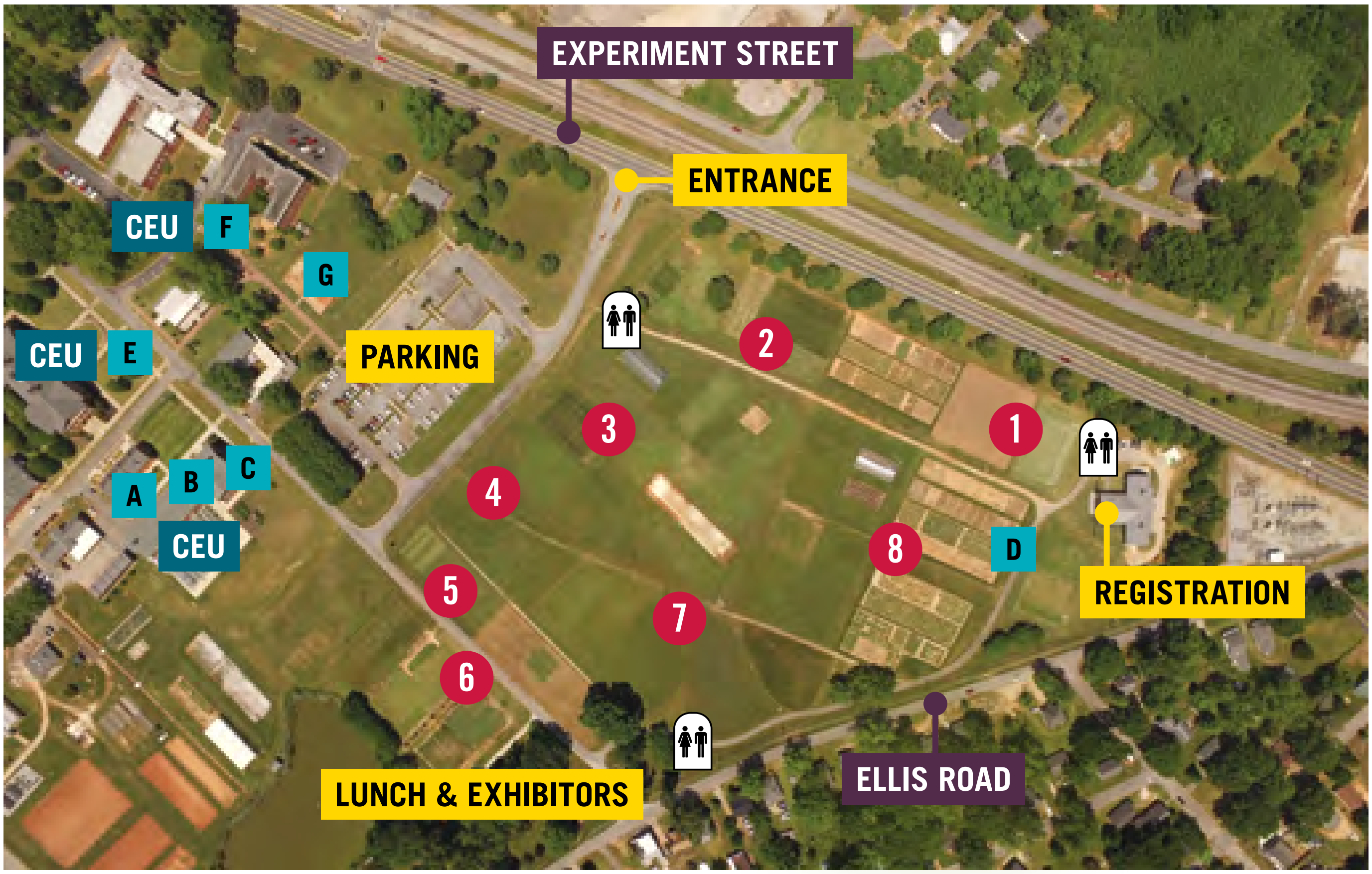
Turfgrass Research FIELD DAY

ONE DAY, ACRES OF INFORMATION

Wednesday, August 7, 2024 | UGA Griffin Campus

MAP and Field Day TOUR STOPS



- Guided morning tour stops: 1–8
- Self-guided afternoon tour venues: A–G
- Restrooms
- CEU — Continuing Education Certification (CEU) credits for pesticide recertification will be available at three locations, no earlier than 2:15 p.m.:
  Stop B — Turfgrass Research and Education Center
  Stop E — Student Learning Center
  Stop F — Stuckey Building

2024 UGA Turfgrass Research Field Day PROGRAM

WEDNESDAY, AUGUST 7

8 to 8:45 a.m.	**REGISTRATION**
8:50 to 9:15 a.m.	**INTRODUCTION**

Welcome – *Clint Waltz*

UGA Griffin Campus Welcome – *Jeff Dean*

9:15 to 11:30 a.m. **GUIDED RESEARCH TOUR***

1. Improving Recommendations for Precision Irrigation Management — *D. Jespersen*
2. Soil Testing and Fertility Management for Turf — *J. Lessl*
3. Cutting Edge Techniques to Determine Sports Field Safety — *Grad Students and G. Henry*
4. Breeding and Evaluation of Turf-Type Tall Fescue at the University of Georgia — *P. Vines*
5. Skyseed: A New Weed Species in Georgia Lawns— *C. Waltz*
6. Rhizoctonia Large Patch Management in Turfgrass — *B. Bahri*
   Management of Turfgrass Diseases: Chemical Control — *A. Martinez-Espinoza*
7. Transovorial Effects of Pyriproxyfen on Japanese Beetles in Turfgrass — *Grad Students and S. Joseph*
8. Toward Seeded Zoysiagrass Cultivars: Base Broadening and Germplasm Improvement at the University of Georgia — *S. Khanal and B. Schwartz*

11:30 a.m. to 1 p.m. **TURFGRASS EQUIPMENT AND PRODUCT EXHIBITS**

11:30 a.m. to 1:15 p.m. **LUNCH**

1:15 to 2:30 p.m. **SELF-GUIDED RESEARCH TOUR**[1]

A. The Things I Have Seen: Turfgrass Problem Solving — *C. Waltz*
B. Diagnosing Turfgrass Diseases: Field and Laboratory[2] — *A. Martinez-Espinoza*
C. The Great Southeast Pollinator Census — *B. Griffin*
D. New and Upcoming Vegetative and Seeded Cultivars of Seashore Paspalum — *P. Raymer*
E. Graduate Student Research — *SLC (B. Bahri and D. Jespersen)*
F. Grasses Can Serve as a Pollinator Food Source — *K. Harris-Shultz*
G. Irrigation Training Center: Opportunities for Industry Use — *R. Orellana*

** A special Spanish translation will be made available for the Guided Research Tour. We would like to thank the following for assisting with Spanish translation: Sergio Sosa, Laura Ney, Eric Marlowe, and Noe Garay.*

[1] Other research plots will be marked and labeled for individual observation.

[2] Talk will begin at 1:30 p.m. and is limited to the first 30 participants.

Pesticide certification credits will be available at three locations (B, E and F) no earlier than 2:15 p.m.

University of Georgia
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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:

Adaptive Symbiotic Technologies
Asahi BioSciences
A.M. Buckler & Associates, Inc.
Amvac Chemicals
Atlanta Athletic Club
Atlanta Braves
Atlanta Country Club
Augusta National Golf Club
Barenbrug
BASF
Bayer
Bethel Farms
Bricko Farms
Brightview
Bulk Aggregate Golf, Inc.
Butler Sand
Buy Sod
Carolina Fresh Farms
Center for Urban Agriculture
Central Garden and Pet
Certis Biologicals
Corbin Turf & Ornamental Supply
Corteva AgroSciences
Dupont
East Lake Golf Club
Envu
Evergreen Turf Farms
Ewing Irrigation
Fall Line Golf Club
First Tee of Augusta
Flat Creek Golf Club
FMC
Foskey Turf Farm
Frederica Club
Georgia Agribusiness Council
Georgia Department of Agriculture
Georgia Certified Landscape Professionals
Georgia Crop Improvement Association
Georgia Golf Course Superintendents Assn.
Georgia Golf Environmental Foundation
Georgia Master Gardeners
Georgia PGA
Georgia Recreation and Park Assn.
Georgia Seed Development Commission
Georgia State Golf Association
Georgia Turfgrass Foundation Trust
Gold Mine Golf Inc.
Golf Agronomics
Golf Course Superintendents Assn. of America
Gowan
Greenville Turf and Tractor
Griffin City Golf Course
Green Tee Golf Inc.
GrupoInesta
Harrell's
Harsco
Helena Chemical
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Howard Fertilizer and Chemical Co.
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ISK BioSciences
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MNI Direct
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National Turfgrass Evaluation Program (NTEP)
New Concept Turf
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NG Turf
Quali-Pro
Rain Bird
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Reynold's Plantation
Rivermont Golf Club
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Sea Island Group
Seed Research of Oregon
SipCamAdvan
SiteOne Landscape Supply, LLC
Smith Farm Supply
Smith Seed
SNF Holding Company
Spanish Greenkeepers Association
Sports Turf Company
Sod Atlanta
Sod Solutions
Solid Ground Services & Supply
Southern States Turf
Southern Turf
Stovall
Sumter Sod
Super-Sod
Syngenta
Target Specialty Products
Tee-2-Green Corp.
The Lawn Institute
The Landings
The Scotts Co.
The Toro Company
The Turfgrass Group
TriEst Ag. Group
Tolar Capitol Partners
Turfgrass Producers International
Turfnology
Turfpro USA
Turf Seed
University of Georgia Golf Course
University of Georgia Research Foundation
UGARF–Technology Commercialization Office
Urban Ag. Council
USDA-ARS
USDA-NIFA
USDA-SCBG
U.S. Golf Association (USGA)
Valent U.S.A.
Valley Irrigation
Wright Turf

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

In Memory of

Alan Christopher Wise

August 6, 1979–December 30, 2023

Alan Wise was a beloved member of the UGA Turfgrass family.

Alan worked with the agronomy program from 2014–2016 and left to pursue a career within the turfgrass industry. He spent several years at Piedmont Park before becoming the coordinator of varsity athletic fields at Emory University.

Alan was a graduate of Gordon State College, enjoyed music and movies, and was an ardent supporter of Atlanta United, Atlanta Braves, and Georgia Tech. He is survived by his wife, Katie, and daughter Mary Beth.

His great smile and jovial attitude will be sorely missed.

Paul L. Raymer: Crop and Soil Sciences Professor's Career Rooted in Green Revolution

By David G. Buntin, UGA entomologist and friend, and Sharon Dowdy, retired UGA Communication Specialist

Paul L. Raymer grew up on a beef cattle farm in rural Arkansas. As a young man entering college and with farming in his bloodline, Paul decided to become an agriculture major because "it was the beginning of the Green Revolution, and agriculture had a bright future."

Today we honor and recognize his accomplishments as a University of Georgia professor who has served Georgia agriculture over the last 40 years. Raymer has received millions of dollars in grant funding, published many scientific papers, and trained numerous successful graduate students. He has contributed in many other ways to the success of the UGA-Griffin campus and the goals of the College of Agricultural and Environmental Sciences (CAES) to improve Georgia agriculture.

His career path began when he studied animal and plant sciences for his bachelor's degree at the University of Arkansas. After that, for his master's degree at Texas Tech University, he researched how cotton deteriorates and, if inhaled, can cause lung disease in textile workers. Raymer did not plan on pursuing a doctoral degree, and he says a friend's encouragement to keep an open mind and "at least take a research job at a university" was some of the best advice he has ever been given. He accepted a position in the crop variety testing program at the University of Illinois and trained as a soybean agronomist.

In 1984, Raymer accepted a position as an assistant professor at the UGA-Griffin campus to lead the CAES Statewide Variety Testing program. Eager to develop his own research program, he added breeding canola to his duties. "Canola had just received 'grass' status and I started working more and more on canola, and the college supported the crop's potential in Georgia and the Southeast," he said. He pulled together a team of economists, agronomists, entomologists, plant pathologists, and UGA Extension personnel. Paul served in a leadership role, and he says, "The level of independence you get and the ability to be creative is amazing. I really enjoy building a successful team, and I enjoy being innovative and creative." In 2000, he added Extension soybean specialist to his list of duties.

In 2003, when UGA turfgrass breeder Ronnie Duncan retired, Raymer stepped into his current position as UGA turfgrass breeder. For the past 20 years, he has been able to focus on developing improved cultivars of seashore paspalum, tall fescue, and creeping bentgrass for high-stress environments. His goals are to develop cultivars for high-stress environments with improved salt tolerance, drought tolerance, and disease resistance. He developed several turfgrass variety releases, including 'Sea Isle Supreme', 'Sea Star' paspalum, and his latest variety release 'SeaScape' paspalum. Raymer has also developed a new, herbicide-resistant, nongenetically modified seashore paspalum turfgrass. He and CAES scientist Jack Huang hold a patent for an enzyme that removes excess thatch from golf courses. Raymer has found success by being innovative in work for which he has a passion. He continued to have a leadership role in the UGA turf team and was instrumental several years ago in securing funding for the new turfgrass research building at the Griffin campus and turfgrass faculties at other UGA campuses. Raymer helped to position the UGA turf program as the premier turf program in the region.

Raymer is a smart and personable individual who is well-liked by nearly all people who meet and work with him. His career at UGA has allowed him to travel the world. He is well-respected within crop and soil sciences and the agricultural industry. Raymer said, "I had many opportunities to do breeding for other universities and private companies, but I enjoy working for the University of Georgia. I've always been committed to the farmers of Georgia and to CAES. I strongly believe in the land-grant mission of UGA. It's the reason (the college) exists."

Improving Recommendations for Precision Irrigation Management

David Jespersen, Associate Professor, Crop and Soil Sciences
UGA-Griffin

Clint Waltz, Professor, Crop and Soil Sciences
UGA-Griffin

Gerald Henry, Professor, Crop and Soil Sciences
UGA-Athens

Brian Schwartz, Professor, Crop and Soil Sciences
UGA-Tifton

Phillip Vines, Senior Research Associate, Crop and Soil Sciences
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ABSTRACT

The use of water for landscape irrigation continues to be a major concern for the turfgrass industry. New techniques and technologies are being developed for precision irrigation management to better utilize precious water resources. This study is part of a multi-state collaboration looking to develop a decision-support system for precision irrigation management by combining plant physiology with remote sensing and machine learning. Data collected from this field will be used to help develop models to better predict when irrigation needs to be applied. Collaboration between academia and industry is critical for this project's success.

INTRODUCTION

Water is required for all plants; however, the use of supplement irrigation for turf areas has become a divisive topic. It is estimated by the EPA that landscape irrigation consumes nearly one-third of all household water use across the United States (https://www.epa.gov/watersense/watersense-summer-infographic).

Turfgrasses provide many services: aesthetic, economic, and environmental. However, the irrigation used to maintain these landscapes is frequently viewed as non-essential or as a luxury. In response to water concern, municipalities in the southwestern U.S. have enacted measures to reduce or eliminate the irrigation of turf areas (at times by eliminating the use of turfgrass altogether). In light of increased pressure on freshwater resources and a desire to be more sustainable, the turfgrass industry has taken many proactive measures to reduce water use. These range from the development of cultivars with improved drought tolerance to the development of irrigation best management practices.

One aspect of improving irrigation efficiency is the development of precision irrigation management. Broadly, this is applying irrigation precisely to where it is needed, in the correct amount, when it is needed. This will improve the efficiency of supplemental irrigation applications and hopefully improve overall turfgrass performance by avoiding situations of over- or underwatering. The development of precision irrigation is complicated by the fact that water requirements depend on multiple factors, including management inputs, the soil, the weather, and the plant itself. By integrating information across multiple levels, we hope to develop models to better identify when plants need water and ultimately make precision irrigation management more available and more effective.

