DECEMBER / JANUARY 2024

Tennessee Turfgrass

The Official Publication of the
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A CONTRARIAN'S GUIDE TO

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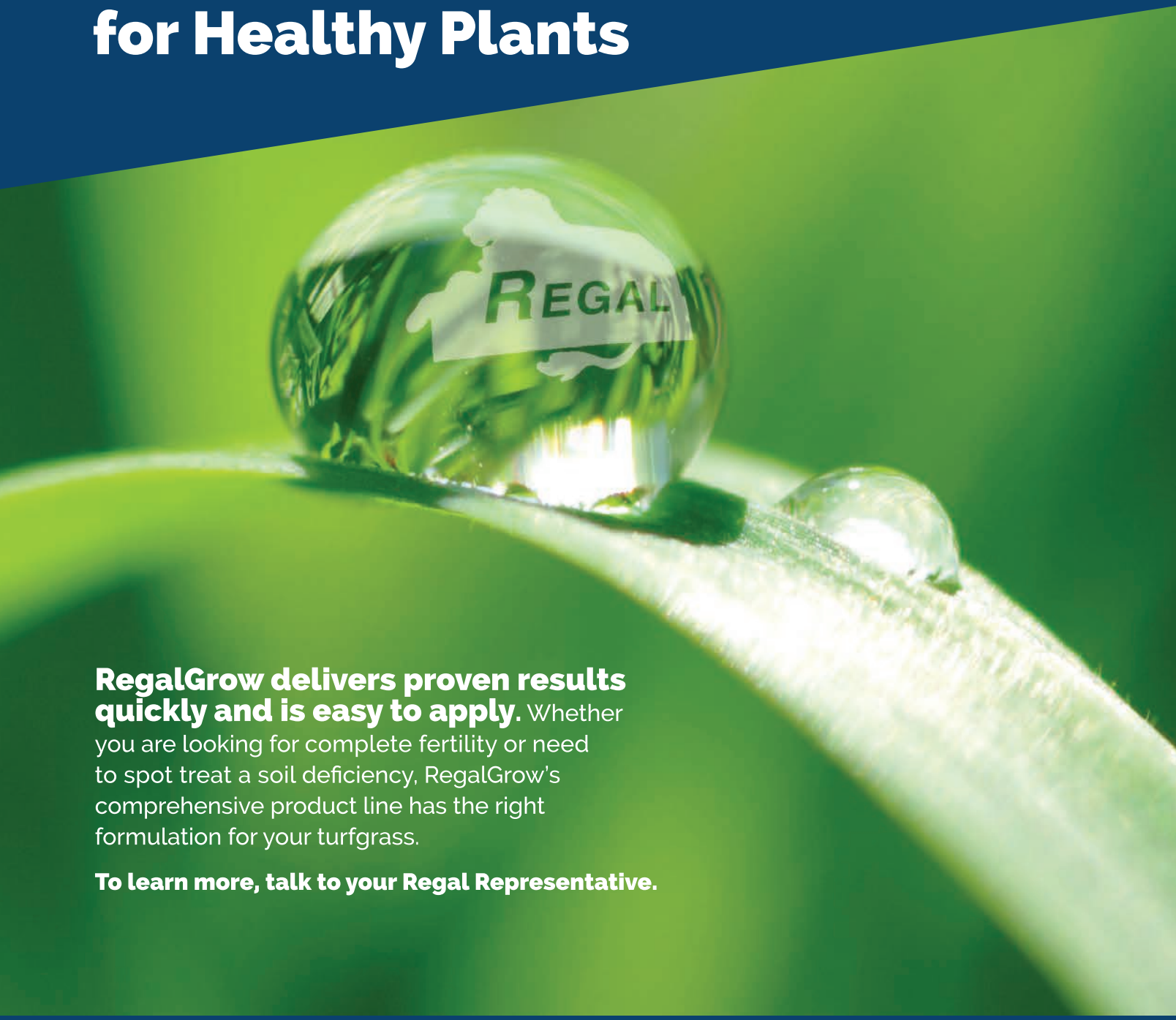

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Joe.Galbreth@RegalChem.com

Sam Womack | 404.374.1206
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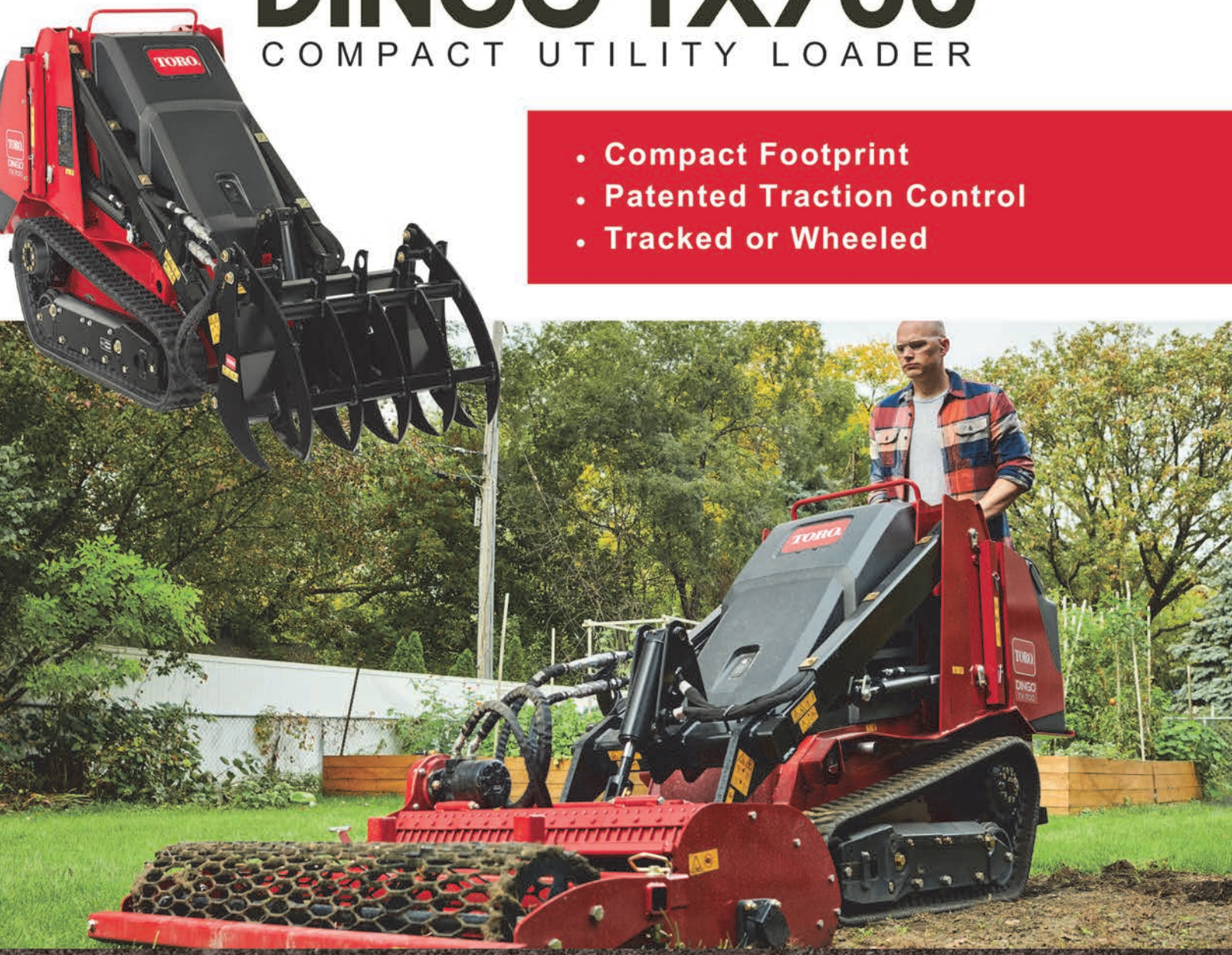

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What a Ride

The holidays have come and gone, and that means its time for the 58th Tennessee Turfgrass Conference and Tradeshow, which kicked off on Monday, January 8th. This year's conference may have been our best yet as there were an array of educational opportunities and the setup for the tradeshow only continues to improve.

