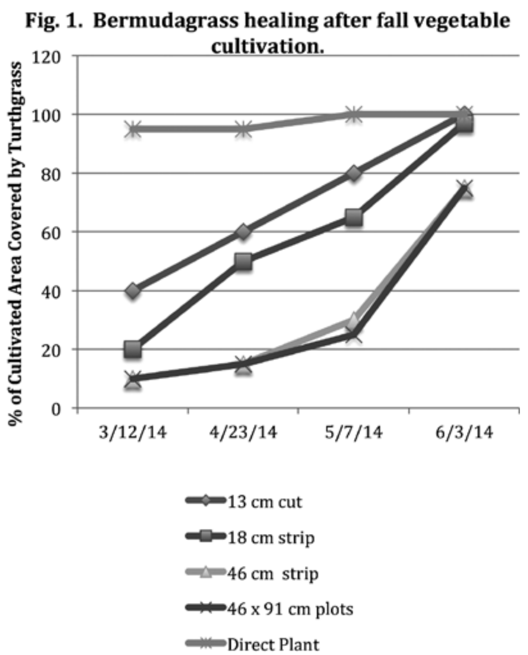
A third option may be possible. This demonstration explored the possibility of enjoying both a summer lawn and a winter vegetable garden. Double-cropping a warm-season lawn with winter vegetables was explored in an informal study on the UGA campus in Griffin, Ga. The objective of this project was to determine if fall vegetables could be grown in a dormant lawn producing both vegetables and a satisfactory summer lawn.

MATERIALS AND METHOD

In late September 2013, sod cutters were used to cut 12 m strips 13 cm, 18 cm, and 46 cm wide into a hybrid bermudagrass lawn. Four plants each of Top Bunch Hybrid collards, Sweet Surprise cabbage, Kaboko cabbage, Pacman Hybrid broccoli (*Brassica sp.*) and Butter Crunch lettuce, (*Lactuca sativa)* were planted into the strips (broccoli and cabbages, 60 cm apart; lettuce, 15 cm apart, and collards, 30 cm apart). Lettuce, collards and broccoli were also planted in 46 x 91 cm plots separated from each other by 60 cm. All cultivars were also planted directly into turfgrass (60 cm apart). Plants were fertilized with 10-10-10 individually at the rate of 50 g/m2 at planting and again at four weeks. Field observations were made through early December on general plant health and yield. Field observations of lawn recovery were made March through June 2014. Vegetables were treated with insecticidal soap as needed to control aphids. No herbicides were applied to the lawn in the spring.

RESULTS

The collard, cabbage and lettuce grown in the 13 cm strip and directly planted into the turfgrass did not thrive. Plants were visibly stunted and produced little harvestable yield. All four broccoli plants produced edible florets in the 13 cm strip and two produced edible florets in the direct planted row. Lettuce and collards did well in 18 and 46 cm strips and in the 46 x 91 cm plots and produced harvestable yield. Broccoli also preformed well in these treatments. Only three Kaboko cabbages were harvested in the study (one in the 13 cm strip and two in the 18 cm strip) and no Sweet Surprise cabbage were harvested as the growing season was not long enough for this cabbage.



In early March, vegetable remains were removed by hand as the collards became entangled in the mower blades. Pulling plants left holes created by the root balls in the strips and plots. Though the bermudagrass was largely dormant at the first evaluation made in mid-March, it had covered 95 percent of the bare soil in the direct-planted row and the 13 cm strip was 40 percent covered (Fig.1). By June the lawn covered the 13 cm strip, but a furrow remained, creating a slightly uneven surface. The 18 cm strip was largely covered with turf by early June, but it was both uneven and unsightly. The 18 cm strip and plots did not exceed 75 percent coverage by early June and were very uneven. Crabgrass was present in all but the direct-planted row.

Several observations were made in the course of this demonstration that will inform future studies. Clearly, caution must be exercised using chemicals on lawns and vegetables. All pesticides should be used only as recommended on labeled crops. The manual sod cutter used to create the 13 and 18 cm strips was designed for use on golf putting greens and was extremely difficult to push through the lawn in this study. As leaves fell from trees they lodged in the strips, creating natural mulch for the vegetables. Irrigation must be maintained on the lawn after the turfgrass is dormant and automated systems must be adjusted accordingly.

CONCLUSIONS

Though none of the cultivation techniques were entirely satisfactory, this demonstration suggests it may be possible to double-crop a lawn with winter vegetables and suggests several options for future study. Direct planting resulted in marginal vegetable production, but the lawn recovered the quickest. The other techniques were either too difficult to implement (13 cm and 18 cm strips) or resulted in unsightly and uneven summer turfgrass. Uneven turfgrass can be a safety hazard as people play, walk, and run across the lawn. Other techniques to prepare the lawn for fall vegetable gardening should be explored. Glyphosate may prove to be a useful tool for turfgrass preparation. The relative success of the broccoli also indicates that some vegetables may preform better than others in a lawn environment. The potential of other vegetables and turfgrass cultivars should be explored. Finally, the use of pre-emergence herbicides for spring crabgrass control should be considered.

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Latest Research on Turfgrass Insects

Kris Braman – Professor, Entomology, The University of Georgia, Griffin Campus
Will Hudson – Professor, Entomology, The University of Georgia, Athens Campus

Topics discussed will include mole cricket, grub and armyworm management.

Zoysia Resistance to Armyworms

Kris Braman – Professor, Entomology, The University of Georgia, Griffin Campus
Shaku Nair – Assistant in Extension, Community/Urban IPM (Team Coordinator)
University of Arizona, Arizona Pest Management Center, Maricopa Agricultural Center
Paul Raymer – Professor, Crop and Soil Sciences, The University of Georgia, Griffin Campus

ABSTRACT
Growth and developmental parameters of the fall armyworm were evaluated on 46 zoysiagrasses, which are an increasingly popular genus of warm-season turfgrass. Results from two growth chamber trials indicated high resistance of zoysiagrasses as evidenced by low larval and pupal weights and survival, and longer time to pupation and adult emergence. Taxa that consistently showed low larval survival were identified for further testing.

INTRODUCTION
Fall armyworms, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae: Lepidoptera), are important pests of turfgrasses. They often cause severe damage in late summer or fall after migrating populations have increased during the season. The caterpillars attack a wide range of plants, but feed preferentially on grasses. They feed above the ground and mostly consume foliage and tender stems. In severe cases, the grasses are cut at the ground level, leaving bare, circular patches.

Previous experiments have evaluated susceptibility of zoysiagrasses to various herbivores such as fall armyworms, tropical sod webworms, zoysiagrass mites, tawny mole crickets, chinch bugs, two-lined spittle bugs, etc. (Patton 2009). Information from these experiments supports and informs breeders in development of turfgrasses adapted to different stresses. Identification and utilization of turfgrasses with resistance to the major turfgrass pests is an important component of integrated pest management strategies in turf production.

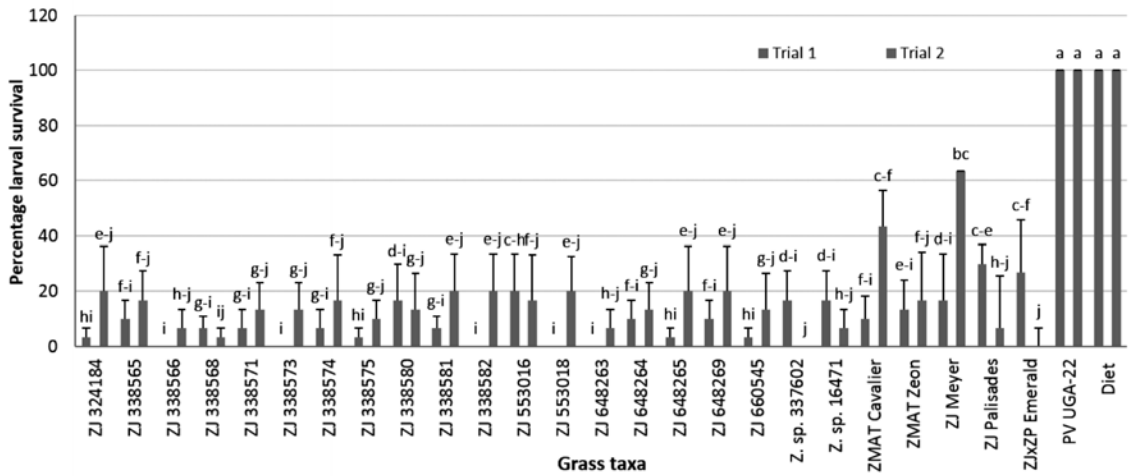
MATERIALS AND METHODS
Plant material. Forty-six zoysiagrass taxa were used for the experiments. These included 41 new and five commercially available zoysiagrass taxa. The susceptible *Paspalum* taxon (P. vaginatum 'UGA-22') (Braman et al. 2013) and artificial insect diet (Benzon Research, Carlisle, PA) were used as positive controls.

Insects. Fall armyworm eggs were obtained from a commercial supplier (Benzon Research, Carlisle, PA) and were held at 27°C until eclosion.

Two separate growth-chamber trials were conducted, each with 48 treatments and 30 larvae per treatment (6 replications, with 5 larvae per replication). Trays containing the cups were randomly stacked within an environmental chamber maintained at constant temperature (24o C) and photoperiod (15:9 Light hours:Dark hours). The larvae were provided daily with fresh grass clippings, till all larvae had pupated or died. Observations recorded included larval weight at 8 d and 15 d, pupal weight, days to pupal stage and adult emergence.

RESULTS
Twenty new zoysiagrasses consistently showed 20 percent or lesser larval survival percentage over both trials and these were Z. *japonica* 324184, Z. *japonica*338565, Z. *japonica* 338566, Z. *japonica* 338568, Z. *japonica* 338571, Z. *japonica* 338573, Z. *japonica* 338574, Z. *japonica* 338575, Z. *japonica* 338580, Z. *japonica* 338581, Z. *japonica* 338582, Z. *japonica* 553016, Z. *japonica* 553018, Z. *japonica* 648263, Z. *japonica* 648264, Z. *japonica* 648265, Z. *japonica* 648269, Z. *japonica* 660545, Z. sp. 337602 and Z. sp. 16471 (Fig. 1).

Fig. 1 New zoysiagrasses showing 20% or lesser larval survival at 8d, in comparison with commercially available *Zoysia* taxa and controls.