The current study is looking at hybrid bermudagrass (*Cynodon dactylon* x *Cynodon transvaalensis*) exposed to a range of drought conditions via a linear gradient irrigation system (LGIS). This system exposes the grass to a range of soil moistures, from well-watered to no supplemental water, within a single field. The field was made possible by collaboration with several industry partners, including SuperSod, NG Turf, Toro, Heritage Link, Irrigation Consultant Services, and Jerry Pate Turf and Irrigation. Across this field we are collecting environmental, plant, and remote sensing data to develop models that can be used to predict plant water status and identify when plants need water. This information will ultimately be used to develop decision support systems for precision irrigation management.

MATERIALS AND METHODS

The research is part of a larger multi-state USDA funded project called "Mobile Remote Sensing and Artificial Intelligence-Guided Precision Management Program for Turfgrass Water Conservation," which is led by Rutgers University and includes collaboration with the University of California–Riverside and the Siemens smart infrastructure unit. The LGIS field was constructed in the summer of 2023 to provide a gradient of irrigation across the field (Figure 1).

Construction of the field was graciously supported by several industry partners for which we are grateful. Irrigation heads and controllers were donated by Toro, design and setup of the system was assisted by Bob Scott of Irrigation Consultant Services and Jerry Pate Turf and Irrigation, installation was supported by Heritage Links, and sod was donated by NG Turf and SuperSod.

Figure 1. Overview of Linear Gradient Irrigation System Field Under Construction.

The field is laid out with two hybrid bermudagrass cultivars, 'Tifway 419' and drought-tolerant 'TifTuf'. These grasses are maintained at two heights of cut to simulate a sports field/home lawn at 1.5 in. or fairway conditions at 0.5 in. Additionally, a sensor network of 24 soil moisture sensors is buried across the field to continuously collect soil moisture data (Figure 2). Additional environmental data is collected by an onsite weather station that is part of the Georgia Weather Network. Information collected from the field includes soil moisture, leaf water content, percent green cover, and dark green color index. Additional remote sensing data includes leaf reflectance data and canopy temperatures. Data collection is ongoing and will be used to help develop models for precision irrigation management.

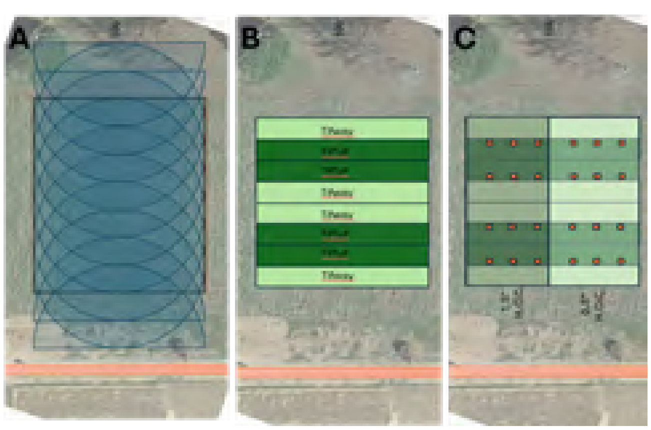

Figure 2. Layout of (A) Irrigation Head Throw Patterns, (B) Cultivars, and (C) Soil Moisture Sensors Across the Field.

RESULTS

When in use, the field produces a gradient of irrigation from well-watered to dry conditions. As seen in data collected from the fall of 2023, differences in spectral reflectance can also be detected between wetter and drier areas of the field (Figure 3). This study is currently ongoing, with data being collected in Griffin as well as linear gradient sites at other universities, including UC–Riverside and Rutgers University (where the focus is on cool-season turfgrass species). For warm-season grasses, information is being combined with data from other locations (Tifton and California) and is being processed by Siemens using artificial intelligence to develop models that can best detect the signals indicating when plants need water. This information is being developed into a decision support system, which is a tool that can integrate data across several different sources to provide meaningful information to end users. The next phase of the project involves testing the developed models on various fields, simulating real-world application of the technology to further refine and quantify the potential savings by implementing this tool. The turfgrass industry, for the most part, is already a good steward of natural resources. Precision irrigation management will be essential for the efficient and sustainable management of one of the most important resources for turfgrasses, water.

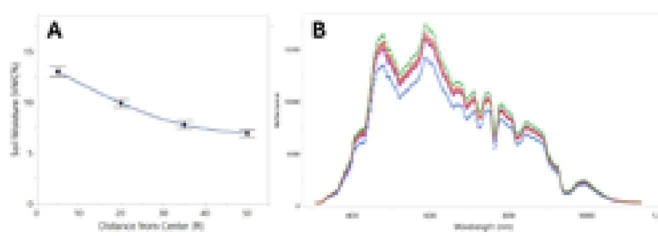

Figure 3. Examples of Decreased Soil Moisture Across the Field and Changes in Spectral Reflectance of the Turfgrass Canopy During a Dry Down.

ACKNOWLEDGEMENTS

This research was supported by Specialty Crop Research Initiative Grant 2021-51181-35855 from the USDA National Institute for Food and Agriculture.

Industry support provided by: Heritage Links, NG Turf, SuperSod, Toro, Irrigation Consultant Services, and Jerry Pate Turf and Irrigation.

Soil Testing and Fertility Management for Turf

Jay T. Lessl, Director, Agricultural and Environmental Services Laboratories
UGA-Athens

ABSTRACT

Developing and maintaining productive soils begins with soil testing. Soil tests provide information on the soil's actual nutrient status. Test results are used to optimize the soil conditions for plants as well as to determine the amount and type of nutrients that should be added for the best growth of lawn, garden, and other types of plants.

STEPS IN SOIL SAMPLING

Recommendations about when and how to apply nutrients are only as good as the soil sample submitted for analysis. To obtain a representative soil sample, the following steps are useful: identify sampling locations (zones), determine the sampling depths, use the right sampling tools, sample at the right time, and handle the samples accordingly.

1. SAMPLING LOCATIONS

Map out the area where the plants are to be grown or are presently growing. This will help in recordkeeping and ensure that the soil is taken from throughout the entire area. Divide the area so that each soil sample represents one plant type or condition. An area that has been divided according to obvious differences in plant types, plant performance, soil types, and drainage is shown in Figure 1.

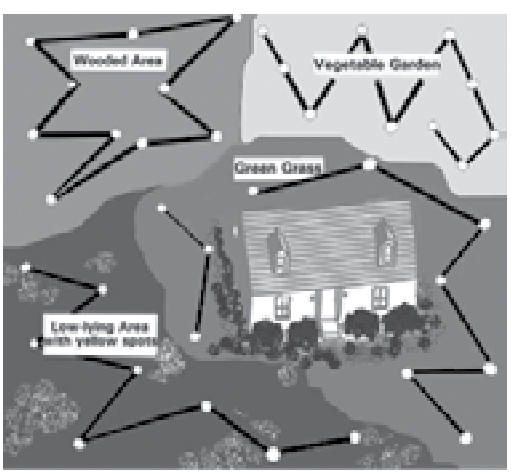

Figure 1. Area Divided According to Vegetation and Soil Characteristics. *Note.* Dots indicate where soil was sampled.

- Use a zigzag approach when taking samples. Collect eight to 10 soil samples from each location (zone) as shown in Figure 1.
- For trees and shrubs, take soil samples from six to eight spots around the drip line of the plants

2. SAMPLING DEPTH

The depth of sampling depends on the type of plants being grown.

- For lawns, sample to a depth of 4 in.
- For gardens, ornamentals, mixed fruit trees, and wildlife plots, sample to a depth of 6 in.

3. SAMPLING TIME

Soil sampling should be done well in advance of planting or spring green-up. This allows adequate time for sample analysis, data interpretation, and fertilizer and lime application.

4. SAMPLING TOOLS

Use clean sampling tools and containers to avoid contaminating the soil sample. Never use tools or containers that have been used for fertilizer or lime. Collect samples with tools like trowels, shovels, spades, hand probes, or hand augers.

5. SAMPLING PROCEDURES

Clear the ground surface of grass thatch or mulch (Figure 2). Using a trowel, push the tool to the desired depth into the soil. Push the handle forward, with the spade still in the soil to make a wide opening. Then, as shown in Figure 3, cut a thin slice from the side of the opening that is of uniform thickness, approximately 1/4 in. thick and 2 in. wide, extending from the top of the ground to the depth of the cut. Collect from several locations. Combine and mix them in a plastic bucket to avoid metal contamination. Take about a pint of the

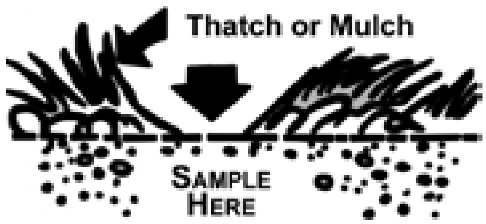

Figure 2. Remove Grass Thatch of Mulch Before Sampling.

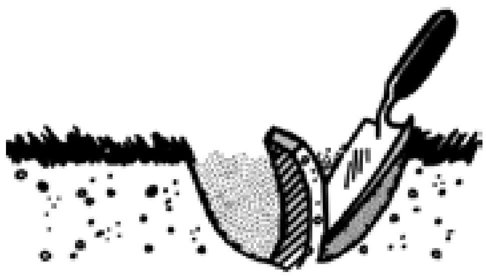

Figure 3. Soil Sampling With a Trowel.

mixed soil and place it the UGA soil sample bag. Be sure to identify the sample clearly on the bag and the submission form before mailing.

SAMPLE HANDING

Samples should be air-dried overnight. Spread samples on a flat surface lined with clean paper. Take care to avoid contamination. After drying, transfer the sample to a soil sample bag and bring it to your local Extension office to fill out the submission forms and to let them know which recommendations and information you need.

FREQUENTLY ASKED QUESTIONS

Q: WHEN AND HOW OFTEN SHOULD SOILS BE TESTED?

A: Soils can be tested at any time during the year. However, allow enough time for the analysis and for fertilizer and lime application. Lime reacts slowly and, if possible, it should be mixed with the soil 2 to 3 months before planting.

Generally, fall and winter are the most desirable times to sample because landscapes and gardens are usually dormant and more easily accessible. Once desired fertility levels are established, lawn and ornamental areas should be tested every 2 to 3 years.

Vegetable gardens and wildlife plots should be tested every year.

Q: HOW SOON WILL I GET MY RESULTS BACK (TURNAROUND TIME)?

A: The analysis takes 2–3 working days from the time the lab receives the samples. In general, it takes 4–6 days from the time we receive the samples to the time you get your test reports back.

Q: WHO DO I CONTACT REGARDING MY SOIL TEST RESULTS AND RECOMMENDATIONS IF I DON'T UNDERSTAND THE NUMBERS?

A: The Soil Test Report provides an interpretation of all soil tests done by the Soil Testing Lab and is accompanied by appropriate nutrient and lime recommendations. If you need further information about your test results, contact your local University of Georgia Cooperative Extension office.

Q: WHAT IF I DO NOT HAVE THE SUGGESTED FERTILIZER OR WANT TO USE ORGANIC AMENDMENTS?

A: We have tools and bulletins to help you make the appropriate conversions. A fertilizer calculator and other helpful information is available on our website: aesl.ces.uga.edu.

Q: CAN I VISIT OR CONTACT THE UGA SOIL LAB DIRECTLY?

A: Our lab is located in Athens and we welcome all questions and visitors. You may contact us at soiltest@uga.edu.

FOR MORE INFORMATION

Contact your location Extension office at 1-800-ASK-UGA1.

ACKNOWLEDGEMENTS

Text modified from UGA Extension Circular 896 (https://extension.uga.edu/publications/detail.html?number=C896) and adapted in part from the materials prepared by Owen Plank, "Soil Testing for Home Lawns and Gardens."

Cutting-Edge Technologies to Determine Sports Field Safety

Gerald Henry, Athletic Association Endowed Professor, Crop and Soil Sciences
UGA-Athens

Erick Begitschke, Doctoral Student, Crop and Soil Sciences
UGA-Athens

Chih Julie Wang, Doctoral Student, Crop and Soil Sciences
UGA-Athens

Audrey Young, Masters Student, Crop and Soil Sciences
UGA-Athens

INTRODUCTION

Athletic injuries will always exist, but a better understanding of player/surface interactions with respect to surface type, profile construction, and field conditions may provide administrators and turfgrass managers with information to help guide future decision-making and reduce injury risk. Previous research within the environmental turfgrass science program at the University of Georgia tangentially linked player injuries with specific agronomic field conditions. However, a more accurate interpretation of these interactions can only be determined through the combination of "real-time" controlled-environment experiments and field trials using wearable sensor technology.

Portable ground-reaction platforms were created at UGA to examine the vertical responses of players to simulated field conditions in a controlled environment setting. These modular systems manipulate a variety of sports field scenarios (surface types, turfgrass species, canopy heights, soil profiles, agronomic conditions, etc.) while being utilized in a laboratory setting to help identify exact field conditions that may lead to an increase in injury occurrence. A force plate inserted underneath the ground-reaction platforms measures the forces sustained by athletes during basic vertical movements (jumping, landing, etc.), while a portable motion-capture system collects kinetic and kinematic data of performed athletic tasks.

Athlete running lanes also were constructed in the field and used in conjunction with a motion-capture system to obtain vertical and horizontal responses (starting, stopping, cutting, etc.) of players traversing areas that consist of different surface types and compositions. Data generated using these techniques are extremely useful to describe differences in injury risk between playing surfaces (natural grass vs. synthetic turf; turfgrass species, cultivars, etc.) and agronomic conditions (soil compaction, soil moisture, poor rooting, etc.) while also providing information to justify the continued use of important management inputs (pesticides, water, etc.) that may face increased regulation in the near future.

MATERIALS AND METHODS

Measuring Vertical Responses in a Controlled Environment

A Bertec portable force plate (load capacity 2000 lb) was placed underneath each ground-reaction platform (3-in. USGA sand profile, 6-in. USGA sand profile, and 6-inch native sandy clay loam profile all grassed with 'IronCutter' hybrid bermudagrass) along with a portable motion-capture system were used to collect kinetic and kinematic data of performed athletic tasks (Figure 1). One healthy 20-year-old male participant (5 ft 9 in. tall, weighing 178 lb) was fitted with an inertial measurement unit (IMU) on the thigh and shank of his dominant leg. Three trials of four athletic maneuvers (jump landing, drop landing, single-leg drop landing, and counter-movement jump) were conducted on the three ground-reaction platforms and the force plate alone (Figure 2). Peak vertical force (Fz) was determined by the force plate for each trial of each maneuver and were reported in bodyweights (BWs). Peak thigh and shank resultant accelerations were determined by the attached IMUs.

Figure 1. Ground-Reaction Platforms Pictured With the Force Plate and Mobile Motion-Capture System.

Figure 2. The Participant Performing an Athletic Maneuver on a Ground-Reaction Platform.

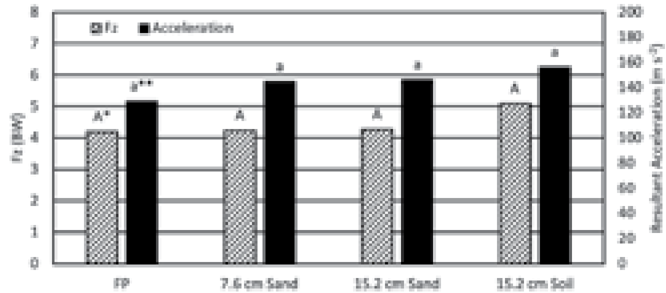

Figure 3. Peak Vertical Forces (Fz) and Resultant Accelerations Determined With IMUs Fitted to an Athlete Conducting the Counter-Movement Jump.

Measuring Horizontal and Vertical Responses in the Field

A portable motion-capture system was used to film athletes as they traversed the running lanes at the Athens Turfgrass Research and Education Center. Three male and five female athletes participated in the trial. Sensors (IMUs) were placed on the pelvis, thigh, and shank of each participant. Three trials of each activity (acceleration/deceleration, jump landing, and single-leg cut landing) were performed by each participant on each of the trial surfaces (hybrid bermudagrass, perennial ryegrass, synthetic turf, large crabgrass, and white clover). Peak vertical and horizontal forces were derived from accelerations measured by the IMUs. Knee angles were calculated using the OpenSense executable function of OpenSim. Performance testing matrices (normalized difference vegetative index, soil moisture, shear strength, and surface hardness) were also recorded on each surface before each participant performed the assigned athletic maneuvers. Infill depth was also measured for the synthetic turf system.