This year's show was my last official act as your President. It has been an honor and privilege to serve our membership through the years. The ride started in 2014 when Paul Carter, who was president at the time, approached me about serving on the Board of Directors. As the saying goes, 'be careful who you make friends with' as I have been heavily involved ever since. I also want to pay special thanks to all the former Board Presidents as the position takes a huge commitment. A special thank you to those who I served under, Theo Lankford, Jason Pooler and most recently Doug Ward. All tremendous leaders who left the association better than they found it, including navigating the COVID pandemic during Doug's tenure and the hiring of our exceptional Executive Director, Melissa Martin, during Theo's term.

The greatest reward is getting to know other members of the association better, especially all my fellow BOD members. I cannot thank you all enough for your service and all your support. There are some, however, who I need to single out:

Jeff Huber, thanks for all your hospitality and unwavering support.

Cal Hill, for always picking up the tab, and when you didn't, Mark Stovall came to the rescue.

Bill Marbet, for being the Godfather of sports turf and Darren Seybold for your impact.

Jason Sanderson and Ryan Blair, my two best friends in the industry, and the TTA gave us the perfect excuse to spend more time together.

Serving on the TTA BOD also allowed me to spend more time with the faculty and staff at the University of Tennessee Turfgrass Department, which I feel strongly is the best in the country. I may not be an alumnus but will quickly claim UT as my Turfgrass school, having learned so much from this group. I have known Dr. Sorochan the longest, being one of the first Supers in TN he got to know during my time at Cherokee. I have spent a lot of time working with Dr. Brosnan on the education portion of the conference and I will never forget Dr. Horvath's role in the first Bentgrass v. Bermudagrass trial. Greg Breeden is a dear friend, and his daughter Taryn is one of my daughter, Palmer's best friends. Dr. Tom Samples is indeed a legend, and the future has never been brighter with Becky Bowling coming on board. Again, the team at UT is simply the best!

To our entire membership, thank you for making our association and conference one of the best in the country.

I hope that I have left things better than I found them as I believe the future is incredibly bright. I know I am leaving the association in great hands with VP Ryan Storey taking the lead. I am not sure exactly what the Past-President role will bring, but I will always be a huge supporter of everything Tennessee Turfgrass.

Love you all!

Chris Sykes
TTA President

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info@ttaonline.org
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EDITOR
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Relentless Focus

When asked to fill the state delegate position for the TGCSA, I was not sure what I was getting into. My first Chapter Delegate Meeting immediately introduced me to a whole other side of our business. It opened my eyes to what the GCSAA really means to our profession, while getting to meet many new faces from different areas of the country that face different problems, but in a similar way.

First, we received updates on the current status of the industry and the association. CEO Rhett Evans and President Kevin Breen heavily promoted our "Relentless Focus" of encouraging engagement in our industry. Please get your staff and colleagues involved if they are not.

Government Affairs continues to stay busy. Chava McKeel, Director of Government Affairs, and Mark Johnson, Director of Environmental Programs caught us up on the most recent issues. The biggest being the potential restrictions from the EPA on certain pesticides, herbicides and insecticides. They were adamant that we need to now adopt the idea that we must work alongside the EPA instead of seeing them as a threat. This brings forth the importance of a Best Management Practices (BMP) manual at your facility. Basically, the only model that the EPA has to go by in our industry is the current model they are using in Europe. BMP manuals are our way to keep us from going down that road completely. It is our way to communicate to the EPA that we are accountable and also presents us as environmental stewards. Every member now has a base model BMP for their facility on the GCSAA website. It is up to you to go and customize them. There are webinars and workshops that help you to customize your BMP to be effective for you.

Leann Cooper, Senior Manager for First Green and Workforces Development, then filled us in on the work they have been doing on the labor frontlines. The focus started on building your own team. This included the professional certificates offered for Superintendents, Assistant Superintendents, and Equipment Managers. The focus was then turned to youth outreach, recruitment tools, and crew training. These concepts can all be exemplified through programs like First Green, FFA (Future Farmers of America), and JAG (Jobs for America's Graduates). Shelia Finney, Department Leadership team member, explained all that they are doing to get knowledge of the golf industry to places like the FFA National Conference and other career development events. There is also work being done on the Labor Hub webpage on the GCSAA site to improve it as a tool moving forward.

The GCSAA will hit its Centennial mark in 2026. The association has formed a committee to make sure that year is celebrated properly. The mission statement is simple and powerful, "Honor the past 100 years…and inspire continued greatness into the next century." This committee will be helping set the stage for the future of the association.

We then broke out into small groups to discuss subjects such as the 2024 CPI Dues process, the Centennial plan, Career Development Certificates, Rounds 4 Research, and BMPs. In 2024, we will be voting to raise dues above the CPI model to possibly get the association more above the break-even line. Our Tennessee chapter was highlighted for our success with R4R. The ways that we have involved the member directly with funds raised, while still providing funds for research seems to have a direct impact on our success. We also brainstormed on ways we could possibly hold facilities accountable for BMPs in the future as it becomes more important.

The second half of the day at headquarters was devoted to the candidates running for offices to be voted on at the Conference and Trade Show (CTS) at the end of January. Kevin Breen will remain with us as Past President. Jeff White will be unopposed for President, as will T. A. Barker running for Vice President. Paul Carter and Doug Dykstra are running for Secretary/Treasurer. There are two open director positions. The terms of Doug Dykstra and Marc Weston are expiring. If Dykstra is not elected to the Secretary/Treasurer position, he will need to run from the floor for an open director position to remain on the board. If Carter becomes Secretary/Treasurer a third person will need to be elected for the one year remaining on his term. So basically, if all of the dominos fall, we could be voting to fill just one single director spot. The candidates for director are as follows:

- Greg Jones, CGCS/MG: Champions Run; Omaha, NE
- Ryan Kraushofer, CGCS:
  Westminster National Golf Course; Westminster, MD
- Christopher Reverie:
  Allentown Municipal Golf Course; Allentown, PA
- Marc Weston CGCS:
  Indian Hill Country Club; Wethersfield, CT

With the assumption that Marc is re-elected to stay on as Director, there are two others that stand out to me that would be a good fit and are ready to serve. There is one of those candidates that would share some of the same ideologies that could benefit our state. He stands out as the best candidate if we were only to vote for one spot. Thank you for allowing me to serve and represent you all through the TGCSA. If you have any concerns or thoughts about this process, please feel free to reach out to me at any time.

Best Regards,

Justin Browning
Golf Course Superintendent, The Course at Sewanee
Tennessee Chapter Delegate
931-598-1525 • jabrowni@sewanee.edu

CALENDAR OF EVENTS

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www.tgcsa.net

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A Contrarian's Guide to AUTONOMOUS TURFGRASS ROBOTIC TECHNOLOGY

By J. Scott McElroy, PhD – *Professor, Department of Crop, Soil, and Environmental Sciences – Auburn University*

The Echo Robotics TM-2050 unit.

As a scientist, I hesitate to make predictions such as those a fortune teller might reveal. I wince when I hear people speaking with absolute certainty that this or that will happen in the future. That some team will win, some politician will lose, or that some event will occur is often pure speculation. Absolute predictions are nonsensical, and an affront to probabilistic thinking. To think probabilistically is to think in terms of the **percentage of probability** that something will occur. This is the foundation of good science.

Having said that, it is highly probable that in the next 10 years autonomous technology will gain a significant portion of the professional and consumer market in the United States. I base this prediction on four pieces of evidence:

1. Robotic technology has already captured a significant portion of the technology in Europe.
2. All major brands that market traditional mowing technology or mowing equipment are developing robotic technology.
3. At one count there were over 40 additional startups and companies developing all manner of robotic technology, including mowers, painters, and sprayers.
4. The labor shortage will be sustained into the foreseeable future and could potentially increase (**https://www.wsj.com/articles/america-still-has-a-worker-shortage-d0c65166**).