New Z. *matrella* (231146, 264343), Z. *macrostachya* (553020) and Z. *sinica* (553019) taxa seemed more favorable for larval growth and development than the Z. *japonica* taxa, as evidencedby numerically higher larval and pupal weights and survival, shorter duration to pupation and adult emergence.

CONCLUSIONS

- Z. *japonica* taxa were unfavorable for development of fall armyworm larvae in general.
- New Z. *matrella*, Z. *macrostachya* and Z. *sinica* taxa seemed more favorable as evidenced by growth and developmental parameters.
- Responses to commercially available zoysiagrasses were consistent with earlier studies (Braman et al. 2000, Reinert and Engelke 2010).
- Further studies on whole plants in greenhouse and field are required.
- Mechanisms of resistance to herbivory in zoysiagrasses should be further investigated. Earlier studies have shown that lignin concentration and leaf tensile strength in Cavalier and Emerald were positively correlated with host resistance (Hale et al. 2009).
- Cultivars providing multiple pest resistance should be identified and popularized for extensive use in new and restored landscapes.

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ACKNOWLEDGEMENTS

We gratefully acknowledge the technical support provided by Jim Quick.

Herbicide Resistant Systems for Turfgrasses

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ABSTRACT

Herbicide resistance has been a sought-after trait to improve weed control options in turfgrasses. However, attempts to commercialize genetically modified (GM) turfgrasses have been unsuccessful. Sethoxydim is a grass-specific herbicide in the ACCase family. Naturally occurring resistance to sethoxydim and other ACCase herbicides has been reported in several grass species as a result of single base-pair mutations. Research was initiated to develop a novel source of resistance to sethoxydim in seashore paspalum (Paspalum vaginatum, Swartz). In vitro selection and regeneration using tissue culture were used to select for naturally occurring mutations conferring herbicide resistance. Callus was induced from immature inflorescences then plated on callus induction medium containing 10 µM sethoxydim for selection. Green plants were regenerated from resistant callus, the Ile to Leu mutation known to confer sethoxydim resistance was documented, and expression of herbicide resistance confirmed. New sethoxydim resistant seashore paspalum experimental lines are now under field evaluation to determine their potential as a new tool to manage bermudagrass and other problematic grasses in seashore paspalum turf.

INTRODUCTION

Herbicide resistance is a trait that has been actively pursued for many crops to improve the efficiency of weed control and as a means to control problematic weeds. Arguably the most notable herbicide resistant systems are the Roundup Ready® (RR) products. Although, a glyphosate-resistant creeping bentgrass (*Agrostis stolonifera* L.) has been developed, the commercial deployment of RR in turfgrasses has yet to occur. Development of turfgrass with transgenically derived herbicide resistance traits to such as glyphosate or glufosinate face steep regulatory concerns before they can be released. In contrast, environmental releases of plants with herbicide resistance obtained by non-transgenic means are not subject to government regulation. Thus, in vitro selection for herbicide resistance is an attractive alternative technology to transformation and greatly improves the potential for both domestic and international commercialization of herbicide-resistant turfgrass cultivars.

Seashore paspalum (*Paspalum vaginatum*, Swartz) is a warm-season turfgrass adapted to coastal environments. This species is generally adapted to the same regions of the world as bermudagrass (*Cynodon dactylon* (L.) Pers.) and has numerous morphological characteristics that make it desirable as a turfgrass. Interest in the use of seashore paspalum as a turfgrass is largely related to its tolerance to salt and other abiotic stresses (Duncan and Carrow, 2000). Golf course architects recommend seashore paspalum for new courses in tropical or sub-tropical coastal areas where salt or water quality are issues. Many existing golf courses around the world have replaced bermudagrass with paspalum (Raymer et al., 2008).

The main difficulty in replacing bermudagrass with paspalum is bermudagrass re-establishment. Bermudagrass is highly competitive and difficult to eradicate once established. Invasion by bermudagrass and other weedy grasses can greatly reduce the aesthetic value and quality of paspalum turf. Currently there are no herbicides available that selectively control bermudagrass in seashore paspalum. Development of herbicide-resistant paspalum could provide an effective means of managing bermudagrass in paspalum and allow golf course and sporting venues to transition from bermudagrass to seashore paspalum.

Sethoxydim is a grass-specific herbicide. Resistance in other grass species has been reported as a result of one of two possible single base-pair mutations. The most common mutation is an Ile to Leu substitution caused by an A to T mutation at positioned aa position 1781 of acetyl coenzyme A carboxylase. The objective of this research was to develop, identify, characterize and evaluate the commercial potential of a seashore paspalum mutant genotype conferring high levels of resistance to sethoxydim and other ACCase herbicides.

MATERIALS AND METHODS

Research was initiated to develop a novel source of resistance to sethoxydim in seashore paspalum using *in vitro* selection and regeneration protocols to select for naturally occurring mutations conferring herbicide resistance (Heckart et al., 2010). A dose response experiment was performed to determine the optimum sethoxydim concentration for selection (data not shown). Callus was induced from immature inflorescences then plated on callus induction medium containing 10 µM sethoxydim for selection. Green plants were regenerated from resistant callus, the Ile to Leu mutation documented, and expression of herbicide resistance confirmed using a series of greenhouse dose response studies. Levels of cross resistance to other ACCase inhibiting herbicides registered for use on turfgrass were determined for the 1781 mutant.

The most vigorous herbicide resistance line SR 31.15 was selected for replicated field trials initiated in 2012 and 2013 under high levels of bermudagrass pressure. Genotypes evaluated included SR31.15 (resistant mutant), SeaSpray (susceptible), and a sethoxydim tolerant line SRSSPRY3 developed in a related project. Each line was evaluated for tolerance to the ACCase herbicides sethoxydim, clethodim, and fenoxyprop at monthly 1X and 3X application rates. Data was collected on bermudagrass control and paspalum injury following the monthly herbicide applications.

A third field experiment was initiated in 2014 with second generation sethoxydim resistant breeding lines obtained through embryo rescue in 2013. Six lines all containing the 1781 mutation conferring ACCase resistance were planted in a similar study to the field studies initiated in 2012 and 2013. Lines tested included the sethoxydim resistant lines SR 31.15-1, -4, -5, -7, -14, and -15; and susceptible controls UGA 1743 and Mauna Key. Herbicides, herbicide rates tested, and data collected were as described above in earlier field experiments.

RESULTS

The effects of sethoxydim rate on injury ratings at 21 days after treatment (DAT) are shown in Fig. 1. The newly developed SR 11 mutant line with the 1781 mutation expressed high levels of resistance (less than 6 percent injury) to sethoxydim even at rates as high as 3200 grams a.i. ha^{-1}, a rate 15 times the labeled rate for centipedegrass. In contrast, the parental line, Mauna Kea had injury scores of >50% at rates of 200 g a.i. ha^{-1} or higher.

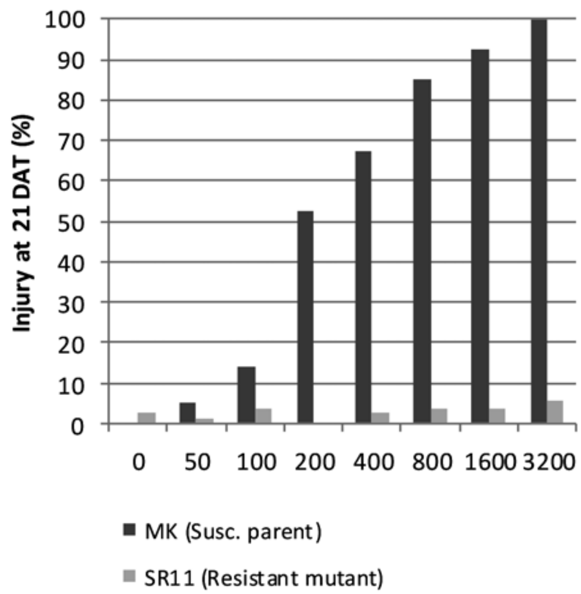

Figure 1. Whole-plant response of resistant SR11 mutant line and MK susceptible parent to a broad range of sethoxydim rates.

Cross resistance dose response studies indicated that the mutant line SR11 showed significantly less injury than the susceptible PT and TCC controls at all fenoxaprop and fluazifop rates above 50 g a.i. ha^{-1} (Table 1). SR11 was also more tolerant to clethodim than the susceptible checks but only at rates up to 200 g a.i. ha^{-1}.

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Herbicide Resistant Systems for Turfgrasses, *continued*

Table 1. Response of parental type (PT), tissue culture control (TCC), and sethoxydim resistant (SR11) to other ACCase inhibiting herbicides.

	Plant Injury 21 DAT‡								
Herbicide	Clethodim (Envoy)			Fenxoxyprop (Acclaim)			Fluazifop (Fusilade)		
Rate†	PT	TCC	SR11	PT	TCC	SR11	PT	TCC	SR11
	%								
0	13.8a§	2.5a	6.2a	8.8a	16.2a	11.2a	12.5b	35.0a	6.2b
50	85.0a	70.0a	22.5a	47.5a	60.0a	10.0b	63.8a	53.8a	10.0b
100	60.0ab	67.0a	42.0b	68.8a	70.0a	8.8b	76.2a	66.2a	12.5b
200	56.3a	52.5a	25.0b	82.5a	91.2a	10.0b	58.8a	70.0a	12.5b
400	85.0a	75.0a	80.0a	92.5a	96.2a	13.8b	83.8a	86.2a	20.0b
800	100.0a	95.8a	100.0a	93.8a	98.8a	12.5b	97.5a	95.0a	50.0b
1600	100.0a	100.0a	100.0a	98.8a	100.0a	8.8b	100.0a	100.0a	40.0b

† Grams a.i. ha^{-1}
‡ DAT = days after treatment.
§ Means on the same row (herbicide rate) and within a herbicide group (i.e. Clethodim) followed by the same letter are not considered to be significantly different at 0.05 according to a protected LSD.

Field studies initiated in 2012 and 2013 indicate that several of the herbicide treatments tested were effective in controlling bermudagrass. Monthly applications of 1X and 3X the recommended rates of fenoxaprop and 3X rates of sethoxydim and clethodim all provided effective control of bermudagrass in test plots. However, the first generation herbicide lines tested lacked vigor and did not perform well enough to be considered for commercial release.
Second generation herbicide resistant lines under evaluation in the 2014 field trial offer renewed promise for development of a non-genetically modified herbicide resistance system for turfgrass.

