UNIVERSITY of ARKANSAS
Turfgrass Field Day

UofA UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

Agriculture Research and Extension Center
Horticulture Field Lab
Fayetteville, AR

Tuesday, August 1, 2023

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Welcome to the 2023 Turfgrass Field Day at the University of Arkansas! The University of Arkansas Turfgrass Research Program has been addressing problems that affect the Arkansas turfgrass industry for twenty-five years. We are entering an exciting time in turfgrass research with the addition of two new faculty, Dr. Wendell Hutchens, and Dr. Hannah Wright-Smith and an expansion of research trials at the Southwest Research & Extension Center. The field day will be a great opportunity to meet them and see what the future will bring to turfgrass research and extension efforts.

Thanks to the Arkansas turfgrass industry, the United States Golf Association, the Golf Course Superintendents Association of America, the National Turfgrass Evaluation Program, the O.J. Noer Foundation, Turfgrass Producers International and Turfgrass Water Conservation Alliance for their generous gifts and grants and base funding provided by the University of Arkansas System's Division of Agriculture, we are making exciting discoveries that impact the turfgrass industries in the mid-south region. This year's program will highlight lawn care, golf course issues, and sports turf research that range from native grasses to drones. I wish you the best for an enjoyable day with lots of learning opportunities.

A continental breakfast will be served early morning next to the registration area. Bottled water will be made available throughout the research tours to help "beat the heat". Additionally, fans are located near the trade show and registration tents to help you cool off. Enjoy a delicious lunch of all you can eat catfish from Catfish Hole and a refreshing Kona Ice for dessert. Lunch will be served at the tent outside the Horticulture Field Laboratory following the research tours.

Thanks again for your attendance today and your support of the Turfgrass program at the University of Arkansas.

Wayne A. Mackay
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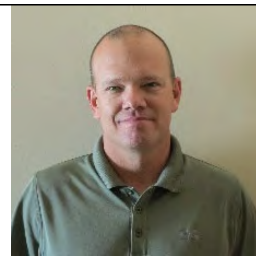
	**Dr. Mike Richardson** Professor Turfgrass Science mricha@uark.edu		**John McCalla Jr.** Program Associate I jmccall@uark.edu
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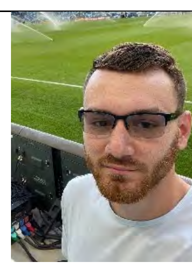
	**John Rowland** USGA Agronomist, Southeast Region JRowland@usga.org		**Michael Battaglia** Graduate Student (MS) mvb003@uark.edu
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United States Golf Association
Winfield Solutions

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Arkansas State Plant Board Pesticide Recertification

Pesticide recertification training is available for all interested parties. This program is coordinated through the Arkansas State Plant Board. **To receive pesticide recertification credit, attendees must sign in before the morning research tours begin and sign out after the afternoon pesticide recertification session.**

Missouri & Oklahoma Pesticide Recertification

If attendees are seeking pesticide certification training credit for other states, please see Dr. Smith, Dr. Hutchens or Dr. Richardson during today's event.

GCSAA Education Points

Today's program has been approved for 0.*25* GCSAA educations points. These education points are applicable towards Class A and certification entry and renewal for GCSAA members. The Event Approval Code will be given after the research tours at lunch. To receive credit for today's attendance, GCSAA members must submit the Event Approval Code to GCSAA headquarters within the 30 days of the event.

Application Strategies for Optimizing Wetting Agent Performance on Sand-Based Putting Greens

Daniel O'Brien

On golf courses, wetting agents play important roles managing water, especially in sand-based putting greens (Jacobs & Barden, 2018; Zontek & Kostka, 2012). Despite their importance, registration and labelling of wetting agents are different from other products such as pesticides. Consequently, labels often list multiple application rates and reapplication intervals for a single product. While flexibility is inherently a good thing, the critical question becomes – *do all of these different rate/timing options perform the same?* In other words – *is there an application strategy that optimizes wetting agent performance?* Identifying how different wetting agent rates and reapplication intervals affect water availability within sand-based greens has important implications for turfgrass health, water savings, and product cost savings.

Another important question is – *can we predict when an applied wetting agent will stop being effective?* For other inputs, such as plant growth regulators and fungicides, there has been a growing shift from calendar-based application schedules to reapplications based on environmental parameters such as growing degree days (GDD) or temperature / moisture conditions. For wetting agents, the first step towards developing similar models is identifying which environmental measurements correspond to changes in product efficacy. By continually monitoring environmental parameters such as GDD, evapotranspiration (ET_o), root zone volumetric water content (VWC), and soil temperature, wetting agent performance can be understood in new ways, leading to more precise reapplication intervals. Tracking wetting agent effectiveness in terms of environmental conditions is an essential part in optimizing their performance.