But here I am addressing the *"Contrarian's Guide to Turfgrass Robotic Technology."* To the robotic contrarian, any positive arguments I present regarding this technology will likely fall on deaf ears. To the contrarian, only seeing is believing. Once my prediction has come true, the contrarian will adopt the technology as self-evident. Don't get me wrong. Skepticism is a good thing. However, a complete understanding and realistic expectation of what robotic technology can do and where the technology is going is necessary to the healthy skeptic. I want to convince the contrarian that instead of waiting for the technology to be tested by fellow industry partners, they should begin testing and evaluating it themselves. With that in mind, I present this article to the contrarian on fundamentals of robotic technology today.

"The Technology is Just Not There Yet."

This is the contrarian's favorite phrase. In frustration I respond, "Where is There?" or even "What is There?". If the technology has not arrived at the point where it can be adopted, what are its current limitations?

What irks me so much about this critique is the underlying assumptions about imagined technological characteristics that may not even be possible. The contrarian's perception of automation is that the technology can be easily set up with little or no planning or understanding of the technology. That it may be deployed for use with little, or no, oversight. The phrase, "The Technology is Just Not There Yet," is normally rooted in some technological advancement in artificial intelligence, or machine learning, that the contrarian has developed based on their perception of technological development, or maybe even a touch of science fiction.

My response is *"The technology is what the technology is."* 2022 might as well have been ten years ago when it comes to robotic and autonomous technology in the United States. 2023 saw an incredible number of major advances. These include allowance for extended range connection to 4G and network RTK systems; daisy chaining of reference station signals for greater lengths; creation of virtual zones that can vary in direction, speed, and height of cut; and mobile deployment across multiple sites. The technology launched in 2023 will be the basis of robotic technology for the next five to ten years.

To the contrarian, if you were talking about 2022, I agree. The technology was not "there" for the professional user. It was largely restricted to wire boundary units, mowing randomly at a single fixed zone height. But 2023 completely changed the game.

Autonomous vs. Semi-Autonomous

Before discussing the technology that now makes robotic automation possible, let me make a rather large distinction in technology – Autonomous vs. Semi-Autonomous Technology. Now and in the future, it will be extremely difficult for any mowers with traditional mowing implements to be fully autonomous simply due to liability. As I have been told (I am not an expert on liability, nor am I a lawyer) liability has been and will continue to restrict deployment of certain technology. Such technology – *semi-autonomous technology* – will require an operator to be watching it while it is completing its task. It will not work at night and will likely not have a fixed position point for deployment. It will need to be taken to the location by hand for deployment. *Fully autonomous technology* will likely be small, lightweight equipment weighing approximately less than 300 lbs. Again, I may be wrong, but making traditional mowing equipment fully autonomous is going to be challenging to say the least.

Robot Positioning- The Leap Forward in 2023

The technology that made 2023 the year of advancement largely dealt with how the robots position themselves in space. And the one acronym you need to know is RTK.

RTK. RTK stands for Real-Time Kinematic. It is a satellite navigation technique used for enhancing the precision of position data obtained from global navigation satellite systems (GNSS) like Global Positioning System (GPS). RTK is commonly used in applications where high accuracy location information is required, such as surveying, agriculture, construction, and autonomous vehicles. RTK requires a base station in a fixed position that can then communicate to a rover (in our case a mower, painter, or range picker). RTK allows for real time positioning and correction for the rover. RTK signals can stretch from 200 meters to 10 miles depending on the signal type. Husqvarna and Echo Robotics use a fixed position RTK signal that extends 200–300 meters. (Actually, Echo Robotics now has 4G RTK which extends up to 10 miles.)

nRTK. nRTK stands for *network* real-time kinematics. nRTK is a mesh network system individual companies deploy and then offer other companies for use. For example, NexMow uses nRTK from TopCon (**https://global.topcon.com/**). Kress (**https://www.kress.com/en-us/all-robot-lawn-mowers/**) has developed its own nRTK system specifically for its mower technology. Tiny Mobile Robots also uses an nRTK system for positioning.

RTK, whether a dedicated local RTK reference station, or a nRTK system, allows for positioning of technology in space, allowing for removal of wire from the field and the creation of virtual boundary systems. RTK also allows for directional or systematic work, not random work. With RTK the efficiency of the equipment increases exponentially and the ability to deploy over a wider area has increased.

Where Should the Contrarian Begin?

If it is true that robotic technology will be a common form of turfgrass management in the next five to 10 years, one probably needs to start learning about and adapting the technology now. To be fair, there are some early adopters that have made significant investments in this technology, but the contrarian samples the product before a full commitment. The key to what to utilize first is choosing equipment that solves a problem. Depending on the operation, you already have mowing equipment, so unless you need to make a major purchase, the first goal is to seek out equipment that solves a problem. Here is my list of useful equipment that solves major issues.

Field Painters. Field Painters have been adopted in the United States faster than any other autonomous technology for one big reason – they solve a problem. Painting field lines is a tedious, repetitive task that was begging for automation. Technology from Turf Tank (**https://turftank.com/us/**) and Tiny Mobile Robots (**https://tinymobilerobots.com/field-marking-robot/**) have taken athletic field maintenance by storm with painters becoming the fasting growing segment of autonomous turfgrass management.

Range Pickers. Ranges can have a myriad of problems that robots can solve. Large pickers used frequently can compact soil. They are very abrasive to the turf reducing stand density and quality and can cause damage during high soil moisture conditions. Light weight pickers such as the Echo Robotics Range Picker (**https://echorobotics.com/en-us/**)can be programmed to pick ranges at all hours of the day. It uses the same positioning technology as Echo Robotics mowers – either a WiFi or 4G signal – which massively extends the range of use of the picker.

Slope Climbers. Mowing slopes is a burdensome task. It can be damaging to the turf and dangerous for the operator. Because of the difficulty, some sloped areas are mowed infrequently reducing the turfgrass stand and leading to debris buildup after mowing.

The Tiny Mobile Robots Field Painter

An example of an RTK beacon – The Echo Robotics Wifi Beacon.

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The Husqvarna 535 AWD hill climber.

The Husqvarna 535 AWD is a compact, light-weight slope mower that can be deployed to cover up to 0.8 acres. While it is random and has a wire boundary, it is efficient, and virtual zones can be created after it has mapped the wire bounded area.

Drop and Mow. Many contrarians are turned off by the idea of fixed position mowers that are bound to a specific docking station and work zone. They would prefer to be able to deploy mowers to other locations during the evaluation phase. The NexMow M1 (**https://nexmow.com/**) is a deployable drop and mow system that allows for mapping and deployment at hundreds of areas stored on the NexMow app. Simply choose the location that you have mapped and stored in the app, deploy one or multiple mowers, and return to pick up when the app tells you the job is complete.

Mowing Technology. Or the contrarian could just deploy other mowing technology. Mowers from Husqvarna, Kress, and Echo Robotics are all light weight, fully autonomous mowers that can be deployed to mow fairways, rough and tee areas, sports fields, common areas, or large multi-use complexes. This will allow the contrarian to evaluate the cut quality, evaluate the equipment for its functionality at their location, and determine how best to scale with autonomous technology. To be fair, the economics do not work out until autonomous technology has been deployed at scale—meaning across a majority of the facility. In the beginning, if you are just evaluating a few pieces of equipment, this will likely add a little to your workload in the first year, as you are adding a new piece of technology without subtracting equipment you are already using. This is part of the process of adopting new technology. The time and money saving on a facility basis are not realized until you are at scale.

Final Thoughts

When the iPhone was introduced in 2007 it was an amazing leap in mobile technology. It has changed the way we work, play, and live. The current version of the iPhone is even more amazing – camera technology; the myriad of apps that are available; and how you can do almost anything on the iPhone. I have never heard a single person who bought the original iPhone complain that they should have waited to buy the current iPhone and skipped the 16 years of previous iterations. Sure, the new iPhone is amazing, but so was the original.