CONCLUSIONS

A novel form of herbicide resistance in seashore paspalum was developed using tissue culture to select for a naturally occurring mutation known to confer high levels of herbicide resistance to sethoxydim with cross resistance to other ACCase herbicides. This novel germplasm offers great hope for the development of a non-genetically modified herbicide resistance system to provide the ability to manage bermudagrass and other problematic grassy weeds in seashore paspalum.

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Bermudagrass Breeding at UGA

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ABSTRACT

DT-1 is a stress tolerance bermudagrass that has been under development for over 20 years. It has consistently performed better than all tested cultivars when grown in short-term and long-term droughty environments. Research to-date indicates that DT-1's drought tolerance is a result of decreased water use rather than deeper rooting or dormancy survival mechanisms. When grown in non-stressed environments with regular mowing, its turfgrass quality is typically very similar to other varieties, although it tends to have a lighter green leaf color. DT-1 has exhibited superior traffic and wear tolerance in several research studies and on real-world demonstration sites. DT-1 has been submitted to the University of Georgia's Plant Variety Review Board for consideration of release and should be commercially available in the upcoming future.

INTRODUCTION

More effort has been devoted to the improvement of bermudagrass than any other warm-season turfgrass. Extensive research and study of bermudagrass has led to the development of many of the techniques and methods that have been adopted as the model for improving other species through breeding. The vast genetic variation within bermudagrass warrants further breeding and selection to overcome weaknesses that still exist, regardless of gains that have been made in the past. Work should continue to reduce the maintenance requirements of turfgrasses in the future by increasing rooting potential and drought tolerance under less management, extending the northern zone of adaptation, and minimizing the need for pesticide application by enhancing nematode, insect, and disease resistances.

MATERIALS AND METHODS

In 1992, seven *C. transvaalensis* parents were crossed with four C. dactylon parents in Tifton, Ga. In May of 1993, over 27,700 progeny from the cross combinations were planted on 46 cm (18 in) centers in the field. Once established, plots were mowed 3× per week at 6.4 mm (¼ in). By the fall of 1994, 421 hybrids that maintained density under close mowing were selected and further evaluated in replicated tests until 1996. Ninety of these hybrids were selected based on turfgrass performance and planted on 30.5 cm (12 in) centers under a rainout shelter in 1999 and evaluated until 2001 under deficit irrigation. DT-1 was selected during 2001 because it maintained quality and green color longer than the other genotypes when under drought stress. DT-1 has since been further tested in 19 drought-stress trials, two traffic-stress trials, and four irrigated, non-stress trials. These replicated field tests were carried out in Georgia, Florida, North Carolina, Oklahoma, and Texas. DT-1 was entered into the 2013 National Turfgrass Evaluation Program (NTEP) trials where it will be evaluated in 20 locations across the United States until 2017.

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RESULTS

Figure 1: Celebration and DT-1 bermudagrasses after sustained droughty conditions in the Linear Gradient Irrigation System (LGIS) evaluation during 2011 at the WFREC in Jay, Fl.

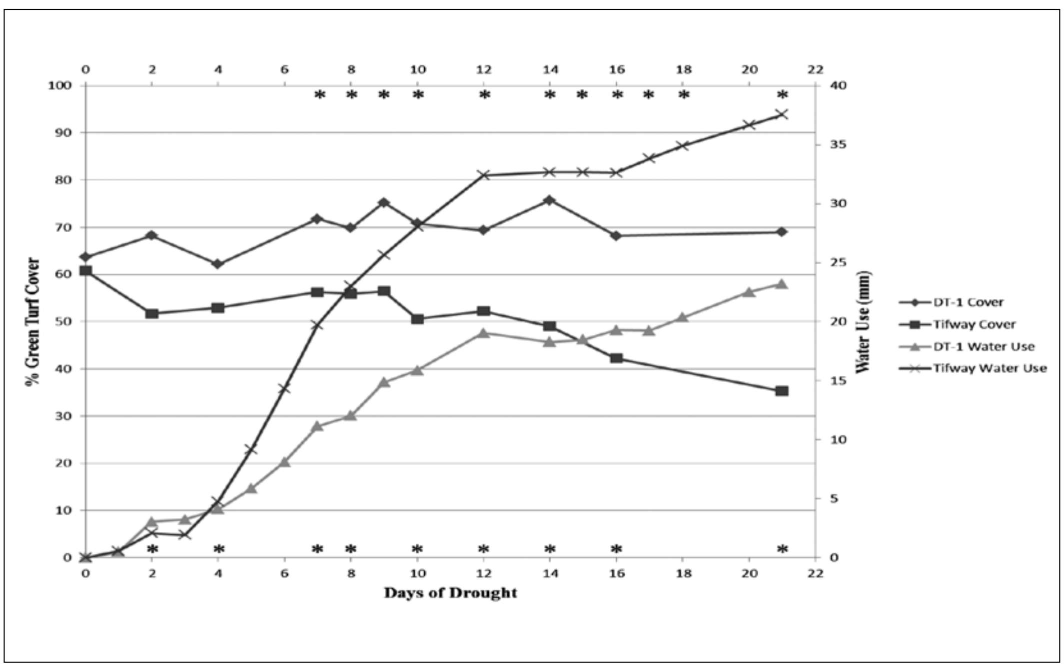

Figure 2: Water-use and green-cover of DT-1 vs. Tifway in a drought trial during 2011 in Griffin, Ga.

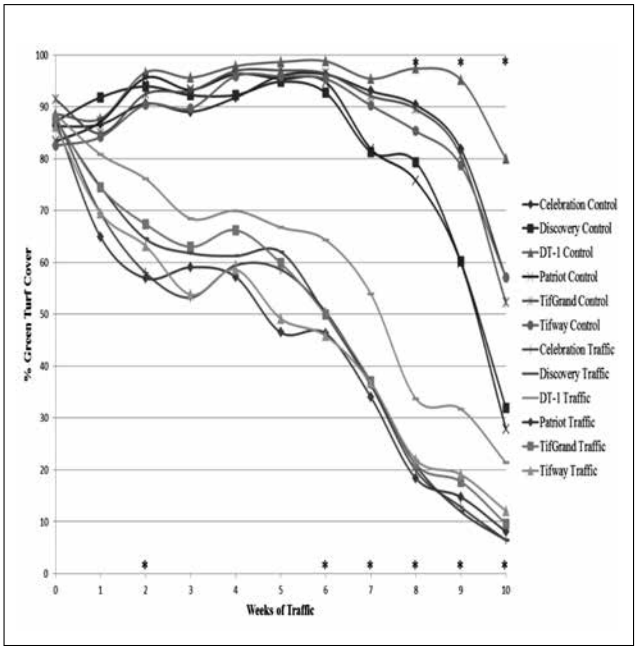

Figure 3: Wear resistance of DT-1 vs. other cultivars in traffic trials during 2012 and 2013 in Tifton, Ga.

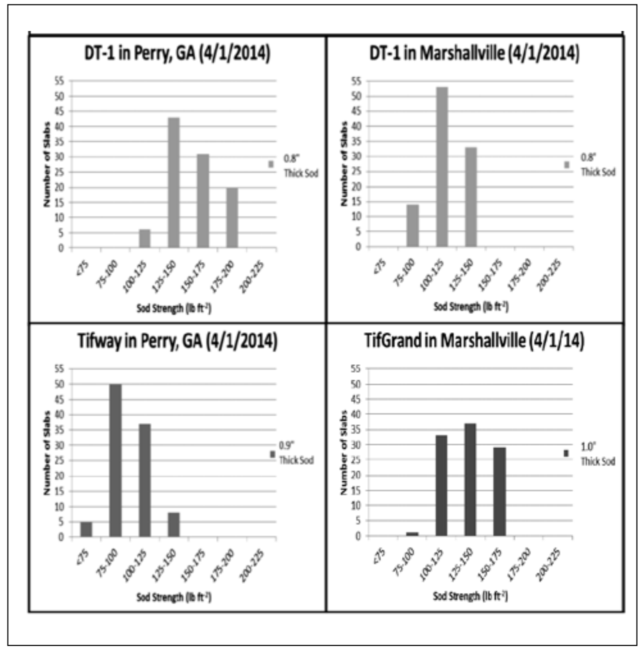

Figure 4: Sod ensile strength of DT-1 vs. other cultivars from on-farm production trials in Perry and Marshallville during the spring of 2014.

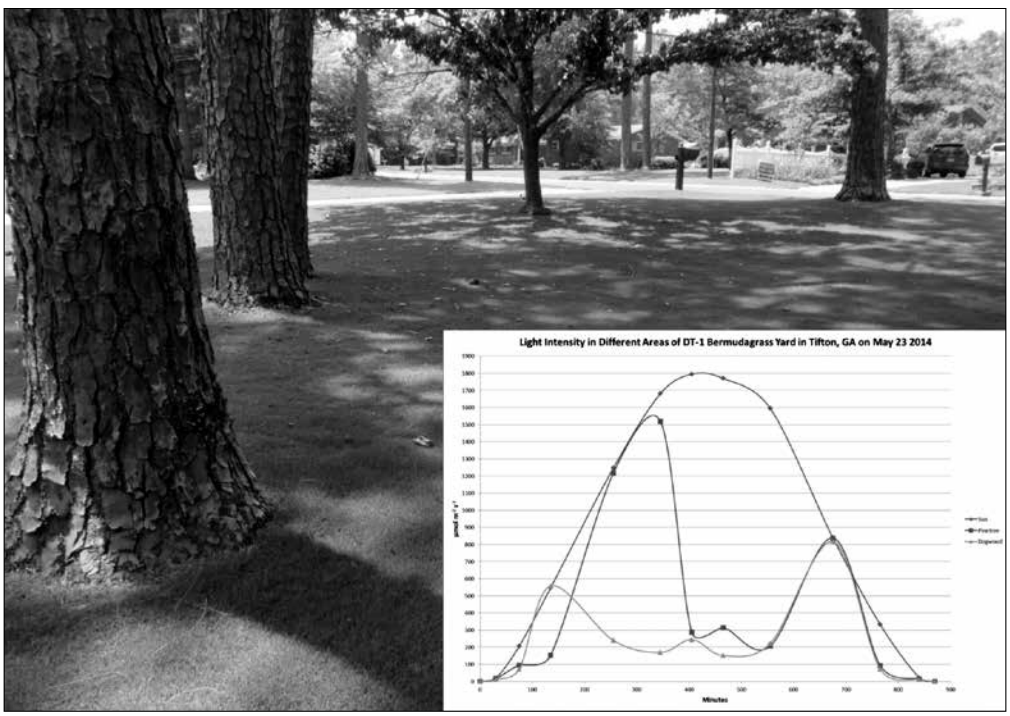

Figure 5: DT-1 bermudagrass mowed at 2.5" in an unirrigated lawn during 2014 in Tifton, Ga. Lawn planted from sprigs during 2012.