RESULTS AND DISCUSSION

Force Plate Vertical Force Measurement

Peak vertical forces (Fz) and resultant accelerations measured across all four athletic maneuvers (jump landing, drop landing, single-leg drop landing, and counter-movement jump) were used to determine the validity/feasibility for using the ground-reaction platforms to accurately compare different surfaces and profiles. The counter-movement jump was the only maneuver that effectively compared the three ground-reaction platforms and the force plate alone (Figure 3). Therefore, this maneuver can be employed to accurately compare surfaces and soil profiles using the ground-reaction platforms.

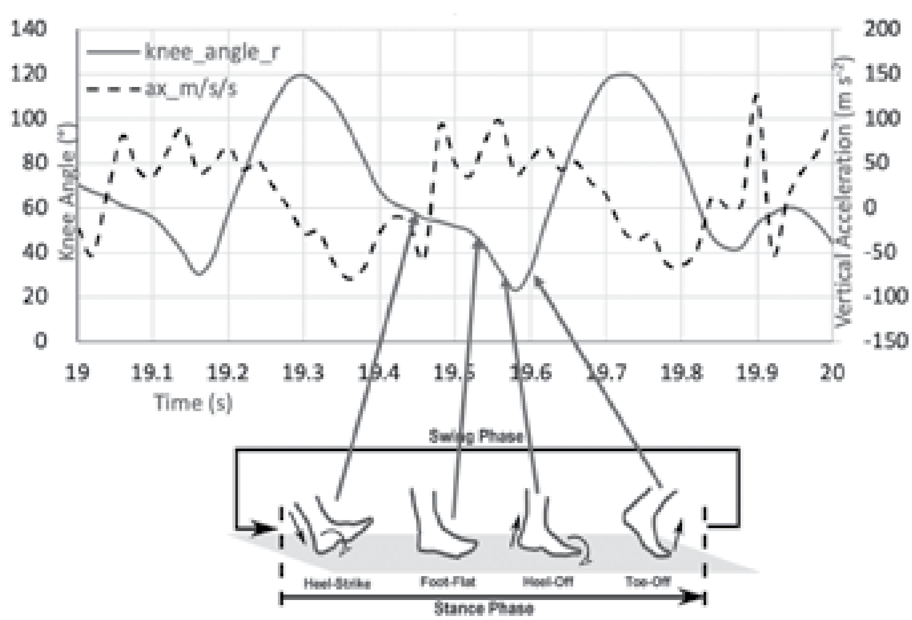

Figure 4. Vertical Acceleration and Knee Angles Measured on a Participant Traversing the Athlete Running Lanes.

Cutting-Edge Technologies, *continued*

Athlete Running Lane Research

Higher vertical ground-reaction forces and lower-leg vertical accelerations are associated with elevated injury risk, but vertical ground-reaction force data is difficult to measure in the field. Therefore, lower-leg vertical acceleration parameters serve as an alternative. Athletes are trained to land with increased knee flexion to decrease knee strain and prevent injuries. Surface characteristics are known to influence knee flexion angles when athletes contact the surface of a playing field. Combining knee flexion angles and tibial acceleration data may be a new way to evaluate playing-surface safety (Figure 4).

Data generated from participants performing the single-leg cut landing maneuver on the athlete running lanes yielded significant differences with respect to knee angle across the tested surfaces (Figure 5).

Synthetic turf had the smallest knee angle, while ryegrass and both weed species exhibited slightly larger knee angles. However, the largest knee angle—and therefore the safest surface—was hybrid bermudagrass. Greater knee flexion in response to the bermudagrass surface will ensure that forces exerted back at the athlete in response to interacting with the surface will be spread throughout more of the body and less concentrated in a smaller region (i.e., responses observed when interacting with synthetic turf). Therefore, when player/surface interactions are compiled over an entire game or over an entire season, they will have less negative impact on the athlete and reduce the risk of injury.

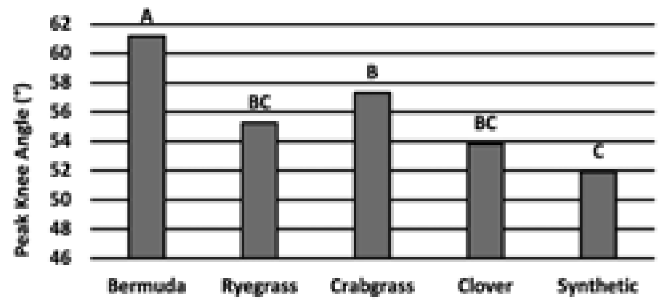

Figure 5. Participant Knee Angles Measured During the Performance of the Single-Leg Cut on All of the Tested Surfaces.

Breeding and Evaluation of Turf-Type Tall Fescue at the University of Georgia

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OVERVIEW

At the University of Georgia, we have initiated a breeding project to improve tall fescue (*Festuca arundinacea*) using diverse environmental conditions across the state (Figure 1). The range of environments among these locations provides immense potential for breeding enhanced tall fescue cultivars, addressing both current and future needs. The ultimate goal of this breeding project is to develop climate-resilient tall fescue cultivars that are suitable for use within Georgia and across a significant portion of the U.S.

Tall fescue is a cool-season, bunch-type perennial grass native to Europe and Asia (Buckner et al., 1979). This allohexaploid species (2n = 6x = 42) was introduced to the United States in the late 1800s and gained popularity in the 1940s following the release of the first commercial cultivars 'Alta' and 'Kentucky-31', which became major forage grasses (Fergus & Buckner, 1972; Watkins & Meyer, 2004; Beard, 2013). In 1962, Dr. C. Reed Funk began a cool-season turfgrass breeding program at Rutgers University in New Jersey (Meyer & Funk, 1989; Meyer et al., 2017). He collected tall fescue germplasm naturalized in the Northeast and Southeast U.S. Through Dr. Funk's efforts, turf quality traits including leaf color and texture, as well as plant density and uniformity, were significantly improved and the first turf-type tall fescue cultivar, 'Rebel', was released in 1981 (Funk et al., 1981). 'Rebel', along with other early turf-type tall fescues, revolutionized the turfgrass industry.

Tall fescue is the most heat- and drought-tolerant cool-season turfgrass (Youngner et al., 1962; Fry & Huang, 2004; Emmons & Rossi, 2016) and is widely used for home lawns, recreational areas, golf courses, and sports fields throughout the northern and transition zone regions of the United States. (Funk et al., 1981; Hannaway et al., 2009). Its persistence under low-maintenance conditions, winter hardiness, and shade performance are additional attributes that have contributed to its popularity (Carrow, 1996; Tegg & Lane, 2004; Miller et al., 2013). Over the past 40 years, tall fescue breeding objectives have centered around improving seed yield potential, turf quality characteristics, disease resistance, and tolerance to drought, heat, shade, and traffic stress.

Several diseases affect tall fescue, both in mowed turf stands and seed production fields, and these have intensified with changing climate and weather patterns. Brown patch, caused by *Rhizoctonia solani*, and stem rust, caused by *Puccinia graminis*, have historically been the most problematic. Brown patch affects mowed turf, causing symptoms that range from plant canopy thinning to severe turf loss.

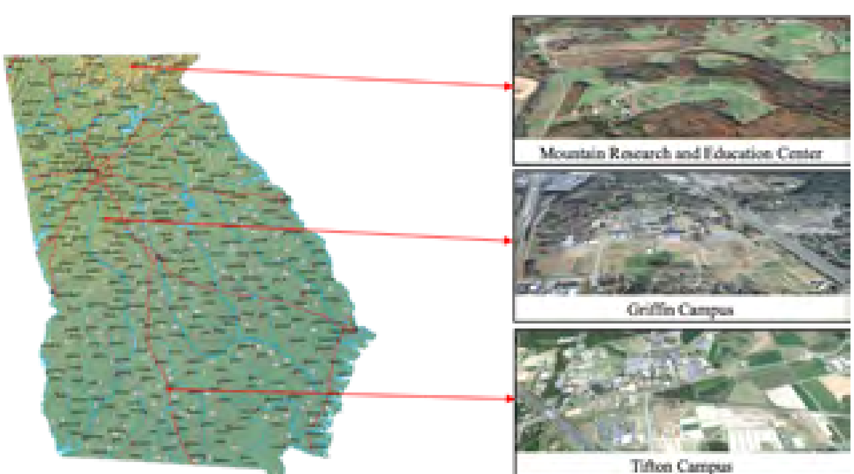

Figure 1. University of Georgia Research Sites Used for Breeding Climate-Resilient and Environmentally-Sustainable Turfgrass Cultivars.

Breeding and Evaluation of Turf-Type Tall Fescue, *continued*

There have been successful breeding efforts in selecting single-spaced plant clones for resistance to this disease (Bokmeyer et al., 2009). Stem rust affects tall fescue during seed production, which is a major industry in the Willamette Valley of Oregon. Tall fescue is the most widely grown grass seed crop in the state of Oregon, with over 60,000 hectacres in production as of 2021 (Anderson et al., 2021). This disease can reduce seed yield by over 70% if untreated (Anderson & Chastain, 2012). Despite its significance, progress in breeding for stem rust resistance has been limited, necessitating costly preventative fungicide applications.

More recently, widespread epidemics of gray leaf spot have been documented on tall fescue. Gray leaf spot is caused by *Pyricularia oryzae* (syn. *Magnaporthe oryzae*), a fungal pathogen that infects more than 50 species of the Poaceae family, including turf and forage grasses such as hard fescue (*Festuca brevipila*), annual ryegrass (*Lolium multiflorum*), perennial ryegrass (*Lolium perenne*), and St. Augustinegrass (*Stenotaphrum secundatum*), and major field crops including rice (*Oryza sativa*), wheat (*Triticum aestivum*), pearl millet (*Pennisetum glaucum*), and sorghum (*Sorghum bicolor*) as noted in Sprague, 1950; Asuyama, 1965; Ou, 1985; Talbot, 1995; Trevathan, 1982; Uddin and Soika, 2000; and Vines et al., 2021.

Gray leaf spot can be lethal to tall fescue plants ranging from young seedlings to well-established stands. The expanded occurrence of gray leaf spot on tall fescue is likely due to pathogen evolution and climate change, which lead to shifts in geographic distributions of plant diseases. Resistance to gray leaf spot is currently the most demanded trait in new tall fescue cultivars (Stephen Johnson, personal communication). However, future cultivars will also need to couple resistance to gray leaf spot with resistance to brown patch and stem rust, along with improved turf quality, drought and heat tolerance, and seed yield.

The long-term objectives of the tall fescue breeding project at the University of Georgia are to identify tall fescue germplasm with high seed yield potential; resistance to important diseases including brown patch, gray leaf spot, and stem rust; improved drought and heat stress response; reduced fertilizer and mowing requirements; and enhanced turf quality characteristics. These efforts aim to develop climate-resilient, environmentally sustainable tall fescue cultivars that are locally adapted to perform well within the state of Georgia as well as cultivars that are more broadly adapted for superior performance across a large geographic range of the United States and beyond.

Our initiatives include (a) collecting tall fescue germplasm from old turf areas (Figure 2) to identify new genetic resources for enhanced pest and stress tolerance, (b) screening tall fescue collections and commercial cultivars for gray leaf spot resistance, and (c) evaluating tall fescue germplasm in the diverse environments across Georgia to identify superior lines for regional and broad adaptation.

Figure 2. Collecting Tall Fescue Germplasm in Georgia, February 2023.

Note. Cool-season grasses are easily distinguished from warm-season grasses during this time of year due to winter dormancy (brown or straw color) of warm-season grasses.

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ACKNOWLEDGMENTS

We are grateful for the contributions by Larry Baldree, Thad Burton, Kamal Dhillon, Jonathon Fox, Sameer Khanal, Harshita Saxena, Amanda Webb, and Lewayne White.

Skyseed: A New Weed Species in Georgia Lawns

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ABSTRACT

Turfgrass is a quality business with expectations of green, weed-free lawns, sports fields, and golf courses. Weeds are opportunistic plants that compete for light, water, space, and nutrients. On sports fields, weeds can compromise field safety by reducing footing and surface uniformity. Due to the impact on safety, competition, and effect on aesthetic appeal, weed control is a significant part of turfgrass management.

Over the past few years, there have been more requests for the identification of weed species that are "new" to an area. This has led to an ability to document known weed species that have moved beyond their reported range and the discovery of new weed species in turfgrass systems. One such new species is *Chevreulia acuminata*, which has the common name of skyseed or Chevreul's sharp lawn-weed (Figure 1).

Figure 1. Skyseed (*Chevreulia acuminata*) in a Well-Maintained, Warm Season Lawn.

Little is known about the biology or control of skyseed in southern lawns. It appears to be a native of South America and was first reported in eastern Alabama, possibly on a Facebook post in 2012. In Georgia, requests for identification occurred in 2021 and have increased since.

Skyseed has been observed in lawns, roadsides, cemeteries, and unimproved turfgrass areas. It was initially speculated that it preferred poor fertility soils, but during spring 2024 skyseed was identified in well-maintained stands of bermudagrass, centipedegrass, St. Augustinegrass, and zoysiagrass.

Taxonomically, skyseed is not well described but is considered in the Asteraceae family, same as sunflower. It is a perennial species with surface-level creeping stems (procumbent). The leaves are hairier (pubescent) on the lower surface than the upper, with an opposite arrangement originating from the base of the plant (basal). Flowers are on solitary heads of elongated 4–6 in. stalks (peduncles). It is the stalks and seedheads that are most noticeable in the lawn during the spring. Like dandelion (*Taraxacum officinale*), seeds are attached to bristles (pappus) that aid in wind dissemination and proliferation of the species.

Skyseed has been misidentified as two other species. It is similar in appearance and growth habit of annual trampweed (*Facelis retusa*), a winter annual. Dwarf dandelion (*Krigia dandelion)* is the second species confused with skyseed. *Krigia* dandelion is a perennial with a diminutive seedhead that resembles a "regular" dandelion. Unlike skyseed, *Krigia* dandelion produces a yellow flower before the fluffy seedhead.

Uncontrolled, skyseed will form a surface level "mat" that can predominate the turfgrass (Figure 2). Beyond the environmentally conducive conditions of the spring, it is not known if skyseed is more competitive than the surrounding warm-season turfgrass. Early observations are that turfgrass outcompetes the weed as temperatures increase, but the weed persists as a subcanopy species.

In June 2024 a simple study was initiated to investigate herbicide control options. Treatments included granular and liquid formulations of a three-way broadleaf weed herbicide (2,4-D, MCPP, and dicamba) applied at a rate of 1.23 lb ai/acre and granular and liquid formulations of atrazine applied at 2 lb ai/acre. Plots were evaluated for weed control throughout the summer and will be maintained until spring 2025 for long-term weed control.

Early indications are that both herbicides and formulations have efficacy on skyseed with a single application. It will not be until spring 2025 before it is known if a single application can effectively control an established mat of skyseed.

Figure 2. Skyseed "Matted" and Predominating in a Fine-Textured Zoysiagrass Lawn.

Rhizoctonia Large Patch Management in Turfgrass

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ABSTRACT

Rhizoctonia large patch (RLP) presents a significant economic challenge for warm-season turfgrass. In this study we aimed to assess the efficacy of biofungicides against RLP, identify RLP-resistant genotypes, and map quantitative trait locus for RLP resistance on zoysiagrass. Main results showed that biofungicides complemented by synthetic fungicides in spray programs reduced RLP by up to 71%, thereby offering alternative strategies for environmentally friendly disease control. In addition, our results provided some valuable RLP-resistant genotypes from our germplasm and several genetic loci for RLP resistance, facilitating marker-assisted selection and breeding efforts in zoysiagrass.