The NexMow M1 drop and mow unit.

I leave the contrarian with this final comparison. The technology released in the US in 2023 will be the dominant technological innovations for the next decade and beyond. There will be upgrades and innovations along the way, but the base technology will remain the same. If you wait for some mythical technological level that may never come, you will miss out on the journey this technology will take us on for years to come.

Disclosure

Dr. McElroy is a professor at Auburn University, and also owns Scotsman Turf Robotics, (**http://scotsmanturfrobotics.com**) which is a distributor of Husqvarna, Echo Robotics, and NexMow. Scotsman does not distribute Kress, Turf Tank, or Tiny Mobile Robots but sees these as valuable additions to a growing autonomous turfgrass technology industry. Dr. McElroy and Scotsman encourage readers to explore all aspects of autonomous and semi-autonomous equipment that will be the future of turfgrass management. Robotic equipment is currently <1% of the US turf equipment market but is slated to grow substantially over the next five years.

ADVERTISER INDEX

This article was originally published in *Alabama Turf Times*, Winter 2023 and is reprinted with permission.

ACHIEVING SUSTAINABILITY IN THE LANDSCAPE

The Sustainable SITES Initiative

By Michael Ross, SITES AP, ASLA, Assistant Professor,
Plant Sciences Department + School of Landscape Architecture, University of Tennessee

and James D. Zimmerman, MLA Graduate Student,
School of Landscape Architecture, University of Tennessee

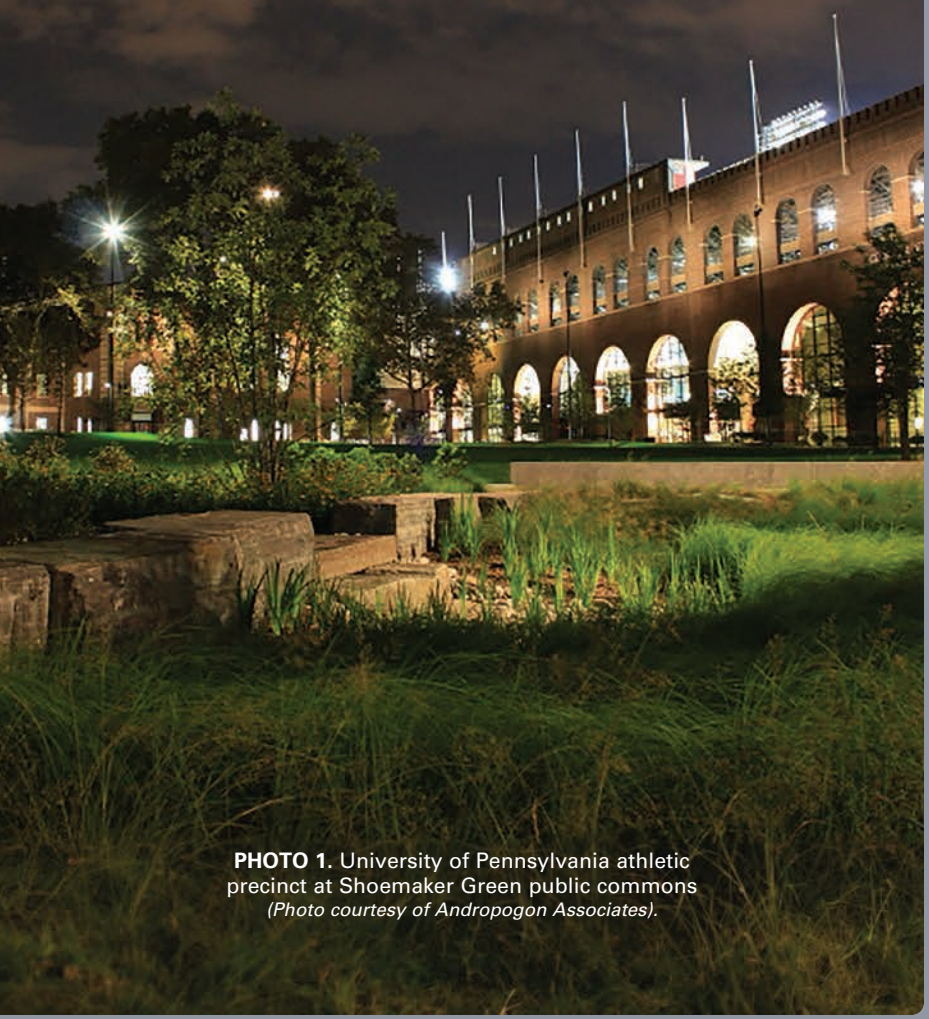

PHOTO 1. University of Pennsylvania athletic precinct at Shoemaker Green public commons *(Photo courtesy of Andropogon Associates).*

I am often asked about references that are available to help designers, gardeners, contractors, and maintenance folks establish more sustainable practices and solutions to common landscape challenges. There are many great resources that provide some basic strategies for residential landscapes and gardens. Suggestions can assist with retrofit and initiation options as well as sustainable enhancements for designs. Often, though, planners find that as the scale of a project increases, or they are facing construction of a completely new development, the ability to maximize sustainability and resilience in the earliest stages can impose some significant challenges…along with real opportunities.

There are several programs that serve as guidelines for pursuing sustainable design, construction, maintenance, and management objectives. In this article, I will focus on The Sustainable SITES Initiative (now, SITES v2).

The Sustainable SITES initiative was developed in collaboration with the American Society of Landscape Architects, The Lady Bird Johnson Wildflower Center, and the United States Botanic Garden. The developers of the SITES concept sought to promote ecosystem services and regenerative landscapes as an investment in resilient futures and ecosystem services. Ecosystem services encompass the goods and benefits that healthy ecosystems provide to people, both directly and indirectly.

The goal of SITES focused on developing a sustainability rating system that would serve a similar role for the landscape that the Leadership in Energy and Environmental Design (LEED) system provided for buildings. Like LEED, SITES provides a rating system that allows projects to earn points and gain recognition for efforts undertaken to integrate sustainability. Initial efforts were undertaken with pilot projects from various parts of the country and at varied scales. As feedback came in from participating professionals, credits were added, refined, and clarified. The Sustainable SITES Initiative is now on its second version and is referred to as SITESv2. The enhanced objectives of SITESv2 are to create regenerative systems and foster resiliency, to ensure future resource supply and mitigate climate change, to transform the market through design, development, and maintenance practices, and to enhance human well-being and strengthen community (SITES v2 Reference Guide, 2014). These lofty goals reflect a contemporary understanding and appreciation for the simple fact that landscape is inherently boundless.

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Although we as designers and planners may be limited to a project site boundary, the decisions, actions, and interventions we take will have impacts beyond the project site.

SITESv2 recognizes four categorical levels that are achieved through meeting prerequisites and achieving point credit accumulations: Certified (70 pts.), Silver (85 pts.), Gold (100 pts.), and Platinum (135 pts.) projects. SITESv2 currently has a total of 200 credits (points) that can be earned. Although a project does not need to earn all possible credits, it must satisfy all the required prerequisites. SITES and SITESv2 are now owned and managed by Green Business Certification Inc. (GBCI), the same company that owns and manages LEED certification. There are now synergies between the two rating systems that allow for credits earned in one to be applied to the other.

At the time of writing, there are more than 290 projects that have been categorized within the Sustainable SITES Initiative. These projects run the gambit from efforts initiated at university campuses (**Photo 1**), city parks (**Photo 2**), public gardens (**Photo 3**), medical facilities, and stormwater mitigation by municipalities. Residential projects also are eligible and could provide some interesting opportunities for expansion of the program. For reference, Tennessee currently has one SITESv2 project, *The Woodland Discovery Playground* at Shelby Farms, which is located in Shelby County in West Tennessee (**Photos 4 & 5**).