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Bermudagrass Breeding at UGA, *continued*

CONCLUSIONS

- DT-1 generally has superior turfgrass performance than many other cultivars (Tifway, Tifton 10, TifSport, Princess-77, Common, Celebration, and Latitude 36) when in short- and long-term drought environments.
- Research to date indicates that the mechanism of DT-1's drought tolerance may be reduced water use, particularly in soils with higher silt and clay content.
- DT-1 has at least equal turfgrass performance, if not superior, to many other cultivars (Tifway, TifSport, TifGrand, Patriot, Celebration, Latitude 36, and Discovery) when well-maintained with regards to irrigation, fertilization, and mowing frequency.
- DT-1 generally has superior traffic tolerance than many other cultivars (Tifway, TifSport, TifGrand, Patriot, Celebration, and Discovery) when subjected to wear.
- The mechanism of DT-1's traffic tolerance may be increased turf cover, particularly in the fall and faster growth.
- DT-1's sod strength is generally superior to that of Tifway, and at least equal to that of TifGrand.

ACKNOWLEDGEMENTS

We gratefully acknowledge the research input from Dr. Paul Raymer, Dr. Alec Kowalewski, Dr. Bryan Unruh, and Dr. Clint Waltz as well as the technical support provided by Larry Baldree, Amanda Webb, John Schaffner and Leanna Leach.

Zoysiagrass Establishment Timing

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ABSTRACT

Zoysiagrass is a warm-season species typically associated with high quality turf. Its popularity has increased the last 20 years due to its aesthetic qualities, persistence under limited light conditions, cold hardiness, and need for fewer inputs (e.g. fertilizer). Most cultivars of zoysiagrass are propagated by vegetative means (e.g. sod, plugs, or sprigs) but seeding is an establishment option for some zoysiagrasses. Establishment rate can be an issue as the species can be slow, taking in excess of a year to provide acceptable surface coverage. Conventionally seeding has been recommended once soil temperatures at the 4-inch depth reach 65°F, leaving four to five months for germination and growth before environmental conditions change, signaling fall dormancy. Seeding zoysiagrass in the fall and early winter provided an acceptable surface coverage earlier the following growing season. This research may change zoysiagrass seeding recommendations.

INTRODUCTION

Establishing an acceptable surface coverage of zoysiagrass via seed within a typical growing season (i.e. May to October) in Georgia is difficult. Studies at more northern locations (e.g. Arkansas, Illinois, and Virginia) have indicated seeding of zoysiagrass as early as February has resulted in earlier surface coverage. Since Georgia, and the Southeastern U.S., have warmer winter temperatures, investigation into the potential of earlier seeding with success of single season establishment have establishment implications for homeowners, commercial sites, and departments of transportation. The objectives of this research were to determine if seeding zoysiagrass during "off-seasons" can help improve rate of establishment in warm, humid climates and if compost seed coverage enhances establishment.

MATERIALS AND METHODS

This study will be conducted as a field study on the UGA Griffin Campus. The plot area is a fumigated native soil. The study will be a randomized, strip-plot, block design with whole plots being seeding timing and sub-plots being compost coverage. Seeding timings will be monthly, approximately mid-month, for 12 months (i.e. October 2012 to October 2013). Compost coverage will be no compost and compost applied to the soil surface. Whole plots will be 4' × 16' with sub-plots 4' × 8.' There will be a total of 24 treatments replicated four times.

With the exception of the initial seeding, the entire plot area will be seeded with annual ryegrass (*Lolium multiflorum*) to serve as a surface cover, prevent soil loss, and maintain surface uniformity. At the initial seeding (i.e. October 2012), 'Zenith' zoysiagrass will be seeded into bare soil. Within two weeks of seeding treatments / whole plots the ryegrass will be treated with a nonselective herbicide (e.g. glyphosate), mowed to 0.5-inch, and debris removed. Zoysiagrass will be seeded to whole plots at 1.0 lb / 1,000 ft^2, covered with compost, and irrigated once daily for the first week following seeding. Soil3 will be applied to sub-plots at 100 lbs / 1,000 ft^2.

Plots will be maintained similar to UGA recommendations for a zoysiagrass home lawn. Grass will be mowed once weekly using a rotary mower at 1.5-inches with clippings returned. Fertility will include four fertilizer applications at 0.5-lb N / 1,000 ft^2 in May, June, July, and August. A 50 percent slow release nitrogen product with an analysis of 16-4-8 will be used across the entire plot area at each application. As to not inhibit seed germination or stolon establishment, no preemergence herbicide will be applied during this study. All weed control will be postemergence.

Zoysiagrass Establishment Timing, *continued*

Data collection will commence one month after the initial seeding and include visual estimates of germination (0 to 100 percent), zoysiagrass surface coverage (0 to 100 percent), and turfgrass quality and color (1 to 9, NTEP scale). Evaluations will continue through October 2014, one year after seeding the last whole plot.

RESULTS

For this trial the addition of compost at time of seeding did not improve rate to establishment (data not shown). The rate (i.e. 100 lbs / 1,000 ft^2) may have been too low or negated by the high rainfall that occurred from February through September 2013. Because of the promising results associated with seeding date, this study was repeated starting in October 2013. The compost rate was increased to further explore its impact on enhancing seedling establishment.

Plots seeded in October and November of 2012 achieved 75 percent surface cover by July 2013 (Table 1). Similarly, seeding date of December, January, February, March, and April achieved 75 percent cover by August 2013. For nine of the seeding dates, the total time to achieve surface cover (≥75%) for seeded zoysiagrass ranged from 3 to 9 months. Grass seeded in July, August, and September may exceed 12 months to establish.

Grass seeded in October or November can be established by mid-summer the following year (e.g. 8 to 9 months later). Fall 2012 and winter 2013 were relatively mild to warm. This trial was repeated in October 2013 to confirm these results. If observed again these results may provide new seeding options for Georgia landscapes.

ACKNOWLEDGEMENTS

Patten Seed

Month of Seeding	Surface Cover (%) July 2013	August 2013	September 2013	July 2014
January	49 c	78 c	100 a	100 a
February	41 d	77 c	98 ab	100 a
March	39 de	78 c	97 abc	100 a
April	37 e	78 c	95 bc	100 a
May	28 f	72 d	94 c	100 a
June	17 g	66 e	94 c	100 a
July		24 f	38 d	73 b
August			6 e	33 c
September				36 c
October	78 a	99 a	100 a	100 a
November	77 a	98 ab	100 a	100 a
December	67 b	96 b	100 a	100 a
C.V.	3.1	3.0	3.4	9.7

Highlighted means indicate rating date plots reached 75% surface coverage.
The first seeding date was October 2012, then monthly through September 2013.
Means with the same letter are not significantly different.

Table 1. Surface coverage of zoysiagrass seeded monthly throughout the year.

NOTES

Heat and Drought Tolerant Bentgrass

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Department of Plant Biology and Pathology, Rutgers University

ABSTRACT

Creeping bentgrass is considered the premiere turfgrass for use on putting greens. However, here in Georgia, heat and drought stress make it difficult to maintain during the summer months. The traditional breeding progress for heat and drought tolerance in bentgrass is limited largely due to lack of superior stress-tolerant grass germplasm and because of poor understanding of physiological and molecular mechanisms for perennial grass tolerance to drought. Recently, turf scientists at Rutgers University have made progress in identifying important genes controlling heat tolerance and developing markers that may prove useful in selection of cultivars with improved stress tolerance. A bentgrass field trial evaluating 144 diverse lines for heat and drought tolerance was established in 2013 in collaboration with Rutgers scientists. Data from field evaluations will used to validate new genetic markers and determine their usefulness in breeding for improved heat and drought tolerance.

INTRODUCTION

Creeping bentgrass is one of the most widely used species on putting greens and fairways, but heat and drought stress often limit its growth and cause quality decline, particularly in warm climatic regions during summer months. Much of the genetic improvement of turfgrass, including creeping bentgrass, has been achieved through conventional breeding techniques. Breeding efforts in recent years have led to the development of genotypes with improved stress tolerance. However, the traditional breeding progress is limited largely due to lack of superior stress-tolerant grass germplasm and because of poor understanding of physiological and molecular mechanisms for perennial grass tolerance to drought stress (Bonos and Huang, 2004). To increase the probability and efficiency of obtaining superior new cultivars, it would be advantageous to identify candidate genes controlling desirable traits in turfgrass, such as stress tolerance. By identifying important genes that control heat tolerance and developing markers to assist in selection, cultivars with improved stress tolerance could be developed more efficiently.

The development of polymerase chain reaction (PCR) based marker systems has enabled automated high-throughput genotyping to be applied to practical plant breeding. The most common PCR-based markers are SSR (simple sequence repeat) and SNP (single nucleotide polymorphism) markers. Currently, SSRs have the broadest application among all major marker systems available for plants, and the SNPs are by far the most abundant source of DNA polymorphism (Collins et al., 1998). Stress tolerance traits are known as quantitative or polygenic traits. Molecular markers linked to quantitative traits that have been localized to a chromosome are called a quantitative trait locus (QTL). We have identified PCR-based molecular markers using QTL analysis and candidate gene-based markers in two previously USGA-funded projects. Breeding selection by using the combined QTL markers and candidate-gene markers will reduce the generations required to selection superior germplasm for crosses and cultivar development and space required for evaluation of segregating progeny and for developing new cultivars.

The objectives of this project are to 1) validate SSR markers linked to heat/drought tolerance QTLs and gene-based markers in a bentgrass breeding population with a wide range of variation in drought and heat tolerance in two different environments or locations; 2) determine the stability of known QTLs over a range of test cross parents and environments; 3) assess physiological traits (phenotypes) linked to these molecular markers in drought and heat tolerance; and 4) identify and characterize ideal phenotypes of newly developed drought and heat tolerant lines using verified markers to facilitate MAS in creeping bentgrass breeding programs.

The overall goal of the current project is to enhance the evaluation, genetic characterization, and efficient use of recently developed new creeping bentgrass germplasm using available QTL and gene-based markers. Our ultimate goal is to provide useful markers to plant breeders to develop new cultivars of creeping bentgrass that are superior to the "best" existing cultivars using marker-assisted selection.