INTRODUCTION

Rhizoctonia large patch (RLP) caused by *Rhizoctonia solani* (AG 2-2 LP) is a challenging disease of warm-season turfgrass that deteriorates turf quality and playability. The disease poses a significant risk when warm-season turfgrass enters or exits dormancy, particularly on zoysiagrass (Kim et al., 2021). Synthetic fungicide applications are widely used to manage RLP, including the use of methyl benzimidazole carbamates [MBC; Fungicide Resistance Action Committee (FRAC) group code 1], dicarboximides (FRAC group code 2), demethylase inhibitors (DMI; FRAC group code 3), quinone outside inhibitors (QOI; FRAC group code 11), and aromatic hydrocarbons (AH; FRAC group code 14). However, the overreliance and repeated use of chemical treatments have raised environmental implications and fungicide-resistance complications (Amaradasa et al., 2014). To date, limited studies have attempted to develop alternatives to synthetic fungicides and explore sources of host-plant resistance. This study was performed on zoysiagrass, and the goals were to assess the efficacy of biofungicides against RLP, identify RLP-resistant genotypes, and map quantitative trait locus for RLP resistance.

MATERIALS AND METHODS

Efficacy of Biofungicides Against Rhizoctonia Large Patch

The efficacy of three biofungicides—*Bacillus subtilis* QST713 (Rhapsody®), *B. amyloliquefaciens* F727 (Stargus™), and *Reynoutria sachalinensis* extract (Regalia®)—seven synthetic fungicides, and 10 different combinations, were tested in vitro in PDA media against *R. solani* 'Meyer' isolate. Fungicides were prepared according to manufacturers' instructions and the "poisoned food technique" was used as described by Grover and Moore (1962). The percent growth inhibition was calculated for each fungicide treatment compared to the nonfungicide amended control plate. In addition, seven fungicide spray programs—incorporating *B. subtilis* QST713 and propiconazole either alone or in a tank mix—were assessed in both growth chamber and field environments against RLP on zoysiagrass cultivar 'El Toro'. Field environments included the UGA Griffin Campus in Griffin, GA, and Rivermont Golf Club in Johns Creek, GA. Visual disease severity and turf quality were evaluated using a modified Horsfall-Barratt scale (1945) of 1–11 and the National Turfgrass Evaluation Program 1–9 ratings, respectively. Analysis of variance was performed using R statistical software (R Core Team, 2021), and group means were separated using Tukey's HSD test (p = 0.05).

Identify Rhizoctonia Large Patch-Resistant Genotypes

Twenty-four zoysiagrass genotypes were assessed for their disease response against three isolates of *R. solani* under growth chamber conditions. Isolates Rs_Meyer2019 and Rs_Seastar2022 were isolated from the UGA Griffin Campus in 2019 from zoysiagrass 'Meyer' and in 2022 from seashore paspalum 'Seastar', respectively. Isolate LPZM2 was sampled from zoysiagrass 'Meyer' in Raleigh, NC, in 2011 and was provided by Susana Milla-Lewis. Visual disease severity, turf quality, and area under the disease progress curve (AUDPC) were evaluated as described above each week for 6 weeks beginning 30 days post-inoculation. Data analysis was performed using R software.

Mapping Quantitative Trait Locus for Rhizoctonia Large Patch Resistance

For this study, we used a mapping population regrouping 228 F1 progenies derived from 'Meyer' × PI 231146 and planted in a randomized complete block design with two replications at the UGA Mountain Research and Education Center in Blairsville, GA. The *R. solani* isolate from seashore paspalum was used to artificially inoculate plots during the spring and fall of 2023. Visual disease severity and turf quality were evaluated as described above. AUDPC also was calculated. Quantitative trait locus (QTL) mapping was conducted using individual replicate values of disease severity and turf quality with Windows QTL Cartographer software (Wang et al., 2012).

RESULTS

Biofungicide *B. subtilis* QST713 reduced *R. solani* growth by up to 100% during in vitro trials. Growth chamber trials showed that spray programs combining bio- and synthetic fungicides in a tank mix and rotation every 14 days were as effective as a stand-alone application of synthetic fungicide propiconazole every 28 days. All spray programs tested in the field reduced RLP by up to 71% in disease severity and 52% in AUDPC, while maintaining acceptable turf quality (> 7.0). The efficacy of biofungicide spray programs was validated in the golf club setting (Figure 1).

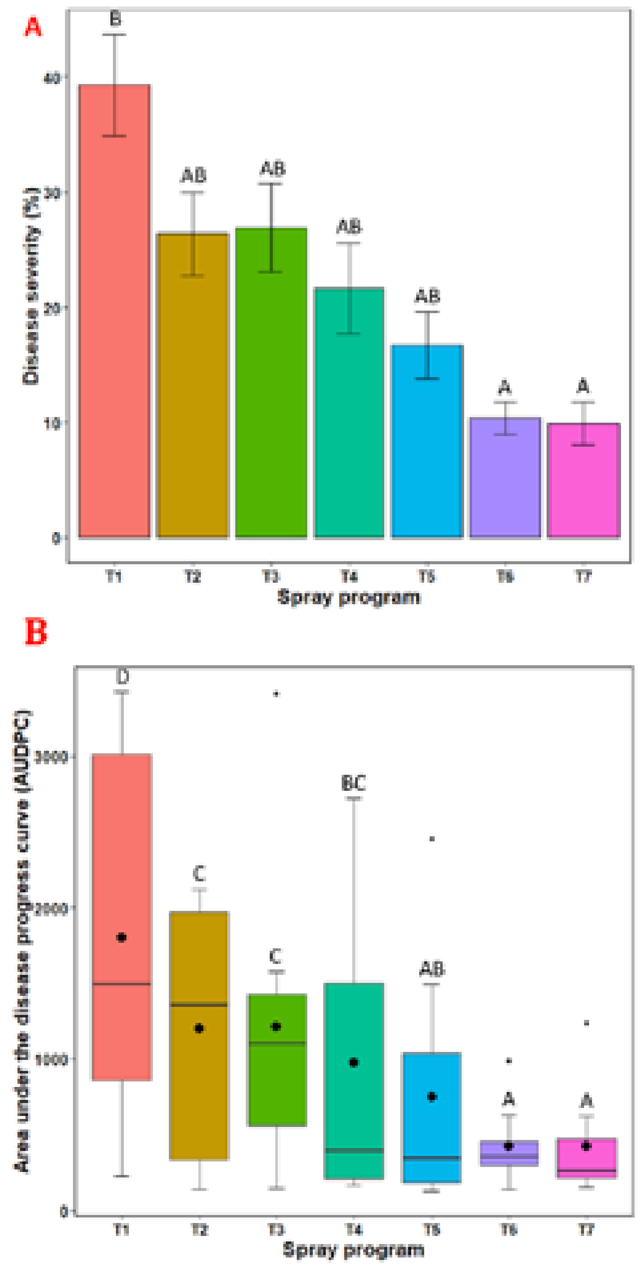

Figure 1. (A) Rhizoctonia Large Patch Average Disease Severity (%) and (B) Area Under the Disease Progress Curve (AUDPC) for Seven Spray Programs (T1–T7) in Growth Chambers Across Two Experiments.

Note. Trials in their respective bar charts with the same letters are not significantly different according to Tukey's test ($p < 0.05$).

T1: non-treated control.

T2: *B. subtilis* QST713 applied every 7 days.

T3: *B. subtilis* QST713 applied every 14 days.

T4: propiconazole applied every 28 days.

T5: tank mix of 75% *B. subtilis* QST713 + 25% propiconazole applied every 28 days.

T6: 75% *B. subtilis* QST713 + 25% propiconazole tank mix in rotation with 100% *B. subtilis* QST713 applied every 14 days.

T7: 100% *B. subtilis* QST713 in rotation with 75% *B. subtilis* QST713 + 25% propiconazole tank mix applied every 14 days.

Rhizoctonia, *continued*

Identify Rhizoctonia Large Patch Resistant Groups

Significant differentiation in disease level was observed across 24 zoysiagrass genotypes when screened against three different isolates (Table 1). Zoysiagrass genotype L1F inoculated with *R. solani* isolate LPZM2 from North Carolina resulted in the lowest AUDPC (43.7) of all genotypes evaluated, exhibiting a high level of resistance. Similarly, genotypes PI 231146 and Matrella recorded the lowest AUDPC (60.0 and 62.8, respectively) when screened against Georgia isolate Rs_Seastar2022. Interestingly, Matrella also showed a high level of resistance (the lowest AUDPC was 114.8) against the Georgia isolate Rs_Meyer2019.

Genotype	Rs Meyer2019 (GA)	Rs Seastar2022 (GA)	LPZM2 (NC)
Cashmere	1706.2	900.5	698.1
Cavalier	1308.8	1708.9	700.8
Diamond	998	1185.7	183
El Toro	2794.6	3018.8	1637.9
Emerald	3204.7	3456.3	2850.2
Empire	1730	1184.9	607.8
Geo	3322.3	153	1009
GZZ-LG3.20	3248.5	1285.1	2665.1
HN 17-4	2008.9	188.5	535.8
Innovation	3363.3	1186.7	3177.3
JaMur	1977.9	430.1	1538.5
L1F	393.6	**43.7**	202.2
Matrella	**114.8**	397.3	**62.8**
Meyer	692.6	1121	798.4
Palisades	1222.2	2748.1	721.8
PI 231146	261.5	382.7	**60**
PI 553020	1563.1	3128.1	1845.8
Pristine Flora	257	1797.4	144.8
Rollmaster	747.3	359.9	806.5
Shadow Turf	1169.3	994.3	1392.6
Trinity	3148.2	2203	3401.6
Zenith	2993.2	2154.7	3317.8
Zeon	951.5	712.6	668
Zorro	668.9	876.7	1570.4

Table 1. Area Under the Disease Progress Curve for Rhizoctonia Large Patch.

Note. AUDPC for 24 zoysiagrass genotypes assessed across 6 weeks, 30 days post-inoculation in growth chamber experiments.

Mapping Quantitative Trait Locus of Rhizoctonia Large Patch Resistance in Zoysiagrass

The female ('Meyer') and male (PI 231146) parent linkage maps consisted of 817 (1723 cM) and 639 SNPs (2039 cM) in 20 linkage groups, respectively. Five (Chr1, 5, 7, and 17) and seven (Chr1, 2, 7, 11, 14, and 18) QTL were identified in the female and male maps, respectively. A total of five QTL exhibited major effects [> 10% phenotypic variance (PV)]. QTL for turf quality on Chr7 (14.0% PV, 79.21 cM) and another QTL for turf quality on Chr14 (19.2% PV, 27.91 cM) had the highest PV in the female and male maps, respectively (Table 2).

CONCLUSIONS

Overall, our findings revealed that:

1. Several particular zoysiagrass genotypes from our germplasm presented significant disease resistance against RLP, and
2. Genetic loci associated with RLP resistance were identified in zoysiagrass.

These results could be valuable for facilitating the breeding of RLP-resistant zoysiagrass cultivars and offering alternative strategies for a sustainable management strategy of Rhizoctonia large patch.

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ACKNOWLEDGEMENTS

This project was funded by the 2021 USDA-NIFA project "Implementation of system-based IPM programs in key production systems in Georgia," the 2022 Georgia Golf Environmental Foundation grant "Remote sensing and biological pesticides to enhance Rhizoctonia control of warm-season turfgrasses in Georgia," and SERA48 Turfgrass Pest Management. The authors thank Bayer, Marrone Bio Innovations, Syngenta, and BASF for providing the bio- and synthetic fungicides used in this study.

Trait	QTL	Chromosome	LOD threshold	QTL interval (cM)	Flanked markers	QTL position (cM)	PV (%)
Female ('Meyer') map							
Severity_R1_Spring 2023; Quality_R1_Spring2023	QTL1	1	2.7; 3.2	40.41–49.41	Tag_228r - Tag_238	45.41	10.7; 10.4
Quality_R2_Spring2023	QTL1	17	3.0	32.71–37.71	Tag_1633 - Tag_1607	35.61	8.8
Severity_R2_Fall2023	QTL1	5	3.1	102.81–108.51	Tag_3514r - Tag_3507r	107.51	10.8
Quality_R1_Fall2023	QTL1	7	3.2	78.31–81.81	Tag_3815r - Tag_2401r	79.21	14.0
Quality_R2_Fall2023	QTL1	7	3.1	82.91–85.41	Tag_3796r - Tag_3813r	83.51	8.6
Male (PI 231146) map							
Severity_R1_Spring2023	QTL1	11	2.8	42.71–43.71	Tag_4484	42.71	6.8
Severity_R2_Spring2023	QTL1	18	3.1	98.81	Tag_2768r	98.81	8.1
Quality_R1_Spring2023	QTL1	7	3.1	28.61–55.11	Tag_1117r - Tag_1035r	36.31	10.4
Quality_R2_Spring2023	QTL1	1	3.2	89.61–93.41	Tag_1773 - Tag_1732	92.41	8.4
Severity_R1_Fall2023	QTL1	2	2.8	30.01–35.31	Tag_519 - Tag_528	31.31	8.7
Severity_R2_Fall2023	QTL1	7	2.9	79.61–87.81	Tag_2374r - Tag_2352	84.11	8.6
Quality_R2_Fall2023	QTL1	14	3.2	20.91–45.81	Tag_4804 - Tag_1967r	27.91	19.2

Table 2. QTL Summary for RLP Resistance Identified in the Female ('Meyer') and Male (PI 231146) Maps Using 228 F1 Progenies at the UGA Mountain Research and Education Center in Blairsville, GA.

Management of Turfgrass Diseases: Chemical Control

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Over the last 2 years, a series of research trials were implemented to determine the efficacy of fungicides, rates, as well as their timing as pre- and post-epidemic control on various turfgrass diseases (large patch, dollar spot, take-all root rot, brown patch, pythium, Microdochium patch, bipolaris leaf spot).

All the fungicide trials were conducted in our turfgrass research areas at the University of Georgia-Griffin campus. The fungicides were tested in zoysiagrass cv. 'El Toro'; bermudagrass cv. 'Princess', cv. 'TifEagle'; and bentgrass cv. A1/A4, 'Pencross 2.0'.

Fungicides evaluated in our research areas included: prothioconazole (Densicor®); tebuconazole (Mirage® Stressgard®); fluopyram + prothioconazole + propamocarb (Resilia™); benzovindiflupyr + difenoconazole (Ascernity®); pydiflumetofen + azoxystrobin + propiconazole (Posterity®Forte, Posterity®XT). Numerous numbered products (fungicides in development) also have been tested in our research plots in the last 2 years.

Recently, several turfgrass fungicides have been introduced to the industry, including (but not limited to) triticonazole + pyraclostrobin (Aramax™), azoxystrobin + propiconazole (Compendium®), fluindapyr + flutriafol (Kalida®), fluoxastrobin (Castlon™), benzovindiflupyr + difenoconazole (Ascernity®); pydiflumetofen + azoxystrobin + propiconazole (Posterity®Forte, Posterity®XT), mefentrifluconazole (Maxtima®); mefentrifluconazole + pyraclostrobin (Navicon®); boscalid + chlorothalonil (Encartis®); prothioconazole (Densicor®); fluopyram + prothioconazole + propamocarb (Resilia®); picarbutrazox (Serata®).

On this stop, we will discuss and answer questions regarding the latest fungicides available to turfgrass professionals. We will also reinforce the integrated pest management strategies for turfgrass disease management. Results obtained in these investigations provide turfgrass managers with new disease management tools, improved disease control, and better turf quality. For a complete and up-to-date list of turfgrass fungicides visit the GeorgiaTurf website (https://turf.caes.uga.edu/publications/pest-control-recomendations.html).

This information is only a guide. Reference to products is not intended to be an endorsement. No criticism is intended of products not listed. Individuals using such products assume responsibility for their use in accordance with the current directions of the manufacturer. Read and follow label directions for mixing and application.

Transovarial Effects of Pyriproxyfen on Japanese Beetles in Turfgrass

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INTRODUCTION

The Japanese beetle, *Popillia japonica*, is a serious pest of landscape trees, shrubs, and turfgrass in the eastern U.S. Native to the Japanese archipelago, it was first detected in New Jersey in 1916. Adults are shiny and attractive, medium-sized, ovoid-shaped beetles, about 1 cm long, with metallic green bodies and iridescent bronze elytra. The elytra, or the first pair of hard wings, do not cover the body completely, exposing six small tufts of white hair along the sides of the abdomen under the wing edges.