A SITESv2 Program Overview

The process to SITESv2 Certification is organized into four steps. First, the site must be registered by completing key forms and paying the registration fee to receive access to SITESv2 worksheets. Then, completion and submission of the necessary worksheets and documentation enable GBCI to begin reviewing the project. Thirdly, GBCI will conduct an examination of the project to ensure credibility.

PHOTO 2.

Xuhui Runway Park
in Shanghai, China
designed by Sasaki

(Photo reprinted with permission, courtesy of Sasaki).

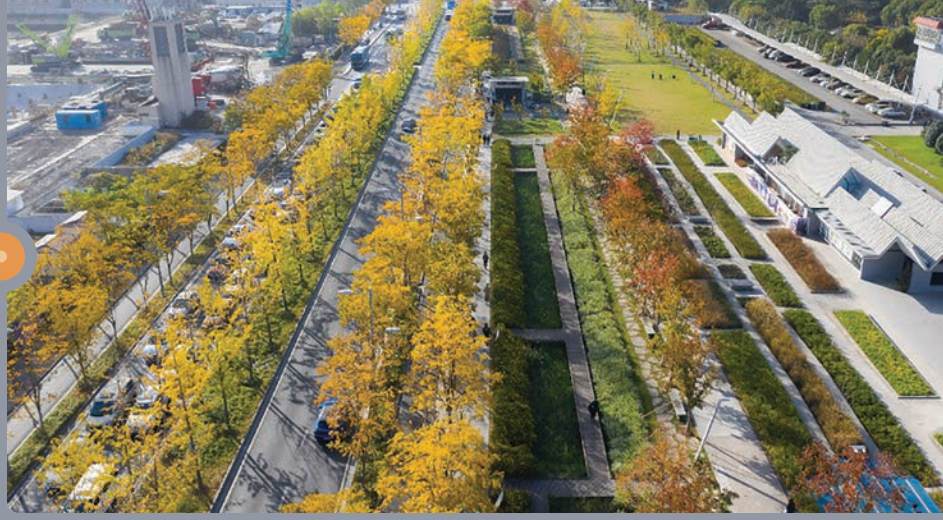

PHOTO 3.

Phipps Conservancy and Botanical Garden in Pittsburgh, PA that was designed by Andropogon Associates

(Photo courtesy of Andropogon Associates).

PHOTO 4.

A playground at *The Woodland Discovery Garden at Shelby Farms* designed by James Corner Field Operations and located in Memphis, TN

(image reprinted with permission: photo © James Corner Field Operations)

PHOTO 5.

A splashpad at The Woodland Discovery Garden at Shelby Farms designed by James Corner Field Operations

(image reprinted with permission: photo © Shelby Farms Park Conservancy / Rebecca Dailey)

Finally, if everything is approved, GBCI completes the final review and awards certification.

Currently the SITESv2 program is broken down into 10 sections with required prerequisites and optional credits. These sections include elements like using an integrative design process and conducting a pre-design site assessment as prerequisites, while reducing outdoor energy consumption and diverting construction and demolition materials from disposal as non-required credits. It is important to note that not all projects will have the ability to hit all the credits, but projects must achieve all the prerequisites.

Additionally, SITESv2 uses a decision-making hierarchy that focuses on conservation, management, restoration, and generation depending on the initial site conditions. As examples, if your project location had an old growth forest, a designer might prioritize conservation as a key strategy. If, however, the location was formerly a parking lot, the designer would utilize a strategy of reintroducing ecosystem services and regenerative systems. These considerations fall within a series of goals for the SITESv2 project.

A Brief Introduction to A Few of SITESv2 Section Opportunities

There are 10 sections of the SITESv2, each with their own prerequisites and available credits. For example, Section 1 deals with site context and focuses prerequisites on minimizing impact to farmland, floodplains, aquatic ecosystems and endangered or threatened species. Credits can be earned for redeveloping degraded sites, or infill projects.

Section 2 involves the pre-design assessments and requires the use of an integrated design process. This is perhaps one of the strongest arguments for the SITESv2 program.

The integrated design process requires that all participants, owner, designers, contractors, and maintenance folks be present and actively engaged in the initial discussions and design planning. Many of us have experienced situations where our voice is left out of the design and planning process only to be brought in after the fact and in some cases too late to effectively guide a sustainable or resilient move on a project. This integration between participants means that everyone is acknowledged as being crucial to the successful outcome of a sustainable project.

Section 3 deals with site design as it relates to water. This includes reducing water use for irrigation, managing stormwater on site, restoring aquatic ecosystems, etc. As with all the sections there are credits that can be earned by using sustainable design best practices.

The remaining seven sections relate to Soil and Vegetation, Material Selection, Human Health and Well-Being, Construction, Operations and Maintenance, Education and Performance Monitoring, and Innovation Exemplary Performance.

Challenges

There are several challenges that arise when working towards SITES Certification. One of the main challenges is the cost of the SITES Certification with registration and certification fees can approach $10,000. Keeping track of forms, deadlines, and credits also is time consuming and can take away time from the project itself. This extra time reduces the effort and money that can be put into designing the site. Another challenge is trying to assemble the integrated design team. This requires a variety of stakeholders to agree to joining the team and can take time and communication to form an effective team.

RESOURCES

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Applying
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Management Challenges

Growing playable grasses in shaded and reduced light stadium environments

By Rhys Fielder, MS student, Tyler Carr, Ph.D., John Sorochan, Ph.D., and Kyley Dickson, Ph.D.;
Plant Sciences' Turfgrass Science Program at the University of Tennessee – Knoxville

Modern-day stadiums are often planned and designed to provide versatile functionality and enhance fan experience. These stadiums are usually promoted as the home of a particular sports team; however, these venues may also become host sites for events year-round that range from concerts to monster truck rallies. Currently, ten of the thirty National Football League (NFL) and eight of the thirty Major League Baseball stadiums are either fully enclosed or have large overhangs covering the seating bowl.