MATERIALS AND METHODS

The UGA Griffin Campus is one of two test locations for the field evaluation of six known QTLs for heat and drought tolerance for their expression and stability in newly developed stress-tolerant lines. The Griffin Campus location is under three fully automated mobile shelters (20' x 40') powered by an electric motor and set on rails. The shelter automatically moves over the plot area when rain begins to fall and returns back to its original position when rain stops.

A total of 144 diverse lines of creeping bentgrass are being evaluated at Rutgers and here in Griffin as part of an association mapping population. Lines were derived from adapted stress tolerant germplasm, older commercially available cultivars (such as Penncross, L93, etc.) and European collections. The effects of different genetic backgrounds and genetic contributions on overall phenotype and agronomic performance versus heat/drought tolerance will be assessed in these field experiments.

Plants were established in the spring of 2013 in replicated mowed spaced-plant evaluation trials in rainout shelters. The 144 individuals were clonally replicated and arranged in a randomized complete block design with three replications. Stress evaluations for performance under heat and drought conditions are to be conducted 2014-2015. During summer months (July, August, September) all plants will be maintained under well-watered conditions and will be analyzed for variation and phenotypic traits for heat tolerance. The plants will be exposed to drought stress by withholding irrigation during the months of October and November for the evaluation of drought performance and then re-watered throughout the winter months to evaluate recuperative potential or drought survival ability.

RESULTS

Spring is not the optimal time to establish bentgrass in Georgia and young plants were quickly stressed even during our unusually cool and wet summer. Mean survival ratings were taken on Aug. 22, 2013. Survival of 144 bentgrass genotypes ranged from 2.6 percent to 100 percent and the overall average survival was 57.3 percent. The top performing standard cultivars were 'Declaration' and 'Luminary' with 72.6 percent survival. Forty experimental bentgrass lines (27 percent) of the entries performed better than the top performing standard cultivars.

Plants that did not survive the summer of 2013 were replanted last winter. Evaluations for heat tolerance will resume this summer and will be followed by evaluation for drought tolerance during the fall.

Latest Research on Cool-season Turfgrass Diseases

Alfredo Martinez-Espinoza — Professor, Plant Pathology
The University of Georgia, Griffin Campus

ABSTRACT

Creeping bentgrass is one of the most popular grasses and 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 *Sclerotinia homoeocarpa*, *Rhizoctonia solani*, or *Colletorichum cereale*; therefore control depends on the use of fungicides. Rotation of several chemical groups including aluminum-tris (Signature), azoxystrobin (Heritage), azoxystrobin + difenconazole) (Briskway), chlorothalonil + acibenzolar (Daconil Action), chlorothalonil (Daconil weather stik), iprodione (26GT), iprodione + trifloxystrobin (Interface), mefenoxam (Subdue Maxx), polyoxin D (Affirm), potassium phosphite (Appear), pyraclostrobin (Insignia), pyraclostrobin + boscalid (Honor), propamocarb (Banol), thiophanate methyl + chlorothalonil (Spectro), tebuconazole (Torque), triticonazole (Trinity), distributed in four fungicide-programs provided significant (α<0.05) disease (dollar spot, brown patch, anthracnose and Pythium) control compared to the non-treated check. Turf quality inversely correlated to disease severity. New research results for lawncare settings 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 (Stier, et al, 2013; Turgeon, 2006, Beard, 2002). The optimum growth temperature range for this cool-season grass is 15 to 24°C for shoots and 10 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 *Sclerotinia homoeocarpa*, *Rhizoctonia solani*, or *Colletorichum cereale* the causal organisms of dollar spot, brown patch and anthracnose (Martinez et al., 2013). The pathogen incites crown and foliar blight that results in necrotic leaves, which form patches of up to 1m in diameter in turfgrass swards. Symptoms are more severe when nighttime temperatures are above 16°C, which coincides with 10 h of leaf wetness. There are no bentgrass biotypes with reported durable resistance to *Sclerotinia homoeocarpa*, *Rhizoctonia solani*, or *Colletorichum cereale*; therefore control depends on the use of fungicides (Smiley et al., 2005, Stier, et al., 2013, Martinez et al., 2013).

MATERIALS AND METHODS

The fungicide trials were conducted on a 20-yr-old sward of creeping bentgrass cv. Penncross grown on a sand/peat root zone (pH 6.2) at the University of Georgia Griffin Campus in 2013. Fertilizer treatments consisted of 1.0 lb and 0.5 lb nitrogen (Lesco 24-4-10) per 1,000 sq ft applied on April 11 and Sept. 26 respectively. Miracle Grow was applied twice a month at a rate of 1/10 lb foliar N ("spoon feeding"). The turfgrass was maintained at a height of 0.2-in. by mowing three times per week. Treatments were arranged as plots (3 ft × 4 ft) in a randomized complete block design with four replications. Fungicides were applied using 2.5 gal of water per 1,000 sq ft with a hand-held, CO2-pressured boom sprayer at 30 psi using XR TeeJet 8002VS nozzles. While heavy, natural infections of dollar spot, anthracnose, brown patch, and Pythium are common on this particular bentgrass green, experimental plots were inoculated separately with autoclaved oats/barley/wheat seed mixtures infested with a bentgrass isolate of *Sclerotinia homoeocarpa* and *Rhizoctonia solani*. The plots received approximately 0.24 in. of irrigation water daily at 15:00 and 17:00 hr to ensure foliar wetness for infection. Visual ratings were performed at 7- to 14-day intervals from the initial application date. For disease incidence and severity (dollar spot, brown patch and Anthracnose) visual estimates were made either counting infection centers (dollar spot) or using a modified Horsfall-Barratt rating scale (brown patch and/or anthracnose). Turf quality was estimated in percent. Values were subjected to analysis of variance and means were statistically separated using Fisher's protected LDS at α=0.05.

RESULTS

Disease pressure started slow, with incidences of dollar spot in late spring/early summer. An early and heavy incidence of anthracnose was also noticed. Severity of brown patch was high and prolonged. Pythium infections were present throughout the duration of the trials. Disease pressure started slow, with incidences of dollar spot in late spring/early summer. An early and heavy incidence of anthracnose was also noticed. Severity of brown patch was high and prolonged. Pythium infections were present throughout the duration of the trial. Throughout the study, rotation of several chemical groups including aluminum-tris (Signature), azoxystrobin (Heritage), azoxystrobin + difenconazole) (Briskway), chlorothalonil + acibenzolar (Daconil Action), chlorothalonil (Daconil weather stik), iprodione (26GT), iprodione + trifloxystrobin (Interface), mefenoxam (Subdue Maxx), polyoxin D (Affirm), potassium phosphite (Appear), pyraclostrobin (Insignia), pyraclostrobin + boscalid (Honor), propamocarb (Banol), thiophanate methyl + chlorothalonil (Spectro), tebuconazole (Torque), triticonazole (Trinity), distributed in four fungicide-programs provided significant (α<0.05) disease (dollar spot, brown patch, anthracnose and Pythium) control compared to the non-treated check. Turf quality inversely correlated to disease severity. No phytotoxicity was observed in any of the products in any of the programs. Results obtained in these investigations provide turfgrass managers with new disease management tools, improved disease control, and better turf quality

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STOP C 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.

Sustainability of Turfgrass with Soil Incorporation of Organic Matter

Becky Griffin – Urban Program Associate, Center for Urban Ag.
Ellen Bauske – Program Coordinator, Center for Urban Ag.
Clint Waltz – Professor, Crop and Soil Sciences
The University of Georgia-Griffin Campus

ABSTRACT

In general, consumers desire turfgrass that is sustainable and requires as few inputs as necessary to maintain acceptable quality and color. Being "sustainable," especially under drought conditions that are periodically experienced in the Southeastern U.S., is critical to the growth of Georgia's turfgrass industry. Soil, or site, preparation prior to turfgrass establishment can affect turfgrass water use and influence sustainability. Too often soil is poorly prepared prior to sodding. The objective of this study was to determine the impacts of proper site preparation, which includes tilling and incorporation of compost, on turfgrass water use. Three turfgrass species were established in 2012 on tilled and non-tilled soil. Tilled soil was amended with one of two composts, each at three different rates. A site tilled only with no compost was included as a control. During the establishment year plots were irrigated to ensure grass survival. In 2013 the intent was to maintain the study under a 30 percent deficit irrigation program. However, the weather did not cooperate and plots were "well watered" throughout the 2013 growing season. Visual differences among treatments were not detectable but differences in soil volumetric water content (VWC) were measured. TifBlair centipedegrass consistently had a higher VWC than TifGrand bermudagrass and JaMur zoysiagrass. Other factors that increased soil moisture included tillage, amendment with compost, and rate of compost incorporation.

INTRODUCTION

Healthy soil rich in organic material absorbs rainwater, helps prevent flooding and soil erosion, and filters water pollutants. Healthy soil also stores water and nutrients for plant use in drought conditions, promoting healthy plants that require less irrigation, pesticides, and other resources. It has long been known that relatively small increases in organic matter (from 0.3 to 3 percent) can double the available water capacity of the soil. In general, soils across Georgia, and the Southeastern U.S., are low in organic matter. This is a function of soil forming factors and the climatic conditions of a subtropical environment. To gain the benefits of organic matter it has to be added to the soil. For establishment of turfgrass the best opportunity is during site preparation prior to laying, or seeding, the grass. Unfortunately, soil preparation, tilling or amending with organic matter, is overlooked and not valued as a practice that can make a lawn "sustainable."

Compost can be a viable source of organic matter. Composts derived from organic sources in Georgia (sod byproducts, organic peat, yard/wood trimmings, and byproducts of the cricket industry) have been previously researched. These studies incorporated compost into the turfgrass canopy, not incorporated into the soil, to investigate the potential for fertilization and disease suppression. Some compost provided improved turfgrass color and quality and reduced incidences of the disease dollar spot (*Sclerotinia homeocarpa*).