In Georgia, adults emerge from the ground in May to June. The recently emerged females mate and drop to grass, burrowing into the soil for egg laying. When the eggs hatch, larvae develop in the soil, feeding on roots and organic matter. The larvae move deeper into the soil profile as they molt into higher instars during late fall and winter. They move up near the soil surface and pupate in the spring. They overwinter in larval stages. Extensive infestation on turfgrass can cause severe damage. Initially, the feeding damage appears as yellow or brown spots on turfgrass, and eventually these spots coalesce into larger patches. Many larvae are found beneath dying or struggling turfgrass.

Insect growth regulators (IGR) are insecticides that primarily target immature stages of insect pests and could play an important role in managing Japanese beetle population development in turfgrass. IGR are insecticides with a reduced risk and low toxicity to nontargets, especially mammals. Pyriproxyfen is a pyridine-based IGR that is a juvenile hormone analog (classified by the Insecticide Resistance Action Committee as Group 7C). Pyriproxyfen is widely used to manage many insect pests in turfgrass and ornamentals. Adult female insects exposed to pyriproxyfen will produce fewer and/or unviable eggs. Such transovarial effects have been reported for pyriproxyfen against many insect pests. However, this mechanism is *not* demonstrated in the Japanese beetle.

The objective of this study was to determine the transovarial effects of pyriproxyfen on adult Japanese beetles. If positive effects are observed, this tool can be used to spray adults feeding on ornamental shrubs and trees so that they will lay fewer eggs or to reduce the viability of eggs.

MATERIALS AND METHODS

In 2023, a trial comparing the effects of pyriproxyfen treatments against Japanese beetle larvae was conducted at the UGA Griffin Campus, in Griffin, GA. Japanese beetles were collected in the field using commercial lures in infested areas in central Georgia. The collected live beetles were maintained in plastic containers on crape myrtle foliage. The adults were sorted into males and females. Pyriproxyfen (Fulcrum®) at 90.3 g per hectacre was used in the study. A water volume of 373.9 L per hectacre was used to prepare the pyriproxyfen solution with a concentration of 241.7 ppm. Adjuvants or surfactants were not used.

The treatments were exposure to pyriproxyfen, which included dipping; feeding; dipping + feeding;

Figure 1. The experimental setup of the white grub trial in the field.

Transovarial Effects, *continued*

and a nontreated control. The adult females were dipped in pyriproxyfen solution for 6 seconds for the dipping treatment. For the feeding treatment, adults were allowed to feed for 24 hr on dried residues of pyriproxyfen applied on crape myrtle foliage. For the dipping + feeding treatment, adults were allowed to feed on pyriproxyfen-treated crape myrtle foliage for 24 hr, then dipped in pyriproxyfen solution for 6 seconds.

Six replicates of each treatment were assigned according to a randomized complete block design. The plot size was 2.3 m^2. Two PVC tubes were deployed on the ground in each plot, where each tube had a 0.02 m^2 turfgrass surface for beetle release. On June 8, 2023, 20 females and 10 males were introduced to each tube and were caged by attaching a screen mesh to the PVC tubes for 7 days (Figure 1). After 7 days, the screen mesh from each tube was removed.

On September 6, 2023, the tubes were pulled from the ground, and the number of live young instars of white grubs (second and third instars) in the soil within the tube was counted ($f = 5.0$; $df = 3{,}15$; $p = 0.013$; Figure 3). The white grub data were subjected to analysis of variance (PROC GLM) procedure using SAS software after log transformation.

RESULTS AND DISCUSSION

The number of young Japanese beetle larvae was significantly lower for dipping + feeding treatment than for the feeding and nontreated control treatments (Figure 3). There was no significant difference in the number of young Japanese beetle larvae between dipping and dipping + feeding treatments.

Data suggest that exposing adults to pyriproxyfen can potentially reduce Japanese beetle populations. This suggests that pyriproxyfen could be sprayed on adults feeding on ornamental shrubs a few days after emergence as they tend to reduce the number of larvae feeding on turfgrass roots. It is not certain if the pyriproxyfen reduced the number of eggs laid by females or if it reduced the viability of eggs. More research is warranted to understand the transovarial effects of pyriproxyfen and other IGR.

ACKNOWLEDGMENTS

I appreciate Chris Hardin, Mahesh Ghimire, and young scholars Maia Ottenberg and Dalila Harris, who provided technical assistance with the experiment.

Figure 2. Pulling Cages From the Field on September 6, 2023.

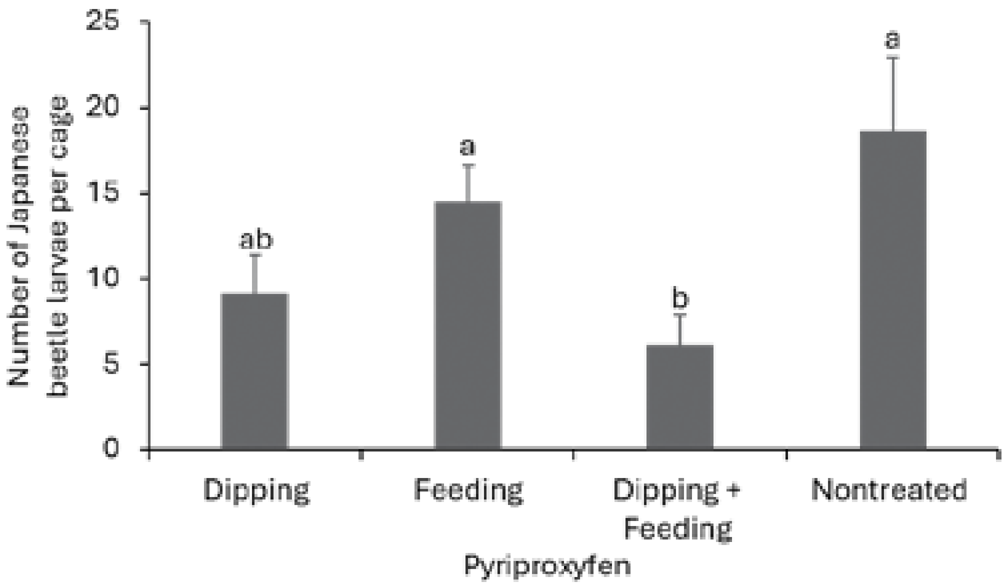

Figure 3. Mean (± SE) Number of Live Japanese Beetle Larvae Recovered From the Cage After Adults Were Exposed to Pyriproxyfen by Various Methods.

Note. The same letters on the bars indicate no significant difference among treatments using Tukey's HSD test ($p < 0.05$).

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Toward Seeded Zoysiagrass Cultivars: Base Broadening and Germplasm Improvement at the University of Georgia

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BACKGROUND

Zoysiagrass stands out as the most adaptable warm-season turfgrass, offering significant potential to meet the evolving challenges and opportunities faced by the turfgrass industry in the context of climate change. It has a suite of multipurpose utilitarian attributes (for example, in sport fields, home lawns, public greenspaces, and roadsides) including drought, shade, and salinity tolerances; low fertilizer, pesticide, and mowing requirements; superior turf quality, and enhanced ecosystem services (for example, better curb appeal, erosion control, pollution filtration, and physical and emotional welfare). However, the broader adoption of zoysiagrass is constrained because it is primarily available as sod, with only two cultivars, ‘Zenith’ and ‘Compadre’, offered in seed form.

Seed-propagated zoysiagrass cultivars with improved aesthetics have high demands in the specialty commodity markets, both in the United States and overseas, for providing a cheaper and easier alternative to vegetative establishment, potentially increasing the adoption of warm-season, drought-tolerant turfgrass landscapes and reducing potable water usage in irrigation. Production of seed-propagated zoysiagrass cultivars will support small- to medium-sized rural farm operations in southern states, while their adoption will promote climate-resilient landscapes across the urban areas of the South and the transition region of the United States. Consumers prefer seeded cultivars for their lower cost compared to sod, faster coverage than sprigs or plugs, and ease of handling, storage, and shipment. Seed propagation is a logistically and economically reasonable choice for many crop species that also can be clonally propagated with relative ease, particularly since seeds can easily be sterilized. Vegetative materials, in contrast, have higher risks of spreading pests and diseases. Further, the broad genetic base of seed-propagated zoysiagrass cultivars (synthetics) is expected to mitigate risks associated with large swaths of intensively managed monocultures. The ease in developing interspecies seed blends can support integrated landscapes and provide refuge lawns for foraging insects and pollinators, satisfying two of the major ecosystem complaints against turfgrass greenspaces.

However, a lack of knowledge of the biological basis (genetic architecture, heritability) of seed yield and yield attributes, and limited efforts to explore and utilize available genetic resources, have hindered progress in seeded zoysiagrass breeding. A multitude of challenges affect seeded breeding efforts, including (a) asynchronous flowering periods and photoperiodic sensitivity, (b) apparently large genotype by environmental interaction influencing seed yield, (c) seed dormancy-related germination issues, (d) poor seedling vigor and slow establishment, and (e) inconsistent and low yields across different years. Further, researchers lack information on zoysiagrass regarding genetic variability in reproductive behavior and overall genetic diversity in breeding germplasm—these are important aspects in any synthetic cultivar breeding effort.

Efforts over the past century in scientific zoysiagrass breeding have been primarily dedicated to developing vegetatively propagated cultivars, which might have led to selection against genotypes displaying flowering prolificacy and seedhead production. Consequently, breeders could have bottlenecked the genetic diversity for traits of interest in seeded zoysiagrass breeding, a situation potentially exacerbated by relying on a single species, *Zoysia japonica*, for seeded breeding.

The warm-season turfgrass breeding program at the University of Georgia Tifton campus seeks to address the challenges associated with seeded zoysiagrass breeding by integrating transdisciplinary scientific research in the cultivar development pipeline.

MATERIALS AND METHODS

A concerted effort toward seeded zoysiagrass cultivar development was started at the University of Georgia Tifton Campus during Spring 2023 and involved following activities:

Evaluation of Germplasm Lines

Spaced-plant nurseries with a total of 15,000 genotypes established in 0.37 m^2 plots were screened for yield and harvest attributes including inflorescence prolificity, culm length, and raceme length. These genotypes were primarily developed as a part of our vegetative cultivar development pipeline. We expected relative scarcity of the seed-propagated type in these populations. Accordingly, 202 genotypes were marked for relative inflorescence prolificity, taller culms, and/or longer racemes. Of these, 112 genotypes were chosen (0.5% of total) based on index selection for the recorded attributes (*initial selections*). Initial selections were plot-harvested and dried at 37 °C for 72 hr. Open-pollinated (OP) seeds were threshed, cleaned, weighed, and stored at 4 °C for germination trials. Leaf texture was recorded from three independent measurements from each initial selection.

Exploratory Field Germination and Establishment Trial

To generate preliminary data on germination potentials, establishment speeds, and management regimes (herbicides) for field-seeding and establishment, OP seeds from ~30 seedheads each from 57 initial selections were scarified with a 1:10 dilution of commercial bleach (0.53% hypochlorite solution) and air-dried at 37 °C overnight before being seeded on August 25, 2023, in an experimental field in Tifton. They were planted in 1.11 m^2 nursery plots with 0.3 m alley spacing between them. The experiment was covered with nylon mesh cloth for a period of 5 days during the first week after seeding to avoid seed washing caused by heavy rains and was irrigated twice a day for 3 weeks (except for when it rained).

Germination Trial in the Greenhouse

OP seeds from 74 initial selections were scarified and dried as discussed above. On October 19, 2023, 270 OP seeds per genotype were seeded in nine pots each (14.37 cm diameter; 30 seeds per pot) with sterilized Tifton topsoil. A randomized complete block design was set up in greenhouse mist benches with three pots of each genotype in each of the three blocks. Mist sprinkle was run twice a day and germination was tracked at 7, 10, 14, and 21 days after planting.

JMP® Pro 17 was used to perform mixed model decomposition of variance with "genotype," "days after planting (DAP)," and "genotype x DAP" as fixed effects, and "block[pot]" and "genotype x block[pot]" as random variables influencing "germination." The Next-Generation Clustered Heat Maps website (https://www.ngchm.net/) was used employing Ward's method for agglomerative hierarchical clustering and Euclidean metric to cluster genotypes and to generate a heat map.

Establishment of OP Nurseries

From the germination trial, a total of 3,484 seedlings were individually transplanted to 7.18 cm diameter pots. These individuals were assessed in the greenhouse for seeded traits, including culm length and seedhead density, in May 2024 and were later transplanted to two different single-spaced plant nurseries (SSPN). In the first nursery, 752 individuals with tall seedheads (5 in. or more from soil surface) were transplanted, each at the center of 1.48 m^2 plots with 0.3 m alley spacing between plots. Remaining individuals were transplanted to the second nursery in 0.37 m^2 plots with 0.3 m alley spacing between them.

A third SSPN (1.11 m^2 plots with 0.3 m alley spacing) was transplanted with 1,500 additional OP seed-propagated germplasm that were not included in the germination trial. We have transplanted a total of 5,000 OP germplasm to the three SSPN.

Toward Seeded Zoysiagrass Cultivars, *continued*

Establishment of Polycross Nurseries

The top 25% highest yielding lines from the initial selection (*elite selections*; 23 in total) were advanced to constitute polycross nurseries. The selection took pedigree into consideration (i.e., truncated within the same background). Vegetative propagules for the elite selections were retrieved from the field and transplanted in the greenhouse. The elite selections and two 'Zenith' reselections were transplanted to isolated polycross nurseries in randomized complete block designs (one replication per block with four blocks) in Blairsville, GA (0.83 m^2 plots; September 21, 2023), and Tifton (0.1 m^2 plots; October 5, 2023), with 0.3 m alley spacing between plots.

RESULTS

Germplasm evaluation

Figure 1 shows seed yields from 0.37 m^2 plots and average leaf blade widths (i.e., texture) of 104 initial selections. Although it's not directly transferable and may even be misleading, the extrapolated average yield of 496 lb per acre for the elite selections is a remarkably high estimate for seeded zoysiagrass. Since some of these high-yielding medium-textured selections are presumably *Z. japonica* x *Z. matrella* hybrids; these genotypes have a potential to contribute alleles for superior turf quality traits and broaden the seeded zoysiagrass gene pool.

Field Germination, Weed Management, and Turf Establishment

Preliminary germination data was recorded; we continue to assess pre- and postemergent herbicide efficacy and record green cover estimates to identify germplasm with high germination and fast establishment.

Greenhouse Germination Trial

Effects corresponding to "genotype," "DAP," and "genotype x DAP" were significant (Table 1), suggesting profound variability in germinability across time. Multivariate analysis (Figure 2) showed that seed yield and germination exhibited a significant negative correlation with a coefficient of -0.29 (p = 0.011), necessitating simultaneous improvement in

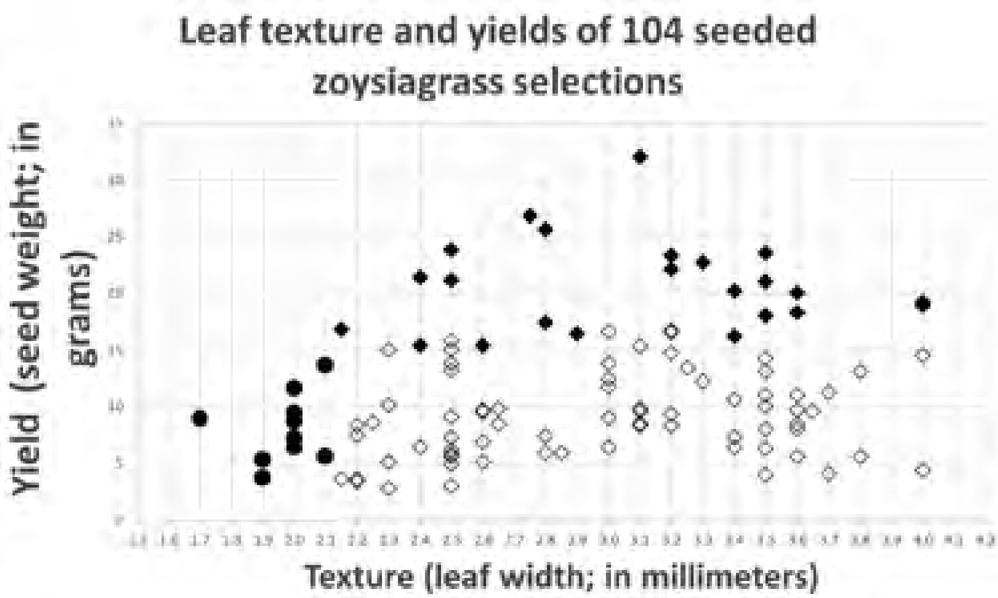

Figure 1. Leaf Texture and Seed Yield of 104 Zoysiagrass Selections.