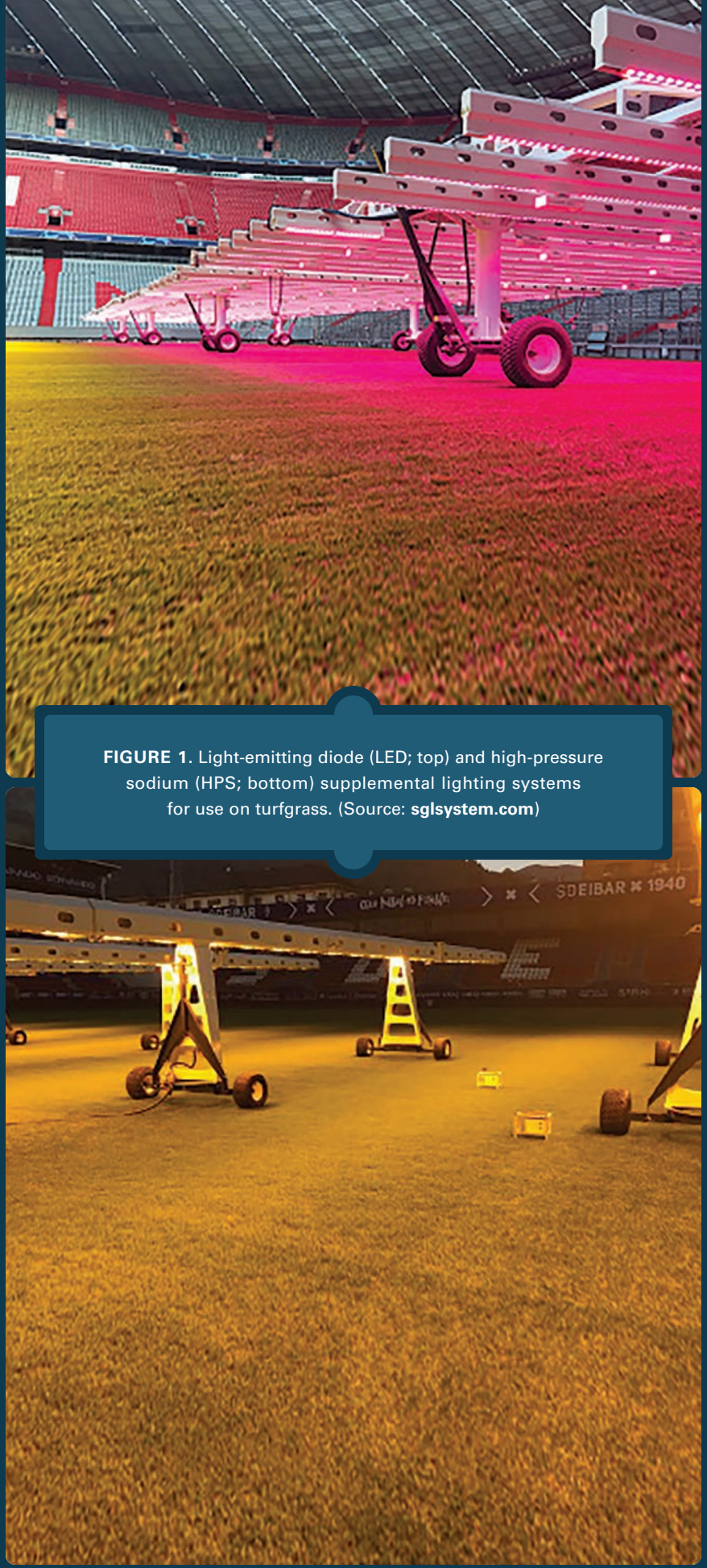

FIGURE 1. Light-emitting diode (LED; top) and high-pressure sodium (HPS; bottom) supplemental lighting systems for use on turfgrass. (Source: **sglsystem.com**)

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The encapsulation of the stadium allows for an increase of fan comfort during events, as well as a reduction or removal of environmental factors when planning or hosting events. While these amenities are important for professional venues, any stadium or pitch that receives heavy shade from high walls, overhangs, or partially enclosed roofs, present difficulties to those managing one of the most important assets a stadium has: the playing surface.

We learn and teach these and other practical challenges in undergraduate and graduate level Turfgrass Sciences coursework in the Plant Sciences degree programs at the University of Tennessee. For some undergraduate student interns, as well as MS and PhD students working on cutting-edge research projects to address a knowledge gap, the solution requires understanding the science of interactions between turfgrasses and structures, the players on the field, and the turfgrass managers who are tasked to maintain the highest quality playing surface across the entire span of seasonal use. This understanding is most often informed by our studies of plant physiology, growth, and performance characteristics of different turfgrass species.

In the real-world scenario that we present here, shaded turfgrasses in stadiums experience considerable challenges to photosynthetic processes that would not typically inhibit plant development in an open-air environment. Unlike humans, plants have the remarkable ability to generate their own food through the process of photosynthesis. A combination of water, carbon dioxide, and light energy allows the plant to manufacture carbohydrates to be used for energy. These three ingredients can be naturally provided by the environment. Within a stadium environment, irrigation can be used to fulfill water needs and air circulation systems such as fans can even be supplemented to increase carbon dioxide availability. However, one of the most difficult challenges a stadium or partially enclosed structure creates is the imposition of shade that reduces the amount of available light.

Shade can be defined as a reduction in both light quality and light quantity. Light quality is explained by observing the wavelengths in light, which are measured in nanometers (nm) and range from very short to very long. Turfgrass requires light quality to be within the range of 380–700 nm in order for photosynthesis to occur. Light quantity is the actual particles of light that provide the necessary energy for photosynthesis to occur. A shade situation appears when there is not enough light energy (quantity) being supplied to the turfgrass for sufficient photosynthesis to occur.

What has been (and can be) done to address these challenges?

In many instances, the simple answer has been to install artificial turf surfaces that do not require light at all. Yet simple solutions can bring challenges and consequences of their own. The decision to switch to artificial turf is often made contrary to player preference and injury data. Results from the NFL Players Association's (NFLPA) 2010 NFL Players Playing Surfaces Opinion Study documented that 69.4% of players preferred to play on natural grass versus preference for artificial turf (14.3%). More recently the NFLPA president, JC Tretter, released a statement that calls for all NFL stadiums to have natural grass playing surfaces. Tretter cited NFL injury data collected from 2012 to 2018, which reported that artificial surfaces increased the likelihood of a player suffering a non-contact lower extremity injury by 28% compared to grass. Faced with calls for action and preferences of players, stadiums that have extreme shade issues and boast artificial surfaces are forced to consider the difficult questions: Is it possible for our venue to support natural grass? and How can that turfgrass be managed for playability across event activity and growing seasons?

Answers to parts of those questions can be supported with solutions from supplemental lighting. Supplemental lighting for stadiums is like the lights used in a greenhouse. They work by replacing the photosynthetically active light that a plant would usually obtain from natural sunlight. Supplemental lighting products for stadiums generally rely on illumination from one of two different light sources: high pressure sodium (HPS) or light-emitting diode (LED) (**Figure 1, page 32**). Currently, the most widely used supplemental lighting systems in the United States and worldwide utilize HPS rigs.

Stadiums housing NFL teams in Miami, Jacksonville, Green Bay, and Kansas City have had success using HPS light systems to promote photosynthesis on areas experiencing shade issues. Colder climates, such as in Green Bay, receive added benefits from HPS lights, as these systems can increase temperatures at the grass surface up to 5°F (3°C). Green Bay routinely reports daily low temperatures below freezing between November and January, so the heat emitted from the HPS lights likely allows the grass to recover between games when there would otherwise be little to no recuperative growth, potentially resulting in a safer surface for the athletes. If excess heat from supplemental lighting is not desired, such as a stadium in a hot climate, one may elect to use LED lights.

LED light systems provide two distinct benefits compared with HPS. First, LED lighting uses less energy during operation than HPS systems. The principle is similar to replacing incandescent bulbs with energy-efficient LED bulbs in residential and commercial buildings. Another benefit of LED systems is the ability of operators to select a desired range of wavelengths from different portions of the light spectrum. This capability is not available with HPS lighting. Although LED systems are currently more expensive up-front than HPS, the gap in cost has been narrowing with advances in technology.

"Results from the NFL Players Association's (NFLPA) 2010 NFL Players Playing Surfaces Opinion Study documented that 69.4% of players preferred to play on natural grass versus preference for artificial turf (14.3%)."

Taking Science to the Gridiron and the Pitch

Since summer 2019, The University of Tennessee has been conducting supplemental light studies in cooperation with Stadium Grow Lighting to quantify how warm- and cool-season turfgrass species respond when grown under light supplied from only LED or HPS systems (**Figure 2**). These are important questions to answer, as indoor stadiums create situations where all light must be supplied supplementally.

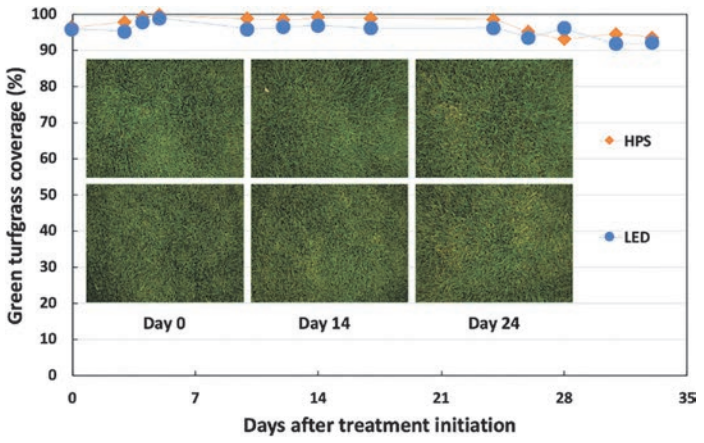
An important way to measure how a cool-season grass, such as Kentucky bluegrass, responds to supplemental lighting is to quantify the turfgrass quality. A subjective way to assess quality is by estimating the percentage of green turfgrass coverage over a given area. In general, greater turfgrass coverage corresponds to greater aesthetic quality.