While compost may be a disease suppression option, the use of these materials as soil amendments for the purpose of long-term water conservation needs further investigation. The objective of this study was to determine the impacts of proper site preparation, which includes tilling and incorporation of compost, on turfgrass water usage.
Materials and Methods

A field experiment was planted in June of 2012. Based previous research, two promising organic amendments were selected (sod by-products and the yard/wood trimmings composts) as amendments to be tilled into the soil prior to sodding. The two types of organic matter were incorporated into the upper 4 inches of the test plots at 500, 1000, and 2000 lbs /1000 ft^2. Two control treatments (no organic matter) were also included. One was tilled, the other was not tilled. These whole plot treatments (8 total treatments) were replicated four times and arranged in a randomized complete block design with three grass species (bermudagrass – TifGrand, zoysiagrass – JaMur, and centipedegrass – TifBlair) arranged as split plot factors within whole plots for a total of 96 test plots. When needed, supplemental irrigation will be applied at a 30 percent deficit (not exceeding 0.7-inch per week) assuring drought stress. Visual turfgrass quality and color is also being assessed during drought conditions. Other data that is being collected is volumetric water content (VWC), digital color analysis, and end-season root mass. This study must be repeated over two growing seasons to establish the impact of organic matter on both installation and maintenance. Because 2013 was a high rainfall year, the study will continue through the 2015 growing season.

RESULTS

The 2013 growing season was a high rainfall year where no water was applied via irrigation. Visual differences among tillage or compost treatments were not evident. However, differences in soil VWC were measured. Regardless of being planted on tilled or non-tilled soil, TifBlair centipedegrass had greater VWC compared to TifGrand bermudagrass and JaMur zoysiagrass for all measurement dates (Table 1). The exception was on the October measurement for tilled soil, there was no difference between TifBlair and TifGrand. TifGrand had greater VWC compared to TifBlair for all measurement dates and soil preparations.

Because of the high rainfall received during 2013 these plots could have been considered "well watered" throughout most of the growing season. From the end of August through September would have been the exception with 33 days between rainfall events. Being "well watered" it is notable JaMur consistently had a lower VWC relative to the other species, indicating it may be a higher water using cultivar (Table 1). These trends are consistent with previous research conducted in Georgia, Texas, and Florida. Zoysiagrass has consistently shown to have good drought avoidance mechanisms, one of which may be luxury uptake of available water that allows this species to maintain quality deeper into drought conditions.

	VWC (%)				
	June	**July**	**August**	**September**	**October**
DAR	2	4	12	33	8
Non-tilled					
TifBlair	45.5 a	47.3 a	36.5 a	22.7 a	22.4 a
TifGrand	41.3 b	38.3 b	26.8 b	16.2 b	19.5 b
JaMur	37.6 c	33.2 c	21.5 c	12.5 c	13.3 c
Tilled					
TifBlair	48.0 a	48.2 a	36.6 a	22.4 a	22.4 a
TifGrand	43.2 b	39.8 b	30.2 b	19.4 b	21.5 a
JaMur	39.5 c	34.6 c	22.8 c	13.1 c	13.9 b

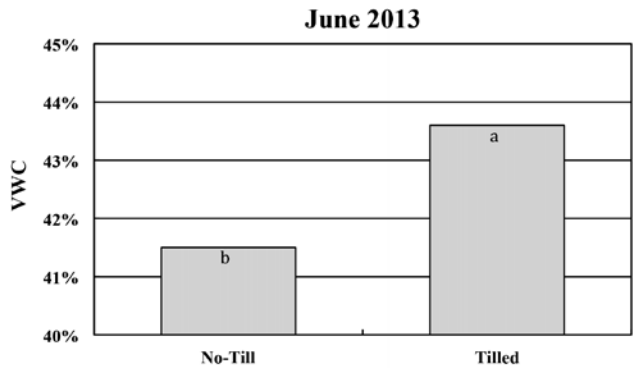
VWC measured with a Spectrum Technologies FieldScout TDR 300 Soil Moisture Meter with 3-inch tines.
Measurements taken in 2013.
DAR = Days After last Rainfall event.

Table 1. Soil volumetric water content (VWC) for three turfgrass species planted onto tilled or non-tilled site preparations.

continued on the next page

Sustainability of Turfgrass with Soil Incorporation of Organic Matter, *continued*

Soil preparation prior to establishment affected VWC for one of the five sampling dates. The water content in tilled soil was greater than non-tilled soil for the June measurement only (Figure 1). Being a year after establishment and considering the amount of water, via rain, which moved through the soil system during the first six months of 2013, the tilling effect may have been negated early in this study. However, amending the soil with compost increased VWC relative to non-amended soil for two of the five sampling dates (Figure 2). From one year's data there does not appear to be a difference between compost sources. On two dates VWC was higher for plots amended with compost at 2000 lbs /1000 ft^2 compared to 500 and 0 lbs /1000 ft^2 (Table 2). During August when plots were able to dry for 12 days, the plots amended with 2000 lbs /1000 ft^2 of compost had a higher VWC than all other compost rates.



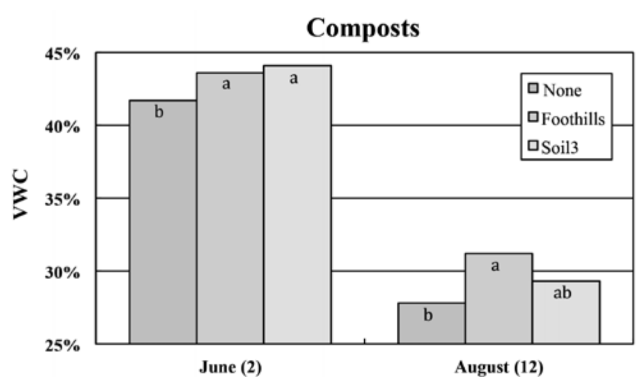
VWC measured with a Spectrum Technologies FieldScout TDR 300 Soil Moisture Meter with 3-inch tines.

Figure 1. Soil volumetric water content (VWC) of tilled and non-tilled site preparations.

	VWC (%)	
	June	August
DAR	2	12
0	41.7 b	27.8 b
500	43.0 b	29.0 b
1000	43.5 ab	29.4 b
2000	45.0 a	32.3 a

VWC measured with a Spectrum Technologies FieldScout TDR 300 Soil Moisture Meter with 3-inch tines.
Measurements taken in 2013.
DAR = Days After last Rainfall event.

Table 2. Soil volumetric water content (VWC) for four compost application rates.



VWC measured with a Spectrum Technologies FieldScout TDR 300 Soil Moisture Meter with 3-inch tines. Measurements taken in 2013. Days After last Rainfall event (DAR) are noted in parentheses.

Figure 2. Soil volumetric water content (VWC) of compost amended soil.

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NG Turf
Sod Atlanta
Super Sod

Reduced Input Bermudagrass Management

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

ABSTRACT
Newer warm-season turfgrasses are being developed, marketed, and sold for professional and homeowner use. Testing and understanding these grasses is necessary to properly advise clientele of expectations and general maintenance. Also, by evaluating these grasses new applications may be discovered (e.g. roadside). The objective of this research is to understand the impact of mowing and nitrogen on bermudagrass growth, such that, inputs can be minimized while maintaining acceptable turfgrass quality. After three growing seasons the impact of nitrogen programs and mowing regimes on individual cultivars are being realized. Similarly, following a harsh winter the impact of nitrogen fertility and mowing affected green-up.

INTRODUCTION
There are many bermudagrass cultivars commercially available for multiple applications (e.g. golf course, sports fields, commercial and residential properties, and general grounds). Because of its adaptability to a wide range of conditions, bermudagrass has traditionally been the cultivar of choice for limited input situations. Inputs range from water use, to pest management, to fertility, to mowing regularity. All these inputs affect labor, which ultimately is generally the greatest input cost to maintaining turfgrass. Performance of bermudagrass cultivars, relative to each other, to varying fertility and mowing, needs better understanding. The objective of this research is a long-term evaluation of the impact of mowing and nitrogen on bermudagrass growth, such that, inputs can be minimized while maintaining acceptable turfgrass quality.

MATERIALS AND METHODS
Beginning in June 2011, turfgrass plots were established from sod and will be maintained for five or more years. Seven bermudagrass cultivars are being evaluated under three nitrogen regimes and three mowing frequencies. Cultivars include Tifway, TifGrand, Celebration, Discovery, Latitude 36, GA-851, and DT-1. Plots are fertilized at an annual nitrogen rate of either 2.0 or 4.0 lbs N / 1000 ft^2. For the 2.0 lbs N / 1000 ft^2 rate (N_1), fertilizer is applied in 2, 1.0 lb N / 1000 ft^2 in mid-May and July. The 4.0 lbs N / 1000 ft^2 (N_2) is treated in 4, 1.0 lb N / 1000 ft^2 in mid-May, June, July, and August. As a nontreated control (N_0) the centers of the plots have no nitrogen applied throughout the duration of the study (Figure 1). The nitrogen source is a 50 percent split of soluble and slow release nitrogen and contain phosphorus and potassium.

The mowing frequencies are no mowing throughout the growing season (M_0), mowed weekly (M_W), and mowed once every two weeks (M_b – biweekly). With the exception of the non-mowed plot, all grasses are maintained with a rotary-type mower with a height of cut between 1.0 and 1.5 inches, simulating homelawns and general use areas.

The study is set up with grass cultivar as a whole plot and subdivided into nine subplots with each fertility regime (e.g. no applied nitrogen, regimes 1 and 2) and mowing frequency (e.g. no mow, weekly and biweekly) within each whole plot (Figure 1). The whole plots are randomized and replicated three times for a total of 189 subplots in split-split design. Evaluations of turfgrass quality, color, and green-up have been made.

continued on the next page

Reduced Input Bermudagrass Management, *continued*

M_w, N_1	M_w, N_0	M_w, N_2
M_0, N_1	M_0, N_0	M_0, N_2
M_b, N_1	M_b, N_0	M_b, N_2

Figure 1. Matrix of mowing and nitrogen treatments within whole plots.

RESULTS

At the conclusion of the 2013 growing season, Latitude 36 had the best turfgrass quality of the seven cultivars in this trial (Table 1). At the September rating date it was the only cultivar with an average turfgrass quality rating above the minimally acceptable level (6.0 = minimally acceptable). Latitude 36 and Discovery held green color deeper into the fall (October rating) relative to the other five cultivars. For the October rating, turfgrass quality and color were improved for the no nitrogen and 4.0 lbs N / 1000 ft^2 / yr treatments (Table 2). Weekly mowing improved quality and color of plots at the end of the growing season (Table 3). To optimize quality and color, weekly mowing will be needed. Weekly mowing improved the turfgrass quality for a cultivar like Discovery which has a maximum growth of 1.5 inches (data not shown).