Note. Leaf texture was averaged from several measurements of fully expanded leaves during the active growing season, and seed yield was derived from the harvest of 0.37m^2 plots in spring 2023. Selections represented by solid diamond shapes were advanced to polycross nurseries as the parents for recurrent selection. Selections represented by circles are prospective parents for fine-textured seed-propagated zoysiagrass breeding.

both traits (i.e., complementary breeding) to improve effective yield. On the other hand, the poor correlation ($r = -0.20$; $p = 0.078$) between leaf texture and germination is encouraging for developing fine-textured seed-propagated zoysiagrass cultivars. Figure 3 displays a heat map from the hierarchical clustering of genotypes based on number of seedlings and shows genotypes with early germination and highest seedling recovery cluster in one of the two major clades, while the second clade groups' genotypes show late germination and poor seedling recovery.

Source[a]		DF	F Ratio	Prob > F
Fixed	Genotype (Geno)	73	25.74	< 0.0001
	Days After Planting (DAP)	3	175.71	< 0.0001
	Geno* DAP	219	6.69	< 0.0001
Random	Variance Component		Wald p-value	
	Block[Pot]		0.1319	
	Geno* Block[Pot]		< 0.0001	

Table 1. Decomposition of Variance Components for Fixed and Random Effects in Zoysiagrass Germination Trial.

Note. [a]A total of three pots per block per genotype with three blocks.

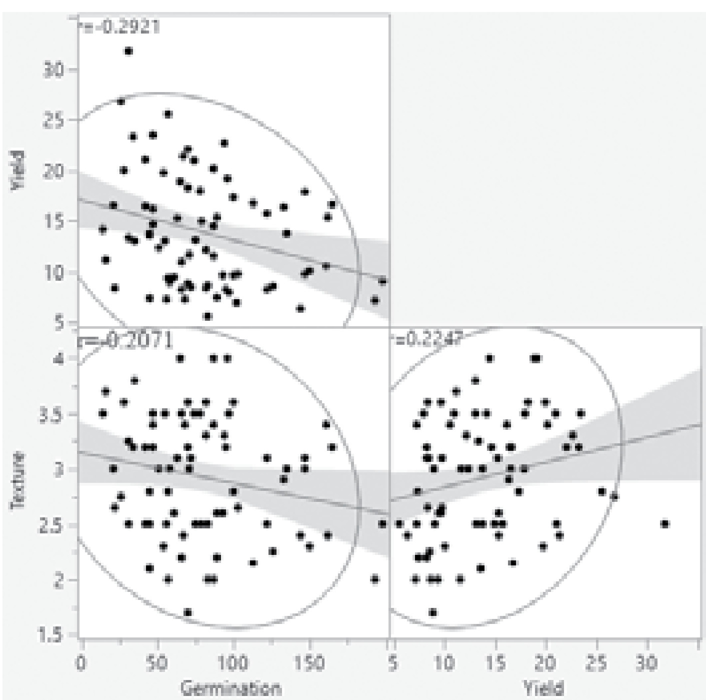

Figure 2. Correlations Between Leaf Texture, Seed Yield, and Germination of 74 Zoysiagrass Selections.

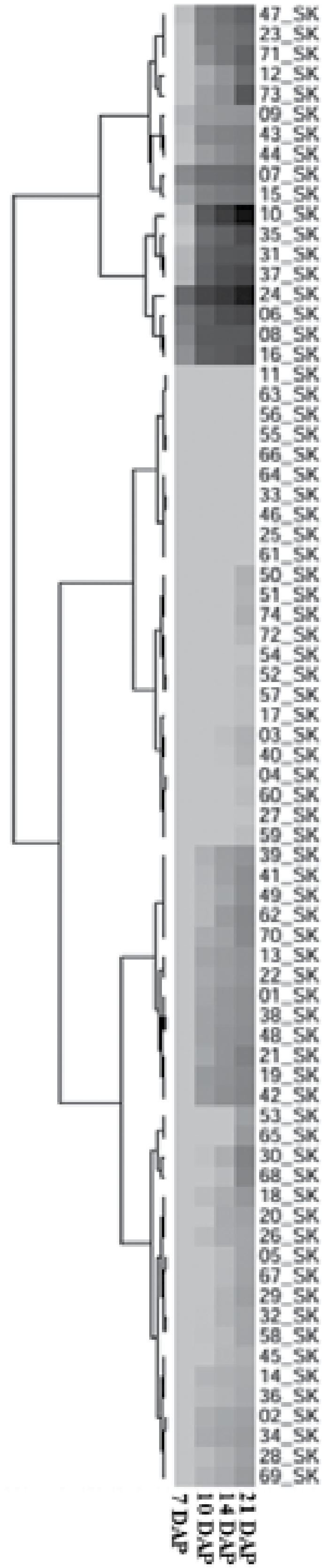

Figure 3. Hierarchical Clustering of 74 Zoysiagrass Selections for Germinability.

Note. Germinability was based on seedling recovery at four different time points (days after planting, DAP). Heat map gradient scale goes from light grey (< 15%) to black (> 75%) based on seedling count numbers.

Toward Seeded Zoysiagrass Cultivars, *continued*

FUTURE WORKS

The three SSPN will be screened for several traits relevant to seeded zoysiagrass breeding and production. The selections from these nurseries will constitute the parents of different phenotypic recurrent selection breeding populations. The most promising lines will be advanced as multi-clone synthetics and assessed for their commercial production potential as seeded zoysiagrass cultivars. Although we expect several different types of zoysiagrass clonal synthetics considering different attributes like flowering synchrony, texture (fine, medium, coarse), turf color, seedhead color (green, purple), and growth characteristics (upright, prostate), the primary basis of parental selection will include harvest traits (culm length, shattering), yield and yield attributes, germination, establishment, turf quality, and insect-pest and disease resistance. We will assess high-throughput phenotyping and machine learning techniques to employ proxies for indirect selection for these traits of interest.

Established polycross nurseries with 25 parental lines will be used to develop half-sib families, constituting first-generation recombinants for the second phenotypic recurrent selection cycle in the select-recombine-repeat breeding scheme.

ACKNOWLEDGEMENTS

Support for this project comes from University of Georgia Research Foundation, Georgia Seed Development, and United States Golf Association. We would like to thank Chris Roquemore (Patten Seed Company/Super-Sod), Melodee Fraser (Pure Seed, Inc.), Paul L. Raymer (University of Georgia), and Kevin Kenworthy (University of Florida) for sharing their insights on seeded zoysiagrass breeding and production. We would also like to thank the turfgrass breeding team at UGA Tifton Campus for their continued help and support toward this project.

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theturfgrassgroup.com
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1197 S Lumpkin St, Ste 192D, Athens GA 30602
Pamela Bracken: 706-583-0424 or pam.bracken@georgiacenter.uga.edu

Yancey Brothers Co.
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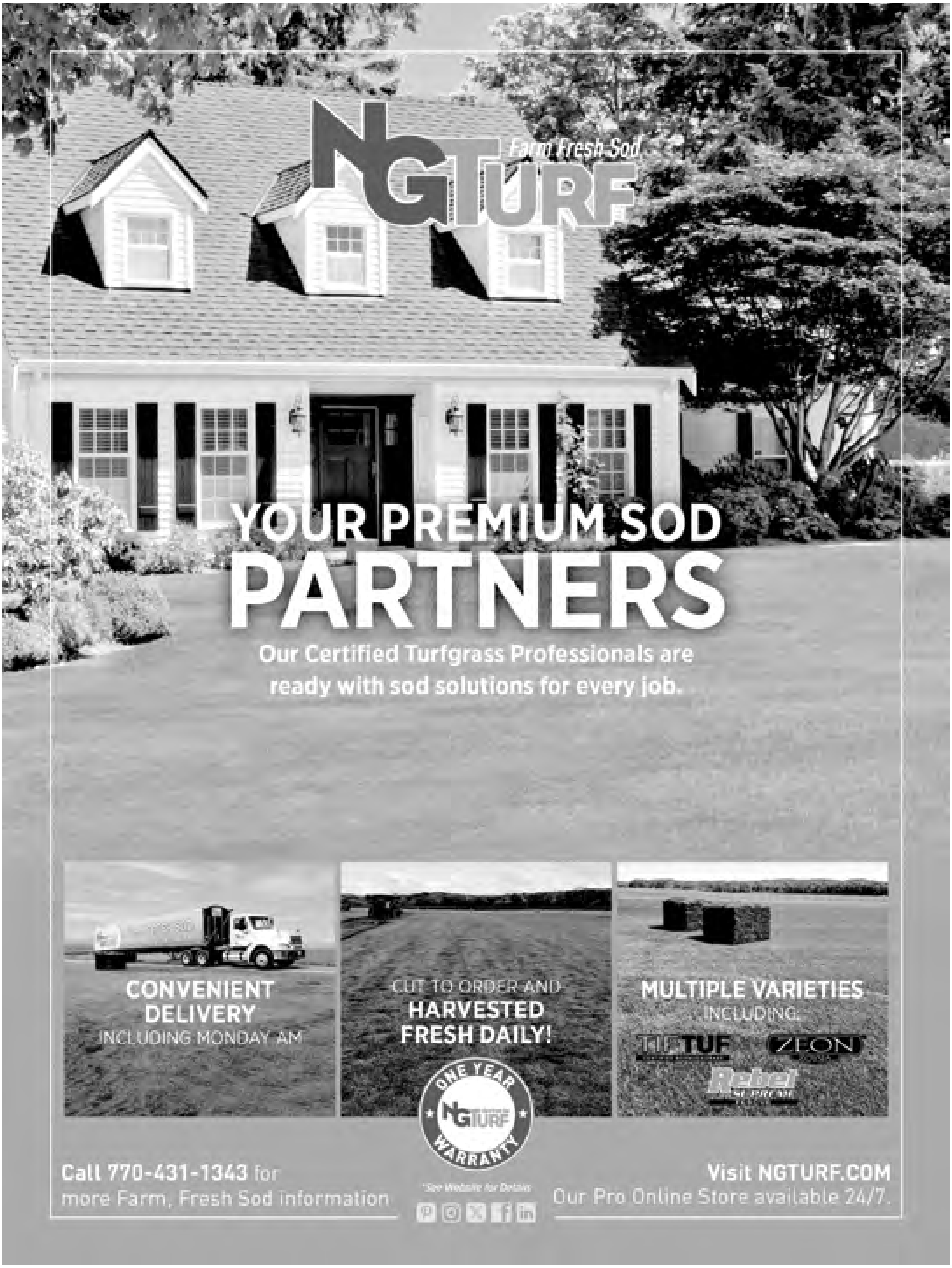
Amy Willoughby: 770-819-5565 or amy_willoughby@yanceybros.com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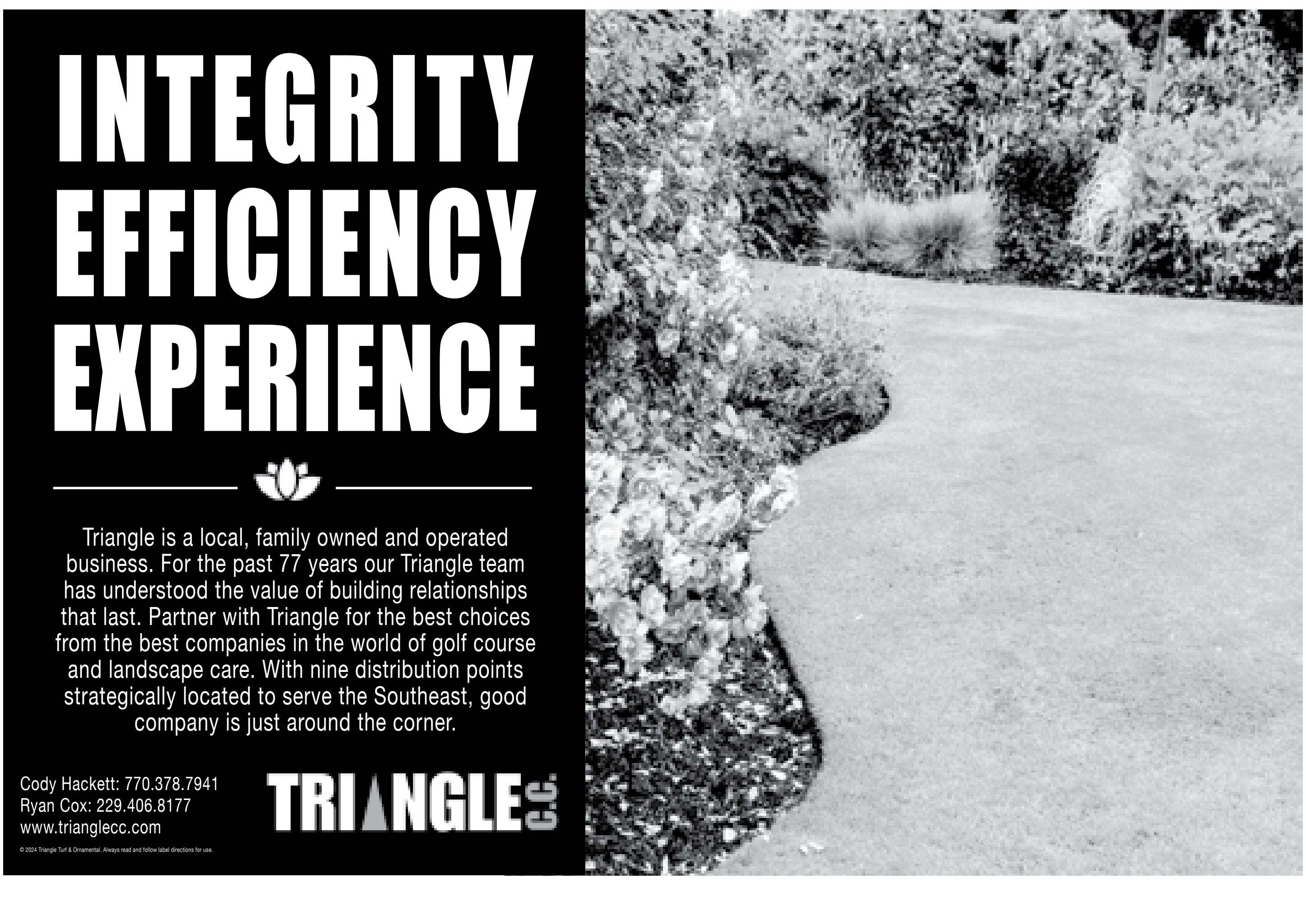
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The Things I Have Seen: Turfgrass Problem Solving

Clint Waltz, Professor, Crop and Soil Sciences
UGA-Griffin

ABSTRACT

This will be attendees' opportunity to observe specific techniques for diagnosing turfgrass problems ranging from basic agronomics (e.g., mowing, fertility, cultivation, etc.), to environmental influences (e.g., drought, heat, cold, limited light, etc.), to pest management and control. Specific examples and case studies will be referenced as educational opportunities (i.e., diagnostics, problem-solving, and remediation options) to impart wisdom from others' mistakes.

Diagnosing Turfgrass Diseases: Field and Laboratory

Alfredo Martinez-Espinoza, Professor, Plant Pathology
UGA-Griffin

Effective and efficient disease management always begins with an accurate diagnosis of the problem. At this stop, we will review practical and critical steps for an accurate turf disease diagnosis.