Throughout the trial, our team identified no significant differences in green turfgrass coverage when comparing HPS and LED in the absence of natural light (**Figure 3**). Kentucky bluegrass maintained turfgrass coverage greater than 90% when grown under both HPS and LED lights. In addition, turfgrass coverage greater than 95% was observed continuously for the first 24 days.

So how could it be possible for an indoor or heavily-shaded stadium to grow natural grass? Our preliminary results with Kentucky bluegrass show that this species can be grown using supplemental lighting when no natural sunlight is available, like in an indoor stadium. a Current and future research at the University of Tennessee is underway and being planned that will provide innovative solutions to other problems associated with growing turfgrass in situations that require solutions for shade and supplemental lighting.

FIGURE 2. The shade structure at the University of Tennessee where supplemental lighting studies occur.

FIGURE 3. Green turfgrass coverage for Kentucky bluegrass grown exclusively under high-pressure sodium (HPS) or light-emitting diode (LED) supplemental lighting systems from November 8 to December 11, 2019 in Knoxville, TN. Images demonstrate the response of Kentucky bluegrass to HPS (top row) or LED (bottom row) after 0, 14, and 24 days.



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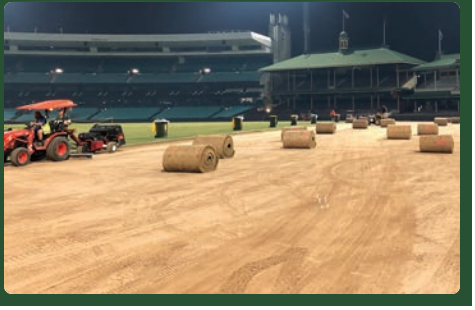

ECOLOGICALLY BENEFICIAL TURF

A CHANGING LANDSCAPE

By Casey O'Neal, *Graduate Research Assistant, Auburn University*
Julie Wang, *Graduate Research Assistant, University of Georgia*
Nikolay Minaev, *Graduate Research Assistant, Mississippi State University*

Movements such as "Save the Bees", "No Mow May", and "Let it Bloom June" are recently trending critiques of monoculture lawns. They highlight the lack of plant and insect diversity in single grass species or cultivar lawns. In recent years, programs like Operation Pollinator have moved the golf industries toward stakeholder interests by supporting research and outreach efforts to improve the ecological function of turf on their facilities. Similarly, the turfgrass industry must prepare to do the same for lawns. While replacing grass lawns with flower gardens, white clover fields, or meadows may be beneficial for pollinators and people in some areas, it ignores the documented want and need for lawns in modern society.

A grass lawn with spring beauty at a park in Starkville, MS.
Photo provided by Nikolay Minaev.

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A hoverfly drinking nectar from a spring beauty flower at Town Creek Cemetery, Auburn, AL.
Photo by Casey O'Neal.

Monoculture lawns, typically a green frame around residential and commercial buildings, accumulate pests and consume a significant sum of inputs. Monoculture lawn alternatives, such as diversified, pollinator friendly, or flower lawns have been discussed; however, a warm-season alternative lawn with known beneficial impact and best management practices (BMPs) has not solidified in science or common practice. Understanding BMPs, and the benefits of these lawns, are crucial goals for the future of the turfgrass industry. The United States Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA) has funded the Refuge Lawn project to help highlight these goals.

The Refuge Lawn project consists of interdisciplinary researchers from Mississippi State University (MSU), Auburn University (AU), and the University of Georgia (UGA). The team set out to identify low-growing, flowering plants that would be easily established and managed in grass lawns, as well as provide the resources necessary to promote an abundant and diverse pollinator community. As some of the graduate students work on different aspects of the project, we would like to share some of our on-going research.

PICKING THE RIGHT PLANTS

At Mississippi State University, Nikolay Minaev, working with Dr. Jay McCurdy, has been looking for flowering plants that could be easily established and propagated within turfgrasses commonly found in southeastern lawns. After evaluating various species based on their blooming properties and appearances in lawns, it was determined that spring beauty (*Claytonia virginica*) shows high potential for inclusion in warm-season lawns. Spring beauty is a perennial wildflower that is native to rich forests and low woodlands. It prefers moist, well-drained soil and light shade to part sun. It grows from a small corm or seeds. The growing season lasts from January through April in the temperate climate of the southeast, after which the plant senesces and lies dormant before emerging from corms the next year. The flowers are showy, pinkish white with deep pink veins, and open in clusters at the apex of the plant, adding a burst of color to the lawn during the early spring period. Additionally, it is a resource for pollinators such as the rare spring beauty bee, a small mining bee native to eastern North America.

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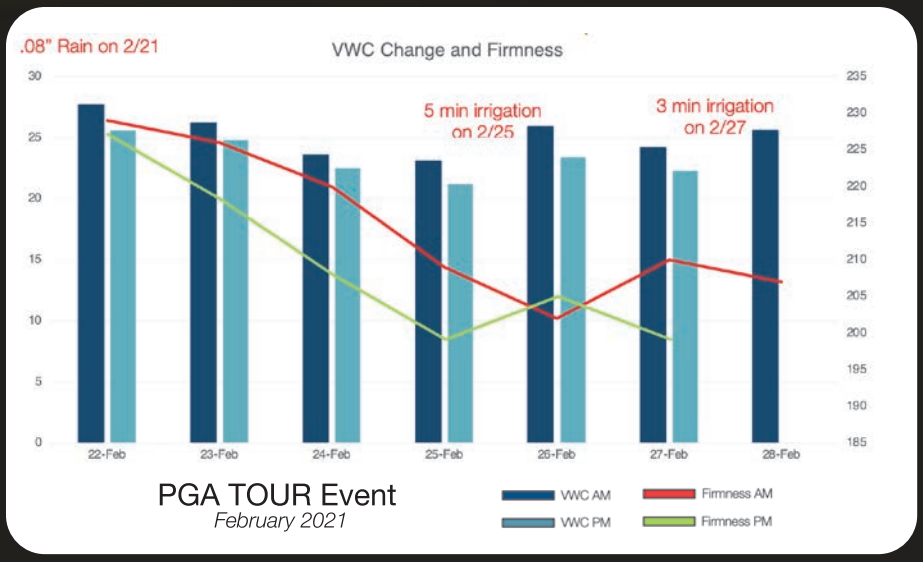

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The current understanding of spring beauty propagation is limited, hence we aim to address this knowledge gap by conducting a comprehensive study. The primary objective is to phenotype different populations of spring beauty and identify those with the most abundant and long-lasting bloom period, accompanied by high seed production and germination rates. This will allow for the selection of the most promising population for inclusion in lawns. In addition to identifying the optimal population, we are also exploring the most convenient method of propagation, with a particular focus on seeding. To achieve this, we are conducting experiments to find the optimal conditions for spring beauty germination, including testing various temperatures and probable treatments for quicker establishment.

Another project investigates the tolerance of spring beauty to commonly used pre-emergence herbicides in lawns. Our objective is to develop management practices that are safe for both turfgrass and spring beauty. By combining these different aspects of our research, we hope to provide a comprehensive understanding of spring beauty propagation and its integration into turfgrass lawns, while also promoting safe and sustainable management practices.

CARING FOR A REFUGE LAWN

Julie Wang and Dr. Gerald Henry at the University of Georgia are investigating the BMPs for cultural management of a refuge lawn. Mowing height is one of the most well documented cultural factors affecting weed populations in turfgrass. Nearly all lawns are regularly mown for functionality and aesthetics. While mowing is relatively well understood in terms of eliminating weeds, it can be similarly applied to encourage flower production and growth of refuge lawn. As part of the Refuge Lawn project, we are studying the effect of mowing height on flowering plants commonly found in turfgrass that have potential to be pollinator resources. We are currently measuring the survival, growth, and reproduction of white clover (*Trifolium repens*), Virginia buttonweed (*Diodia virginiana*), and common lespedeza (*Kummerowia striata*) in response to different mowing heights. The results may explain the persistence of flowering plants in turfgrass as well as their potential as floral resources for pollinators.