Winter 2014 was relatively harsh and affected green-up. Celebration and Discovery were slower to green-up relative the other cultivars (Table 1). While TifGrand was slower to green-up at the April evaluation, by the May rating it was no different than Tifway, Latitude 36, UGA-851 and DT-1. Nitrogen program affected green-up. For spring ratings, the 4 lbs N / 1000 ft^2 / yr retarded green-up (Table 2). The N_0 treatment is mowed prior to the start of the growing season, mid- to late-March. Interestingly, when green-up was evaluated in April and May, the N_0 treatments had improved green-up relative to plots that have been mowed throughout the study and still had thatch and dead leaf tissue on the surface (Table 3).

	Turfgrass Quality (1-9)		Turfgrass Color (1-9)		Green-up (%)	
	Sep. 2013	Oct. 2013	Sep. 2013	Oct. 2013	Apr. 2014	May 2014
Tifway	5.33 bc	4.85 c	5.57 c	4.69 b	55 ab	93 a
TifGrand	5.28 bc	4.75 c	5.56 c	4.81 b	43 b	91 a
Celebration	4.94 c	4.87 c	5.22 c	4.80 b	24 c	71 b
Discovery	5.35 bc	5.33 b	6.11 ab	5.63 a	27 c	71 b
Latitude 36	6.37 a	5.94 a	6.44 a	5.54 a	62 a	96 a
UGA-851	5.46 bc	4.69 c	5.72 bc	4.70 b	51 ab	96 a
DT-1	5.69 b	4.98 bc	5.59 bc	4.70 b	61 a	96 a
LSD	0.56	0.45	0.53	0.55	14.5	8.4

Turfgrass quality and color are rated on a 1 to 9 scale with 9 = ideal quality or dark green color, 6 = minimally acceptable, and 1 = bare soil or brown grass.

Table 1. Turfgrass quality, color and percent green-up of seven bermudagrass cultivars.

	Turfgrass Quality (1-9)		Turfgrass Color (1-9)		Green-up (%)	
	Sep. 2013	Oct. 2013	Sep. 2013	Oct. 2013	Apr. 2014	May 2014
N_0 – no N	5.48	5.09 a	5.74	5.04 a	46 a	88 a
N_1 – 2 lbs N /yr	5.45	4.98 b	5.74	4.89 b	47 a	89 a
N_2 – 4 lbs N / yr	5.54	5.12 a	5.76	5.02 a	45 b	85 b
LSD	NS	0.09	NS	0.10	1.2	1.9

Turfgrass quality and color are rated on a 1 to 9 scale with 9 = ideal quality or dark green color, 6 = minimally acceptable, and 1 = bare soil or brown grass.

Table 2. Turfgrass quality, color and percent green-up of three annual nitrogen rates to bermudagrass.

	Turfgrass Quality (1-9)		Turfgrass Color (1-9)		Green-up (%)	
	Sep. 2013	Oct. 2013	Sep. 2013	Oct. 2013	Apr. 2014	May 2014
M_0 – no mow	4.34 c	3.59 c	4.87 b	3.75 c	54 a	90 a
N_W – weekly	6.23 a	5.91 a	6.26 a	5.73 a	42 b	87 b
N_b – biweekly	5.90 b	5.69 b	6.11 a	5.46 b	43 b	86 b
LSD	0.20	0.13	0.15	0.18	2.9	1.6

Turfgrass quality and color are rated on a 1 to 9 scale with 9 = ideal quality or dark green color, 6 = minimally acceptable, and 1 = bare soil or brown grass.

Table 3. Turfgrass quality, color and percent green-up of three mowing regimes to bermudagrass.

Warm-season Putting Green NTEP Trial

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

ABSTRACT

In 2013 the National Turfgrass Evaluation Program (NTEP) and U.S. Golf Association (USGA) initiated the first evaluation of warm-season putting green grasses. The UGA Griffin Campus was fortunate to be selected as one of twelve sites nationally for this trial which will continue through 2018. It is unique from other NTEP trials, in that, this trial includes cultivars of three species (bermudagrass, seashore paspalum, and zoysiagrass) with different characteristics and management requirements. The objective of this research is to identify grasses that can maintain quality putting surfaces with a higher mowing height and fewer inputs than a typical ultradwarf bermudagrass program. For example, a target green speed of 9 to 10 feet on the stimpmeter throughout the growing season is one research parameter. This will be accomplished using a Tifdwarf management program with a height of cut between 0.140- and 0.165-inch and, less fertilizer, verticutting and topdressing than ultradwarf bermudagrass programs. These three species may ultimately require independent management, information golf course superintendents will need as these new cultivars become the next generation of putting green surfaces.

BERMUDAGRASSES (15)

Tifdwarf
TifEagle
Mini-Verde
Sunday
08-T-18
11-T-861
AES 1302
OKC 13-78-5
OKC 1-75-2
OKC 16-13-8
MSB-264
MSB-285
CTF-E3
CTF-B10
JK 110521

ZOYSIAGRASSES (11)

FAES 1301
10-TZ-74
L1F
DALZ 1306
DALZ 1307
DALZ 1308
DALZ 1309
Diamond
DALZ 1304
DALZ 1305
ZOYSIU

SEASHORE PASPALUMS (4)

SeaDwarf
UGA 1743
Platinum TE
SeaStar

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NTEP
USGA
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STOP G Afternoon Self-guided Research Tour

Step into the Shade: Conversations about Urban Agriculture

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Center for Urban Agriculture
The University of Georgia, Griffin Campus

LOCATION

After a morning outside on the turf plots join the faculty of the University of Georgia Center for Urban Agriculture in the air conditioning of the Student Learning Center (the big brick building in center of campus with the cupola) in room 105, 1:15-2:30 p.m.

ABSTRACT

UGA Center for Urban Agriculture faculty members will hold open discussions about current issues in urban agriculture and available University of Georgia resources. The latest mobile and web-based applications for landscape plant, turfgrass, and insect management will be discussed. Specifically we will demonstrate use of wireless microscopes and iPads for insect identification. Next, we will take you inside the web classrooms for landscaper and nurseryman certification. Lastly, we will have a friendly team competition testing pesticide safety procedures from your workplace.

For more information, **visit http://ugaurbanag.com**

STOP H Afternoon Self-guided Research Tour

Demonstration: Pesticide Storage and Handling

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

ABSTRACT

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 course, sports fields, commercial lawn care, landscaping, sod production, etc.). Proper handling, mixing, and storage ensure efficacy of pesticides and 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
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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.

STOP J Afternoon Self-guided Research Tour

Demonstration: Reel Grinders and Mower Set Up

Chris Langley, Bernhard and Co.

Mowing is the single most important maintenance procedure that is conducted on turf and a well-maintained mower with a sharp cutting unit will produce more attractive and healthier turf. Clearly it is vital that lawnmowers are kept sharp, but what is the best way to do this? Bernhard representatives will be on hand to discuss 'back lapped' and 'non-contact' methods of mower sharpening.

STOP K Afternoon Self-guided Research Tour

Demonstration: Applications for UAVs in Turf

Ben Worley, Vision Services Group

The Vision Service Group-Unmanned of Norcross, GA will conduct a demonstration of advanced aerial imaging technologies that provide a new perspective and a different way of seeing things. Company representatives will be available to discuss applications of this now affordable technology..

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 landscapes areas.
- The Georgia turfgrass and related industries contribute a total of $7.8 billion annually to the economy.
- In terms of earnings and value added, the 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 researched-based information.
- Through drought periods, the golf and landscape segments have demonstrated exceptional environmental stewardship with their Best Management Practices (BMPs) 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+ 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 partnership to increase economic development, further scientific exploration and enhance the environment.

Georgia Farm Gate Information

2012 Georgia Agricultural Commodity Rankings

Rank	Commodity	Farm Gate	% of GA Total
1	Broilers	$4,698,860,078	33.84%
2	Cotton	$1,303,963,388	9.39%
3	Peanuts	$891,855,186	6.42%
4	Eggs	$792,868,250	5.71%
5	Beef	$537,688,093	3.87%
6	Timber	$523,290,282	3.77%
7	Corn	$507,140,881	3.65%
8	Horses	$342,171,919	2.46%
9	Dairy	$338,351,360	2.44%
10	Greenhouse	$259,160,015	1.87%
11	Pecans	$249,298,409	1.80%
12	Blueberries	$229,294,286	1.65%
13	Breeder Pullet Unit	$224,937,059	1.62%
14	Ag-based Tourism	$194,138,372	1.40%
15	Pork	$171,607,605	1.24%
16	Onions	$163,045,682	1.17%
17	Watermelon	$159,552,119	1.15%
18	Container Nursery	$141,767,646	1.02%
19	Hay	$130,368,410	0.94%
20	Soybeans	$126,664,100	0.91%
21	Misc. Vegetables	$114,739,943	0.83%
22	Bell Peppers	$108,814,073	0.78%
23	Wheat	$104,369,607	0.75%
24	Hunting Lease - Deer	$95,641,803	0.69%
→ 25	Turfgrass	$83,700,746	0.60% ←
26	Sweet Corn	$79,209,882	0.57%
27	Field Nursery	$68,006,337	0.49%
28	Pine Straw	$58,766,800	0.42%
29	Silage	$53,010,200	0.38%
30	Snap Beans	$51,404,905	0.37%
31	Quail	$46,234,305	0.33%
32	Cabbage	$45,978,712	0.33%
33	Tobacco	$45,064,752	0.32%
34	Cucumbers	$43,371,337	0.31%
35	Tomato	$39,008,214	0.28%
36	Peaches	$33,867,850	0.24%
37	Greens (collards, kale, lettuce, mustard, spinach, turnip greens)	$33,011,004	0.24%
38	Straw	$32,672,238	0.24%
39	Zucchini	$27,257,213	0.20%
40	Cantaloupe	$21,968,530	0.16%
41	Sorghum	$18,631,094	0.13%
42	Honeybees	$17,488,270	0.13%
43	Goats	$17,356,138	0.13%
44	Eggplant	$17,339,586	0.12%
45	Squash (Yellow and Winter)	$16,706,584	0.12%
46	Rye	$11,149,942	0.08%
47	Christmas Trees	$10,201,575	0.07%
48	Strawberries	$9,871,698	0.07%
49	Apples	$9,482,967	0.07%
50	Southern Peas	$9,331,174	0.07%
51	Hunting Leases - Turkey	$8,285,409	0.06%
52	Catfish	$6,771,248	0.05%
53	Blackberries	$6,382,213	0.05%
54	Grapes	$6,107,478	0.04%
55	Oats	$5,950,222	0.04%
56	Other Peppers (banana and hot)	$4,321,351	0.03%
57	Sheep	$2,141,949	0.02%
58	Hunting Leases - Duck	$1,565,300	0.01%
59	Okra	$525,574	0.00%
60	Barley	$471,476	0.00%
	Crop Insurance	$61,995,265	0.45%
	Government Payments	$192,650,105	1.39%
	All Other Miscellaneous	$277,704,543	2.00%
	2012 Total Farm Gate Value	**$13,884,552,747**	