Microscopic and visual observation will be part of the session. Advanced yet practical molecular techniques for disease detection will be discussed, as well as a review of environmental and cultural factors that promote each disease. Turfgrass pathogen biology and the different methods of disease control will be emphasized.

Rhizoctonia

Diseases: brown patch, large patch, yellow patch, leaf and sheath

Common species: *Rhizoctonia solani, Rhizoctonia cerealis, Rhizoctonia zeae, Binucleate Rhizoctonia* species

DIAGNOSTIC TIPS

Field:

Brown patch: The symptoms of brown patch can vary depending on the grass cultivar, climatic and atmospheric conditions, and soil management of the turfgrass. This disease typically causes rings and/or patches of blighted turfgrass that measure 5 in. to more than 10 ft in diameter. It also causes leaf spots and "smoke rings," which are thin, brown borders around the diseased patches that appear most frequently in the early morning. After the leaves die in the blighted area, new leaves can emerge from the surviving crowns. On wide-bladed species, leaf lesions develop with tan centers and dark brown to black margins.

THIS STOP IS LIMITED TO 30 PARTICIPANTS.

Large patch: The disease occurs during the spring and fall, when warm season turfgrasses are entering or exiting their period of winter dormancy. Circular patches of diseased turf are observed, ranging in diameter from less than 3 ft to up to 25 ft. Leaves of recently infected turf, located at the periphery of the patch, may appear orange in color. Some patches may be perennial, recurring in the same location and expanding in diameter year after year. In contrast to brown patch, *R. solani* infection of warm season grasses occurs on the leaf sheaths, where water-soaked, reddish-brown or black lesions are observed. Foliar dieback from the leaf tip toward the base occurs as a direct result of these leaf sheath infections.

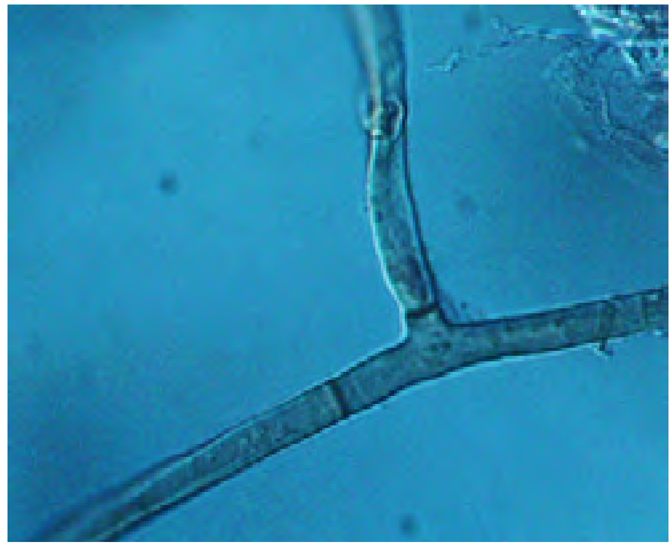
Diagnosing Turfgrass Diseases, *continued*

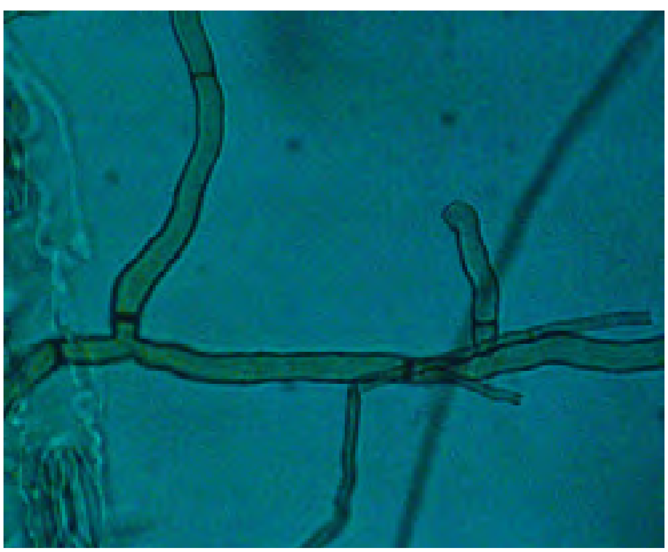
UNDER A MICROSCOPE, LOOK FOR:

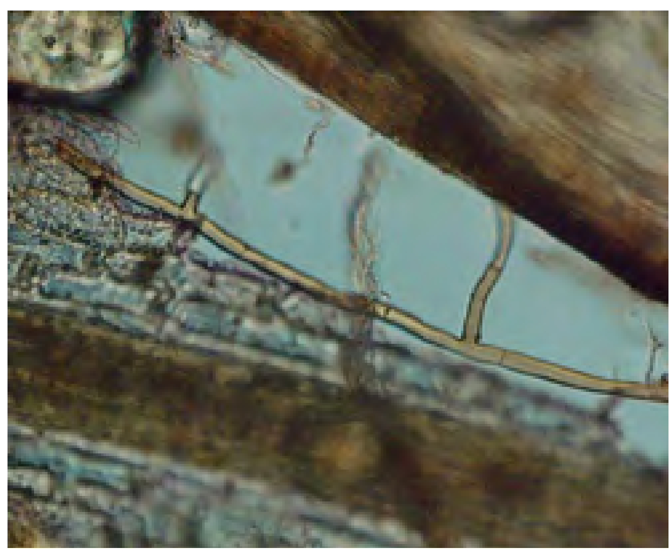
- Septate hyphae, uniform diameter
- Right-angle branching of hyphae
- Constrictions at the base of branching
- Hyphae are tan to light brown
- Mycelium formation, no spore production

PROCEDURE:

1. Start with a dissecting scope and scan crowns of turf.
2. Using a scalpel and tweezers, remove infected tissue containing mycelium.
3. Place on a glass slide containing a drop of stain.
4. Examine at low magnification on a compound microscope (4X, 10X objective).







The Great Southeast Pollinator Census

Becky Griffin, MPPPM, Community and School Garden Coordinator and Pollinator Health Associate
UGA-Griffin

INTRODUCTION

Pollination is valued in Georgia at over $600 million per year, highlighting the importance of pollinators to the Georgia economy. The Great Southeast Pollinator Census is a response to this issue.

On August 23–24, 2024, community members across Georgia, South Carolina, North Carolina, and Florida will count pollinators as part of the sixth annual Great Southeast Pollinator Census. Over the past 5 years, more than 35,000 counts were submitted! We are looking forward to welcoming Florida counters this year.

Participants are asked to count the insects that land on a favorite pollinator plant for 15 min. A “favorite” pollinator plant is one that shows an abundance of insect activity. Counters place the insects they find into one of eight categories:

- bumble bees
- carpenter bees
- small bees
- honey bees
- wasps
- flies
- butterflies/moths
- other insects

The goals of the project are to gather data on our pollinator insect population, create sustainable pollinator habitats, and increase entomological literacy around these insects. The project’s website (https://GSePC.org) contains all the information that someone needs to be a part of the project. The Insect Counting and Identification Guide (available in English and Spanish) gives detailed instructions on counting, a video explains the process, and counting sheets are available for download. Interested citizens can sign up for a monthly newsletter full of information on pollinator gardening and insect identification.

This project is perfect for schools doing STEAM lessons. The “educators” page on the website has all the resources teachers need for their classrooms to successfully participate, including lesson plans. Educational pieces are posted on the Southeast Pollinator Census Facebook page and on Instagram as @SoutheastPollinators. Students feel empowered to be a part of an important initiative.

The project is a natural fit for families who want to participate in insect conservation. Businesses can be involved either by having their employees participate as a company outreach effort or by having events at their place of business (like breweries or restaurants) to attract conservation-minded customers. Civic groups also enjoy participating.

Landscape groups have capitalized on pollinator gardens and habitats by offering clients packages featuring native pollinator plants and using best pollinator management strategies in landscape maintenance. Clients use their gardens to count during the census.

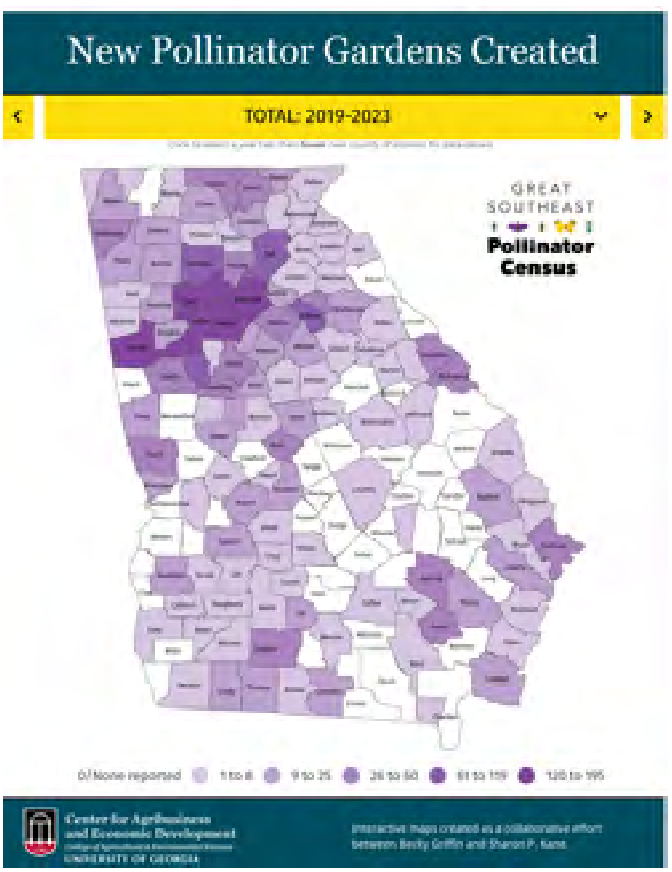
Census data is available on the website for public use. The data is being used by researchers who are interested in pollinator economic valuation studies, as well as by growers who are interested in pollinators residing in their counties. Educators use the data for real-world classwork.

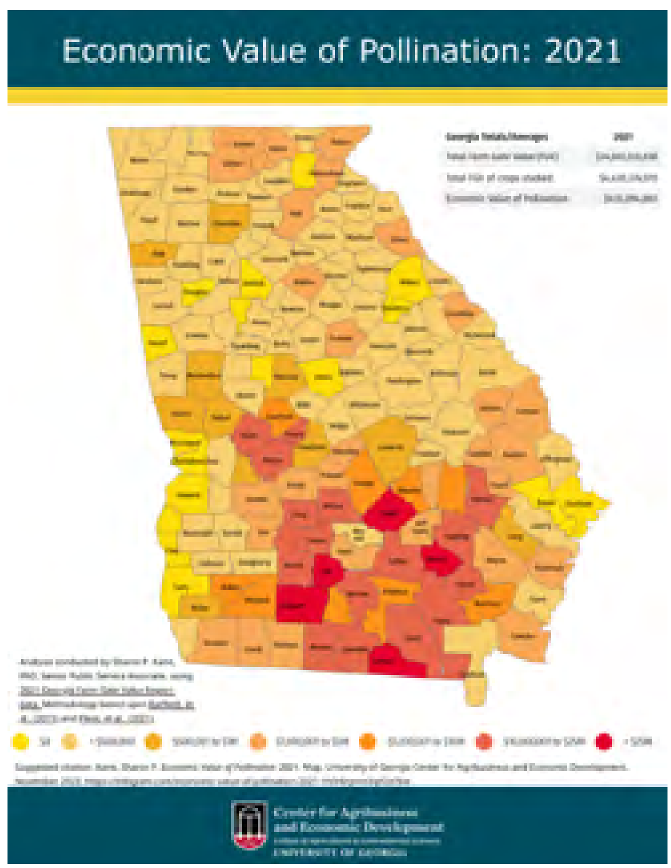
This project is just one of many led by University of Georgia faculty focused on pollinator habitat and health.

Pollinator Census, *continued*

Pollinator	2019	2020	2021	2022	2023
Carpenter Bees	11,066	4,435	2,282	15,270	23,444
Bumble Bees	13,517	8,989	23,250	21,182	32,854
Honey Bees	7,979	5,009	8,818	12,410	21,237
Small Bees	20,039	10,382	14,391	17,538	40,124
Wasps	15,151	8,001	10,828	10,964	26,678
Flies	14,555	11,588	12,115	14,537	24,702
Butterflies/Moths	29,692	18,564	16,502	22,847	51,450
Other Insects	19,845	14,127	17,557	24,754	32,954
TOTAL INSECTS	131,844	81,095	111,743	139,502	253,443
TOTAL COUNTERS	4,698	3,746	5,941	8,671	12,293
New Pollinator Gardens	897	525	436	314	359

Table 1. Five Years of Data From the Great Southeast Pollinator Census.





New and Upcoming Vegetative and Seeded Cultivars of Seashore Paspalum

Paul L. Raymer, Professor, Crop and Soil Sciences
UGA-Griffin

ABSTRACT

Our seashore paspalum program announces the development of three new cultivars that are likely to have a major impact on the global turfgrass industry over the next few years. In 2023, the University of Georgia released 'SeaScape' seashore paspalum, a vegetatively-propagated conventional cultivar suitable for course-wide use on golf courses and on athletic fields, home lawns, and other recreation venues.

Pure Seed Testing has recently announced the release of 'Pure Dynasty with ACCe', an exciting new herbicide-resistant seeded paspalum marketed by Atlas Turf International. This new product represents the first herbicide-resistant paspalum and utilizes ACCe technology developed by our breeding program. ACCe technology utilizes a mutation conferring high levels of crop tolerance to several ACCase-inhibiting herbicides and provides greatly enhanced control options for weedy grasses, such as bermudagrass, in seashore paspalum.

In addition, a new vegetatively-propagated cultivar with ACCe technology developed by UGA is in the final stages of testing and expected for release later this year. Join us for an informal walking tour of demonstration plots featuring these new cultivars.

Introducing a new non-GMO herbicide resistance system for seashore paspalum

- Improved tolerance to ACCase-inhibiting herbicides
  - Sethoxydim (Segment)
  - Fenoxaprop (Acclaim Extra)
  - Fluazifop-Butyl (Fusilade II)
  - Pinoxaden (Manuscript)
- Enhanced control of annual and perennial grasses
  - Bermudagrass
  - Crabgrass
  - Goosegrass
  - Tropical Signal Grass
  - Others

NTEP Entry	2016 (1–9)+	2017 (1–9)	2018 (1–9)	2019 (1–9)	2020 (1–9)	Top Statistical Group	5 yr. Average (1–9)
Salam	**6.1***	6.1	6.0	6.0	**6.2**	2/5	6.1
Sea Isle 1	**6.2**	6.0	**6.1**	**6.2**	**5.9**	4/5	6.0
SeaStar	**5.9**	6.1	**6.1**	**6.1**	**6.0**	4/5	6.0
SeaScape	**6.3**	**6.5**	**6.2**	**6.3**	**6.1**	5/5	6.3
C.V.	4.4	1.3	2.6	2.1	**3.0**		
LSD	0.4	0.1	0.2	0.2	0.3		

Table 1. NTP 2016 –2020 Seashore Paspalum - Turf Quality.
+ Rated on 1–9 scale with 6 = acceptable and 9 = excellent
* Means in the top statistical group are bolded.

Graduate Student Research

Turf Team Master's and Doctoral Graduate Students
Crop and Soil Sciences, Plant Pathology, and Entomology
UGA-Griffin

Graduate students are a key component of the UGA Turf Team, and much of what we do would not be possible without them. The research they perform while completing their degrees represents some of the cutting-edge research going on at the university.

Student research ranges from answering applied questions—such as how to improve turfgrass performance—to fundamental research seeking to understand the molecular underpinning of basic biology. These students pursuing master's and doctoral degrees in various departments, including Crop and Soil Sciences, Entomology, and Plant Pathology, will go on to careers ranging from industry to academia. The skills they learn at UGA extend into the future as they become leaders serving our communities.

Students will give a brief presentation about their work and answer any audience questions.