Fertilization, another common cultural practice in lawns, affects species competition and plant diversity. A high nitrogen (N) content increases turfgrass productivity and competitiveness with flowering plants adapted to limited N availability. This is especially relevant as fertility practices vary by turfgrass species. For instance, centipedegrass (*Eremochloa ophiuroides*) is adapted to lower maintenance regimes in contrast with hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) that requires regular fertilization during peak growth. We are evaluating the competition between common flowering plants and turfgrasses under different fertility treatments, focusing on white clover, Virginia buttonweed, centipedegrass and hybrid bermudagrass. Preliminary results suggest that low fertility inputs hinder hybrid bermudagrass growth, leading to an open canopy, which encourages flowering plant growth. On the other hand, exorbitant amounts of fertility on centipedegrass only enhances flowering plant competition and further plant growth. The understanding of flowering plant and turfgrass dynamics will help create BMPs for both homeowners and the turfgrass industry.

A sweat bee collecting pollen from yellow wood sorrel (*Oxalis stricta*) at the AU Turf Unit.
Photo by Casey O'Neal.

A pure green sweat bee (*Augochlora pura*) visiting white clover at Kiesel Park, Auburn, AL.
Photo by Casey O'Neal.

Virginia buttonweed in a lawn on AU campus.
Photo by Casey O'Neal.

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WHAT DO THE BUGS THINK?

At Auburn University, Casey O'Neal and Dr. David Held want to know what insects benefit from integrating flowering plants into warm-season grasses. Beginning in fall 2021, we established plots of seven potential flowering plant species in lawns at the AU Turf Unit, Town Creek Cemetery, and Kiesel Park in Auburn. These sites consist of established turfgrass lawns that host a range of common warm-season turfgrasses including bermudagrass and centipedegrass. The flowering species include spring beauty, white clover, and Virginia buttonweed, allowing us to connect our research with the teams at MSU and UGA. In 2022, the flowering sites were monitored for visitation by insect pollinators, and the insects were collected and identified. Due to the drought in 2022, data collection at these sites will continue in 2023. From these collections, we can establish a pollinator network. This network will show which flowering plants provide resources for the largest number of pollinators, and which plants provide resources for rare or threatened pollinators. While the exact number is unknown, it is expected that there are more species of bees in Alabama than any other southeastern state, and currently over 500 species have been identified in Georgia alone. With such a high diversity of insect pollinators, it is important to include flowering plants that serve as many of the native pollinators in the southeastern US as possible.

By combining the knowledge gained from our respective studies, we can establish a model refuge lawn with known BMPs and beneficial impacts on pollinators. To keep up with us and the rest of Refuge Lawn project's work, or to contact any of the researchers involved, please visit our website at **www.refugelawn.com**.

This work is supported by Agricultural and Food Research Initiative grant no. 2021-67013-34145 from the USDA National Institute of Food and Agriculture.

Refuge Lawn
A USDA-NIFA project connecting people, plants, and pollinators

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WORKING SLOWER

By Neal Glatt, CSP, ASM

There are times when managers have no choice but to jump into the field and lend a helping hand to meet some pressing obligations. And while most managers bring a big boost of productivity in these times, I no longer personally contribute that way. My goal, when I have to perform a critical task outside my role, is to work slower, and it's a strategy that more managers might want to copy.

The key reason why I work slower is because if I'm performing duties outside of my role it means something has gone wrong. Either we don't have the manpower available (because we made them feel undervalued and quit) or the manpower available isn't competent enough to perform the task (because we haven't trained them well enough). Either way, the problem lies with us as managers.

So, I leverage the opportunity to be hands-on not to perform work as quickly as possible because I can, but rather to work slow and remedy those two workforce problems. I enter "training mode" where workers are protected from all the time pressure of the job, and we slowly demonstrate every step of every process. Work is frequently paused to explain the reasoning that tasks occur, and work is done in specific ways. And, when something is completed, we often undo the work so it can be redone without my involvement while I supervise and provide feedback.

The other benefit of slowing work down is that there is plenty of time to express appreciation for everything that employees are doing well. That may be as simple as being open and receptive to instructions or exercising care in delivering quality work. Whatever behavior is occurring that I would like to see replicated I affirm, compliment, and reinforce.

Working slowly is like saving money. In the moment, it requires discipline and doesn't deliver immediate gratification. Something must be sacrificed in the short-term, but there are real benefits in the long-term. When I work slower, it's usually only once or twice with an employee on any given task because they become empowered to run the show on their own after that point. It's like earning compound interest.

The solution to not having enough time and people to complete all of the obligations is to slow down, not speed up. Taking this counterintuitive approach to dedicating resources and effort to training, especially when it feels like we can't, is the way to empower organizations to break the vicious cycle of always playing catch up.

Neal Glatt is the Managing Partner of GrowTheBench, an online training platform for the green industry. Connect with Neal at www.NealGlatt.com.

THE TURFGRASS TEAM AT THE UNIVERSITY OF TENNESSEE, KNOXVILLE

José Javier Vargas Almodóvar
Research Associate II
Turf & Ornamental
Weed Science
The University of Tennessee
2431 Joe Johnson Drive
252 Ellington Plant Sci. Bldg.
Knoxville, TN 37996
(865) 974-7379
jvargas@utk.edu
tnturfgrassweeds.org
@UTweedwhisperer

Jim Brosnan, Ph.D.
Professor,
The University of Tennessee
Director – UT Weed
Diagnostics Center
112 Plant Biotechnology Bldg.
2505 EJ Chapman Drive.
Knoxville, TN 37996
Office: (865) 974-8603
tnturfgrassweeds.org
weeddiagnostics.org
mobileweedmanual.com
@UTturfweeds

Midhula Gireesh, Ph.D.
Assistant Professor
and Extension Specialist
Department of Entomology
and Plant Pathology
The University of Tennessee
UT Soil, Plant and Pest Center
5201 Marchant Drive
Nashville, TN 37211
mgireesh@utk.edu
(615) 835-4571

Becky Bowling, Ph.D.
Assistant Professor and
Turfgrass Extension Specialist
The University of Tennessee
112 Plant Biotechnology Bldg.
2505 E.J. Chapman Dr.
Knoxville, TN 37919
(865) 974-2595
Rgrubbs5@utk.edu
@TNTurfWoman

John Stier, Ph.D.
Associate Dean
The University of Tennessee
2621 Morgan Circle
126 Morgan Hall
Knoxville, TN 37996-4561
(865) 974-7493
jstier1@utk.edu
turf.utk.edu
@Drjohnstier

Greg Breeden
Extension Specialist,
The University of Tennessee
2431 Center Drive
252 Ellington Plant Sci. Bldg.
Knoxville, TN 37996-4561
(865) 974-7208
gbreeden@utk.edu
tnturfgrassweeds.org
@gbreeden1

Kyley Dickson, Ph.D.
Associate Director, Center
for Athletic Field Safety
Turfgrass Management
& Physiology
(865) 974-6730
kdickso1@utk.edu
@DicksonTurf

Brandon Horvath, Ph.D.
Associate Professor,
Turfgrass Science
The University of Tennessee
252 Ellington Plant Sci. Bldg.
2431 Joe Johnson Drive
Knoxville, TN 37996
(865) 974-2975
bhorvath@utk.edu
turf.utk.edu
@UTturfpath

John Sorochan, Ph.D.
Professor, Turfgrass Science
The University of Tennessee
2431 Joe Johnson Drive
363 Ellington Plant Sci. Bldg.
Knoxville, TN 37996-4561
(865) 974-7324
sorochan@utk.edu
turf.utk.edu
@sorochan

Nar B. Ranabhat, Ph.D.
Assistant Professor and
Extension Plant Pathologist
Department of Entomology
and Plant Pathology
University of Tennessee
UT Soil, Plant and Pest Center
5201 Marchant Drive,
Nashville, TN, 37211
(615) 835-4572
nranabhat@utk.edu
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