Georgia Turfgrass Farm Gate Information

2012 Turfgrass Farm Gate Value

Rank	County	Acres	Harvest	$/Acre	Farm gate
39	Appling	50	0.700	$5,772.00	$202,020
-	Atkinson		0.000		$0
-	Bacon		0.000		$0
26	Baker	150	0.700	$5,772.00	$606,060
-	Baldwin		0.000		$0
40	Banks	45	0.700	$5,772.00	$181,818
-	Barrow		0.000		$0
4	Bartow	1,212	0.700	$5,772.00	$4,896,965
-	Ben Hill		0.000		$0
22	Berrien	210	0.700	$5,772.00	$848,484
-	Bibb		0.000		$0
-	Bleckley		0.000		$0
54	Brantley	2	0.700	$5,772.00	$8,081
-	Brooks		0.000		$0
-	Bryan		0.000		$0
3	Bulloch	1,600	0.700	$5,500.00	$6,160,000
-	Burke		0.000		$0
-	Butts		0.000		$0
-	Calhoun		0.000		$0
-	Camden		0.000		$0
33	Candler	100	0.700	$5,000.00	$350,000
14	Carroll	400	0.700	$5,772.00	$1,616,160
19	Catoosa	300	0.700	$5,772.00	$1,212,120
-	Charlton		0.000		$0
-	Chatham		0.000		$0
-	Chattahoochee		0.000		$0
52	Chattooga	5	0.700	$5,772.00	$20,202
-	Cherokee		0.000		$0
53	Clarke	5	0.700	$5,772.00	$18,182
-	Clay		0.000		$0
-	Clayton		0.000		$0
-	Clinch		0.000		$0
-	Cobb		0.000		$0
-	Coffee		0.000		$0
39	Colquitt	50	0.700	$5,772.00	$202,020
49	Columbia	10	0.700	$5,000.00	$35,000
2	Cook	1,800	0.700	$5,772.00	$7,272,720
-	Coweta		0.000		$0
-	Crawford		0.000		$0
34	Crisp	100	0.700	$4,975.00	$348,250
-	Dade		0.000		$0
46	Dawson	15	0.700	$5,772.00	$60,606
8	Decatur	672	0.700	$5,772.00	$2,715,149
-	DeKalb		0.000		$0
-	Dodge		0.000		$0
10	Dooly	550	0.700	$5,772.00	$2,222,220
6	Dougherty	950	0.700	$5,772.00	$3,838,380
-	Douglas		0.000		$0
32	Early	87	0.700	$5,772.00	$351,515
-	Echols		0.000		$0
21	Effingham	250	0.700	$5,772.00	$1,010,100
-	Elbert		0.000		$0
-	Emanuel		0.000		$0
13	Evans	400	0.700	$6,000.00	$1,680,000
-	Fannin		0.000		$0
-	Fayette		0.000		$0
45	Floyd	17	0.700	$5,772.00	$68,687
-	Forsyth		0.000		$0
42	Franklin	40	0.700	$5,772.00	$161,616
37	Fulton	60	0.700	$6,000.00	$252,000
-	Gilmer		0.000		$0
-	Glascock		0.000		$0
-	Glynn		0.000		$0
23	Gordon	1,100	0.700	$1,100.00	$847,000
38	Grady	55	0.700	$5,772.00	$222,222
-	Greene		0.000		$0
30	Gwinnett	100	0.700	$5,772.00	$404,040
18	Habersham	350	0.700	$5,772.00	$1,414,140
50	Hall	7	0.700	$5,772.00	$28,283
27	Hancock	150	0.700	$5,700.00	$598,500
-	Haralson		0.000		$0
41	Harris	40	0.700	$5,775.00	$161,700
35	Hart	74	0.700	$5,772.00	$298,990
24	Heard	175	0.700	$5,772.00	$707,070
-	Henry		0.000		$0
19	Houston	300	0.700	$5,772.00	$1,212,120
7	Irwin	700	0.700	$5,772.00	$2,828,280
17	Jackson	350	0.700	$6,000.00	$1,470,000
-	Jasper		0.000		$0
-	Jeff Davis		0.000		$0
28	Jefferson	120	0.700	$5,772.00	$484,848
-	Jenkins		0.000		$0
-	Johnson		0.000		$0
-	Jones		0.000		$0
-	Lamar		0.000		$0
12	Lanier	475	0.700	$5,772.00	$1,919,190
-	Laurens		0.000		$0
19	Lee	300	0.700	$5,772.00	$1,212,120
-	Liberty		0.000		$0
-	Lincoln		0.000		$0
-	Long		0.000		$0
-	Lowndes		0.000		$0
46	Lumpkin	15	0.700	$5,772.00	$60,606
1	Macon	2,900	0.700	$5,772.00	$11,717,160
-	Madison		0.000		$0
-	Marion		0.000		$0
-	McDuffie		0.000		$0
-	McIntosh		0.000		$0
36	Meriwether	65	0.700	$5,772.00	$262,626
28	Miller	120	0.700	$5,772.00	$484,848
19	Mitchell	300	0.700	$5,772.00	$1,212,120
-	Monroe		0.000		$0
-	Montgomery		0.000		$0
25	Morgan	160	0.700	$5,772.00	$646,464
-	Murray		0.000		$0
-	Muscogee		0.000		$0
-	Newton		0.000		$0
43	Oconee	25	0.700	$5,850.00	$102,375
-	Oglethorpe		0.000		$0
-	Paulding		0.000		$0
9	Peach	600	0.700	$5,700.00	$2,394,000
-	Pickens		0.000		$0
-	Pierce		0.000		$0
-	Pike		0.000		$0
-	Polk		0.000		$0
14	Pulaski	400	0.700	$5,772.00	$1,616,160
-	Putnam		0.000		$0
-	Quitman		0.000		$0
-	Rabun		0.000		$0
-	Randolph		0.000		$0

Georgia Turfgrass Farm Gate Information

2012 Turfgrass Farm Gate Value

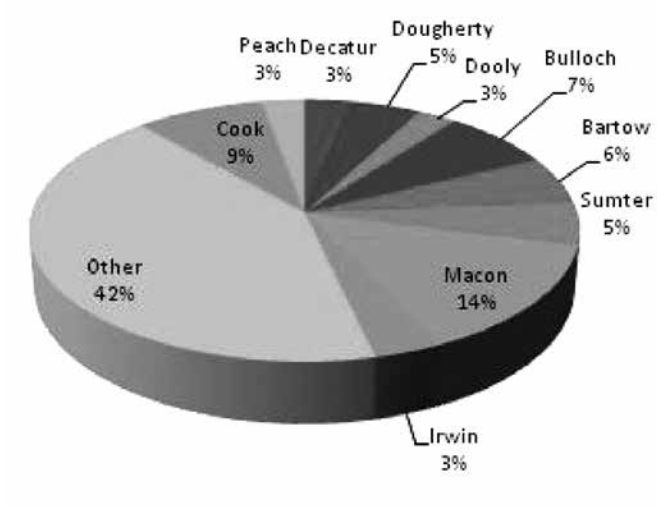
Rank	County	Acres	Harvest	$/Acre	Farm gate
39	Richmond	50	0.700	$5,772.00	$202,020
-	Rockdale		0.000		$0
-	Schley		0.000		$0
30	Screven	100	0.700	$5,772.00	$404,040
29	Seminole	150	0.700	$4,200.00	$441,000
-	Spalding		0.000		$0
-	Stephens		0.000		$0
-	Stewart		0.000		$0
5	Sumter	1,100	0.700	$5,772.00	$4,444,440
-	Talbot		0.000		$0
-	Taliaferro		0.000		$0
-	Tattnall		0.000		$0
44	Taylor	20	0.700	$5,772.00	$80,808
-	Telfair		0.000		$0
30	Terrell	100	0.700	$5,772.00	$404,040
47	Thomas	13	0.700	$5,772.00	$52,525
11	Tift	500	0.700	$5,772.00	$2,020,200
-	Toombs		0.000		$0
-	Towns		0.000		$0
16	Treutlen	373	0.700	$5,772.00	$1,507,877
-	Troup		0.000		$0
19	Turner	300	0.700	$5,772.00	$1,212,120
-	Twiggs		0.000		$0
-	Union		0.000		$0
-	Upson		0.000		$0
31	Walker	92	0.700	$5,772.00	$371,717
48	Walton	10	0.700	$6,000.00	$42,000
-	Ware		0.000		$0
28	Warren	120	0.700	$5,772.00	$484,848
15	Washington	380	0.700	$5,772.00	$1,535,352
51	Wayne	6	0.700	$5,772.00	$24,242
-	Webster		0.000		$0
-	Wheeler		0.000		$0
-	White		0.000		$0
-	Whitfield		0.000		$0
20	Wilcox	278	0.700	$5,772.00	$1,123,231
-	Wilkes		0.000		$0
-	Wilkinson		0.000		$0
24	Worth	175	0.700	$5,772.00	$707,070
	Totals & Avg.	**21,728**		**$5,503.23**	**$83,700,746**

Percent of Ornamental Horticulture 11.18%

Top Ten Counties by Value – Turfgrass

County	Acres	Price	Farm gate
Macon	2,900	$5,772.00	$11,717,160
Cook	1,800	$5,772.00	$7,272,720
Bulloch	1,600	$5,500.00	$6,160,000
Bartow	1,212	$5,772.00	$4,896,965
Sumter	1,100	$5,772.00	$4,444,440
Dougherty	950	$5,772.00	$3,838,380
Irwin	700	$5,772.00	$2,828,280
Decatur	672	$5,772.00	$2,715,149
Peach	600	$5,700.00	$2,394,000
Dooly	550	$5,772.00	$2,222,220

Top Ten Counties for Turfgrass



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2014 Turfgrass Research Field Day

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Georgia Turfgrass Foundation Trust (GTFT)
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