Grasses Can Serve as a Pollinator Food Source

Karen Harris-Shultz, Research Geneticist
USDA-ARS-Tifton

Shimat Joseph, Associate Professor, Entomology
UGA-Griffin

Carl Scott Clem, Postdoctoral Associate, Entomology
UGA-Athens

Jonathan O'Hearn, Research Entomologist
USDA-ARS-Tifton

ABSTRACT

Pollination of agricultural crops in the United States is valued at $10 billion annually. Yet, pollinators are experiencing global declines, resulting in heavy efforts by conservation, extension, and outreach organizations to encourage the planting of nectar-rich plant species.

Wind-pollinated plants, such as grasses, are often overlooked, though at least 96 species are visited by pollinators. While grasses do not provide nectar, their pollen can be vital to insect reproduction and survival.

To quantify this behavior, researchers at the USDA-ARS in Tifton, GA, in collaboration with the University of Georgia, observed insects collecting and consuming pollen from the turfgrass centipedegrass (*Eremochloa ophiuroides*) and the row crops sorghum and pearl millet.

Numerous pollinators, including bumblebees (*Bombus impatiens*) and honey bees (*Apis mellifera*), were identified as common visitors of these grasses, collecting pollen from the three species. Bees that were only observed collecting grass pollen from one species included *Augochlorella* sp. (sweat bees) for centipedegrass, *Xylocopa micans* (southern carpenter bee) for sorghum, and *Bombus pensylvanicus* (American bumblebee, a threatened bee species) for pearl millet. Additionally, hoverflies, which also function as biological control agents, were observed consuming grass pollen for all three grass species.

These studies show that bees and hoverflies are utilizing grass pollen as a food source and that growers and homeowners wanting to protect pollinators should limit the use of insecticides.

Irrigation Training Center: Opportunities for Industry Use

Rolando Orellana, Urban Water Management
UGA Center for Urban Agriculture, UGA-Griffin

Whitney Ottinger, Sustainable Agriculture Program
UGA Center for Urban Agriculture, UGA-Griffin

IRRIGATION EDUCATION SITE

The University of Georgia Griffin campus presents its state-of-the-art irrigation demonstration site that opened in August 2022. This facility serves as a hub for training, research, and education on the latest irrigation technologies, catering to industry professionals, homeowners, and researchers.

The site features products from leading manufacturers such as Toro/Irritrol, Hunter Industries, and Rain Bird, offering a comprehensive look at modern irrigation solutions. It is comprised of four 30 x 30 ft plots, with three designated for industry partners to showcase their latest products and technologies and the fourth reserved for UGA-Griffin research.

Since its launch, the site has become a valuable training ground for various groups, including landscape companies, Master Gardeners, homeowners, and park and recreation staff. The demonstration site offers numerous benefits:

1. Education on the latest irrigation technologies: Homeowners can learn about and see demonstrations of the newest irrigation products and technologies.
2. Training on efficient water use: The site provides training on achieving water efficiency and troubleshooting irrigation system issues.
3. Access to expert knowledge: Homeowners can interact with and learn from UGA Extension staff and faculty who are knowledgeable about sustainable water use practices.
4. Hands-on learning: The demonstration plots offer a practical, hands-on environment for homeowners to see irrigation systems in action and better understand their operation.
5. Improved landscape health: By learning proper irrigation techniques, homeowners can maintain healthier lawns and gardens while potentially reducing water waste.
6. Potential cost savings: Understanding efficient irrigation practices can help homeowners save money on water bills and reduce overwatering.
7. Environmental benefits: The site promotes water conservation techniques, helping homeowners reduce their environmental impact.

UGA CENTER FOR URBAN AGRICULTURE—SUSTAINABLE AGRICULTURE PROGRAM

This program focuses on profitable, environmentally friendly agricultural production systems that provide a good quality of life for farmers and communities. Research areas include soil chemistry, soil fertility, soil microbiology, water conservation, and more.

The Center collaborates and helps host several events and programs to promote sustainable agriculture. These events provide education, networking opportunities, and support for sustainable farming practices.

The sustainable agriculture program offers numerous resources and publications to help individuals and communities engage in sustainable agricultural practices. This includes guidance on vegetable gardening, native plants, and time management strategies for better agricultural productivity.

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 landscaped areas.
- The Georgia turfgrass and related industries contribute a total of $14.8 billion annually to the economy.
- The federal, state, and local tax impact is over $1.4 billion annually.
- This industry accounts for 111,000 full- and part-time jobs.
- The majority of these jobs are related to landscape maintenance of buildings and households.
- Annually, Georgia's golf-related activities generate approximately $5.0 billion of direct and indirect economic impact and account for greater than 45,000 jobs.
- The landscape and golf industries have 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.
- These industries have 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 70+ 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.

2022 Georgia Agricultural Commodity Rankings

Rank	Commodity	Farm Gate	% of GA Total
1	Broilers	$6,672,840,000	36.39%
2	Cotton	$1,311,533,294	7.15%
3	Eggs	$960,213,000	5.24%
4	Peanuts	$790,820,291	4.31%
5	Timber	$780,829,934	4.26%
6	Beef	$729,973,522	3.98%
7	Greenhouse	$611,163,834	3.33%
8	Corn	$522,738,318	2.85%
9	Blueberries	$449,363,632	2.45%
10	Pecans	$400,790,725	2.19%
11	Dairy	$378,370,162	2.06%
12	Hay	$347,681,076	1.90%
13	Field Nursery	$249,495,796	1.36%
14	Horses	$249,192,000	1.36%
15	Container Nursery	$223,055,843	1.22%
16	Turfgrass	$194,421,413	1.06%
17	Misc. Vegetables	$188,423,056	1.03%
18	Sweet Corn	$187,848,254	1.02%
19	Onions	$173,945,307	0.95%
20	Bell Peppers	$152,758,734	0.83%
21	Watermelon	$142,671,769	0.78%
22	Pine Straw	$126,682,500	0.69%
23	Pullets	$109,550,416	0.60%
24	Ag-based Tourism	$105,377,166	0.57%
25	Soybeans	$103,229,081	0.56%
26	Tomato	$83,518,714	0.46%
27	Cucumbers	$82,419,256	0.45%
28	Peaches	$80,573,343	0.44%
29	Honeybees	$78,096,659	0.43%
30	Pork	$74,548,513	0.41%
31	Greens (collards, Chard, kale, lettuce, mustard, spinach, turnip greens)	$68,305,035	0.37%
32	Hunting Lease - Deer	$65,918,488	0.36%
33	Silage	$65,664,773	0.36%
34	Wheat	$60,537,643	0.33%
35	Squash (Yellow and Winter)	$52,787,969	0.29%
36	Grapes	$47,293,024	0.26%
37	Zucchini	$42,068,361	0.23%
38	Cabbage	$36,496,044	0.20%
39	Tobacco	$33,995,068	0.19%
40	Other Peppers (banana and hot)	$27,408,580	0.15%
41	Catfish	$24,343,800	0.13%
42	Hunting Leases - Turkey	$22,759,716	0.12%
43	Citrus	$22,399,571	0.12%
44	Goats	$22,287,533	0.12%
45	Snap Beans	$20,902,864	0.11%
46	Blackberries	$19,870,484	0.11%
47	Eggplant	$17,193,187	0.09%
48	Straw	$17,136,365	0.09%
49	Cantaloupe	$16,666,474	0.09%
50	Strawberries	$15,299,904	0.08%
51	Oats	$15,129,894	0.08%
52	Rye	$10,291,398	0.06%
53	Apples	$9,906,395	0.05%
54	Sorghum	$9,179,899	0.05%
55	Sheep	$8,607,269	0.05%
56	Olives	$7,580,600	0.04%
57	Southern Peas	$5,256,418	0.03%
58	Christmas Trees	$4,504,850	0.02%
59	Flight Quail	$2,404,750	0.01%
60	Hunting Leases - Duck	$1,794,250	0.01%
61	Okra	$1,076,675	0.01%
62	Meat Quail	$1,000,633	0.01%
63	Barley	$79,697	0.00%
	Crop Insurance	$186,060,042	1.01%
	Government Payments	$595,774,195	3.25%
	All Other Miscellaneous	$217,340,135	1.19%
	2022 Total Farm Gate Value	**$18,337,447,590**	

Annual Comparison of Farm Gate Value by Commodity

Commodity	2017	2018	2019	2020	2021	2022
Ag-based Tourism	115,458,449	125,119,491	125,675,476	80,016,950	95,350,006	105,377,166
Apples	9,961,740	8,089,100	11,225,675	9,357,650	8,691,797	9,906,395
Barley	336,280	206,742	52,386	239,030	259,742	79,697
Beef Cows	453,680,067	482,163,793	491,015,718	428,428,373	492,690,996	561,932,968
Beef Cattle Finished Outside Co	51,104,865	51,213,470	57,502,556	65,636,349	77,024,269	77,242,093
Beef Stockers	91,858,254	99,802,715	117,618,093	97,794,648	88,895,618	90,798,462
Blackberries	4,469,712	4,342,483	6,629,830	17,958,993	18,435,161	19,870,484
Blueberries	226,635,695	300,358,592	220,444,595	304,188,699	348,745,413	449,363,632
Citrus	--	--	--	8,812,165	13,246,531	22,399,571
Olives	--	--	--	--	--	7,580,600
Pullets	168,803,844	272,881,260	52,493,085	27,986,919	84,150,059	109,550,416
Broilers	4,422,695,768	4,460,396,286	4,032,731,000	2,950,332,000	4,215,196,000	6,672,840,000
Catfish	27,509,530	28,173,880	26,663,480	25,403,700	23,819,500	24,343,800
Christmas Trees	8,380,980	8,622,357	5,589,310	5,258,250	5,265,625	4,504,850
Corn	244,094,642	288,229,368	321,373,871	358,088,054	509,054,907	522,738,318
Cotton	901,546,722	792,718,852	983,630,257	727,796,434	1,003,028,657	1,311,533,294
Crop Insurance	172,245,029	290,082,679	163,817,298	129,075,471	156,105,501	186,060,042
Dairy	323,884,589	308,349,680	305,971,569	296,960,246	302,889,598	378,370,162
Eggs	850,689,401	948,205,221	230,723,940	276,503,402	635,134,000	960,213,000
Goats	19,369,663	18,460,353	16,078,279	17,455,249	20,280,000	22,287,533
Government Payments	467,802,224	471,803,832	572,798,956	934,196,586	712,623,031	595,774,195
Grapes	18,675,180	19,730,336	24,698,747	26,824,096	31,532,019	47,293,024
Greenhouse for OrnHort	443,966,174	487,692,208	476,533,296	566,227,546	635,867,449	611,163,834
Hay	241,030,654	232,130,985	306,246,800	291,166,976	312,843,677	347,681,076
Hogs, Farrow to Finish	26,397,119	23,139,890	21,441,019	11,337,942	13,697,202	17,469,945
Hogs, Feeder Pigs	65,705,955	45,173,040	66,229,950	34,157,063	47,623,412	50,922,375
Hogs, Finishing Only	23,951,247	13,396,178	11,228,661	3,683,454	5,803,995	6,156,193
Honeybees	46,732,437	49,055,753	52,051,965	55,654,183	62,235,836	78,096,659
Horses	261,129,300	247,745,600	246,202,650	239,553,900	238,292,625	249,192,000
Hunting Lease - Deer	80,655,781	87,928,735	88,468,286	102,222,938	102,453,568	65,918,488
Hunting Leases - Duck	1,610,750	1,661,605	1,900,555	1,921,018	1,798,970	1,794,250
Miscellaneous (All Other)	86,524,663	114,133,211	136,257,030	127,553,067	126,570,359	154,886,151
Hunting Leases - Turkey	10,895,021	11,580,925	13,135,760	16,566,165	17,144,031	22,759,716
Nursery - Container	160,817,885	144,726,279	177,969,627	232,942,530	211,868,388	223,055,843
Nursery - Field	115,420,347	125,696,305	182,489,887	211,361,055	195,738,099	249,495,796
Oats	6,323,155	9,183,231	6,766,487	7,605,733	17,661,835	15,129,894
Peaches	30,011,587	48,322,284	71,776,414	63,644,163	84,868,921	80,573,343
Peanuts	825,040,700	624,572,608	663,042,432	678,038,017	776,675,989	790,820,291
Pecans	401,146,059	218,477,486	263,359,174	282,289,363	383,798,591	400,790,725
Pine Straw	74,401,250	80,619,320	100,165,580	92,011,700	138,988,980	126,682,500
Flight Quail	47,936,969	66,922,906	51,424,325	59,210,023	53,349,584	64,858,734
Meat Quail	16,908,885	15,902,099	17,996,754	3,428,154	4,721,608	1,000,633
Rye	7,819,263	7,914,788	7,140,723	9,162,520	9,438,730	10,291,398
Sheep	3,955,734	4,316,968	4,610,715	5,456,236	7,350,949	8,607,269
Silage	109,095,047	60,624,172	81,463,741	86,650,875	64,945,395	65,664,773
Sorghum	10,295,545	16,308,707	16,144,661	13,360,380	12,209,116	9,179,899
Soybeans	77,088,542	66,855,752	37,501,377	51,999,653	90,664,377	103,229,081
Straw	18,339,779	19,493,833	71,991,458	21,026,678	15,765,935	17,136,365
Strawberries	9,438,120	9,893,856	10,570,169	11,931,532	14,438,573	15,299,904
Timber	669,471,994	632,205,059	679,546,899	649,792,710	660,610,744	780,829,934
Tobacco	52,287,901	44,221,582	36,486,446	29,781,306	30,984,920	33,995,068
Turfgrass	116,679,820	118,321,229	125,936,720	130,489,485	126,430,568	194,421,413
Vegetables - Bell Peppers	115,294,892	125,983,101	127,851,345	133,518,013	153,806,782	152,758,734
Vegetables - Cabbage	53,689,775	41,888,607	51,946,265	49,566,931	39,888,567	36,496,044
Vegetables - Cantaloupe	19,601,989	13,450,217	12,915,395	18,071,325	17,211,250	16,666,474
Vegetables - Cucumbers	78,313,805	83,651,291	75,519,198	79,039,320	68,032,299	82,419,256
Vegetables - Eggplant	29,453,435	23,541,796	28,324,105	24,016,990	17,154,709	17,193,187
Vegetables - Greens	48,510,903	36,505,804	67,462,333	72,570,961	55,647,581	68,305,035
Vegetables - Okra	1,401,596	1,018,008	953,145	1,125,871	971,035	1,076,675
Vegetables - Onions	140,672,645	149,550,320	133,179,945	134,272,853	168,031,196	173,945,307
Vegetables - Other Peppers	12,736,472	14,553,662	17,134,592	22,467,765	19,793,180	27,408,580
Vegetables - Other Veg	221,077,479	209,450,320	206,195,361	209,979,821	206,124,162	188,423,056
Vegetables - Snap Beans	23,621,698	24,011,849	25,790,094	22,446,744	19,788,241	20,902,864
Vegetables - Southern Peas	5,326,353	5,216,301	5,390,740	5,815,611	4,938,761	5,256,418
Vegetables - Squash	31,712,494	40,837,931	37,603,158	51,732,200	54,446,734	52,787,969
Vegetables - Sweet Corn	158,867,276	156,679,146	145,026,886	173,249,586	212,620,365	187,848,254
Vegetables - Tomato	49,239,946	50,921,844	37,624,476	54,100,556	88,094,613	83,518,714
Vegetables - Watermelon	134,853,988	123,888,134	180,278,529	158,288,446	176,427,310	142,671,769
Vegetables - Zucchini	23,179,186	25,058,564	26,014,038	25,699,051	34,997,875	42,068,361
Wheat	26,688,478	21,710,328	29,912,201	30,799,891	48,700,104	60,537,643
Totals	**13,794,522,725**	**13,755,084,305**	**13,001,935,486**	**12,145,301,560**	**14,693,935,618**	**18,337,447,590**

Turfgrass Research FIELD DAY

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Annual Publication 117-4 **July 2024**

Published by the University of Georgia in cooperation with Fort Valley State University, the U.S. Department of Agriculture, and counties of the state. For more information, contact your local UGA Cooperative Extension office.