In May of 2023, with the support of the Golf Course Superintendents Association of America (GCSAA) Foundation and the Dr. Michael Hurdzan Research Grant Endowment, a new research trial was initiated at the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, AR. Essentially, the research boils down to the simple question, *how do you get the most out of a wetting agent application?* To address that question, the trial is broken down into comparisons on three distinct levels: 1) *comparisons among wetting agents*, 2) *comparison among application rates/timings*, and 3) *comparisons among technology for evaluating wetting agent performance and longevity.*

Experimental Design & Data Collection

Starting with comparisons among wetting agent products, six different wetting agents were selected, each from a different manufacturer (**Table 1**). While many product options are available, this trial specifically sought to include products marketed both for monthly reapplications, as well as those for "long-term" or "season-long" effectiveness from a single application.

Second, comparisons among application rates/timings meant that each wetting agent was applied six different ways. To maintain the ability to compare different products, it was important that the six different "application strategies" shared some common features (**Table 2**). Generally, it can be said that two of the application strategies were season-long applications, two were monthly reapplications, one was a reapplication every two months, and one was zero product applied (nontreated control).

For each individual wetting agent, the specific rates/timings started with what was listed on the product label and when necessary, additional rates were calculated to ensure that each product met the general guidelines for each of the six application strategies. Specifically, the questions of interest were: *with season-long applications, does more product lead to increased performance and/or longevity?* And for repeat applications, *can we create cost-savings and still achieve the same level of performance with reduced rates or extended intervals between applications?*

Finally, the third comparison was not about wetting agents themselves as much as it was the technology/methods used to evaluate how well they are working. Both portable moisture meters (TDR350, Spectrum Technologies) and installed moisture sensors (Dual Depth Sensors, Soil Scout) were selected to help capture moisture differences across both space and time. Along with these devices, an onsite weather station was also used to calculate ET_o, GDD, and growth potential (GP). Bringing all of these technologies together allows us to ask the underlying question, *what is the best way to track wetting agent performance and determine when reapplication is necessary?* Ultimately, understanding *when* and *why* wetting agents stop working can lead to more informed decision-making about how often (and how much) to apply.

The trial is a split-plot design, arranged as a randomized complete block with four replications (**Image 1**), and is located on a block of Tyee creeping bentgrass (*Agrostis stolonifera* L.) within a USGA sand-based putting green. Initial treatment applications were made on 10 May 2023 using a single-nozzle CO_2 sprayer, and all applications were watered-in with 0.2" irrigation **(Image 2)**. Weekly data collection began seven days after initial treatments (DAIT) and in addition to TDR measurements, included visual ratings for turfgrass quality and % localized dry spot (LDS), digital image analysis (DIA), surface firmness using a Clegg Impact Soil Tester (2.25 kg), and images from unmanned aerial systems (UAS). Additional data collection included water drop penetration time (WDPT) tests, comparing soil cores collected prior to initial treatment applications to those collected approx.. 60 and 120 DAIT. Data collection is ongoing and will continue through the first week of September.

This research is made possible by financial support from:

- GCSAA Foundation & Dr. Michael Hurdzan Endowment
- The Arkansas Chapter of the Golf Course Superintendents Association of America
- The Mississippi Valley Chapter of the Golf Course Superintendents Association of America
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- The Ozark Turf Association Chapter of the Golf Course Superintendents Association of America
- The University of Arkansas System Division of Agriculture

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- AQUA-AID Solutions
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- J.R. Simplot Company
- Mitchell Products
- Precision Laboratories
- Target Specialty Products

REFERENCES

Jacobs, P., & Barden, A. (2018). Factors to consider when developing a wetting agent program: A one-size-fits-all approach to developing a wetting agent program is not possible. *USGA Green Section Record*, 56(9), 1-6.

Zontek, S. J., and S. J. Kostka. (2012). Understanding the different wetting agent chemistries: A surfactant is a wetting agent but a wetting agent may not be a surfactant. Surprised?. *USGA Green Section Record, 50*(15), 1-6.

Table 1. Wetting agent treatments

Product	Manufacturer	Active Ingredient
Brilliance	J.R. Simplot Company (Lathrop, CA)	99% Alkoxylated Polyols
Tricure AD	Mitchell Products (Millville, NJ)	100% Oxirane 2-methyl polymer with oxirane
PBS 150	Aqua Aid Solutions (Rocky Mount, NC)	100% Polyoxyalkylene polymers
Revolution	Aquatrols Corporation (Paulsboro, NJ)	100% Modified Alkylated Polyol
Distance	Target Specialty Products (Santa Fe Springs, CA)	100% Alkoxylated Polyols
Cascade Plus	Precision Labs (Kenosha, WI)	10% Alcohol Ethoxylates; 90% Polyethylene-polypropylene Glycol Block Copolymer

Table 2. General application strategies used within each wetting agent treatment

Application Strategy	Description
Long-term 1	Season-long application at a ***standard label rate***
Long-term 2	Season-long application at an ***increased/high rate***
Monthly 1	Reapplications every 4 weeks at a ***standard, label rate***
Monthly 2	Reapplications every 4 weeks at ***half*** the monthly rate
Bi-monthly	Reapplications every 8 weeks at a ***standard, monthly rate***
Nontreated control	No wetting agent applied

Image 1.

Image 1. New wetting agent research at the University of Arkansas will compare different wetting agent products, application rates & timings, as well as different technologies for assessing wetting agent performance in sand-based putting greens.

Image 2.

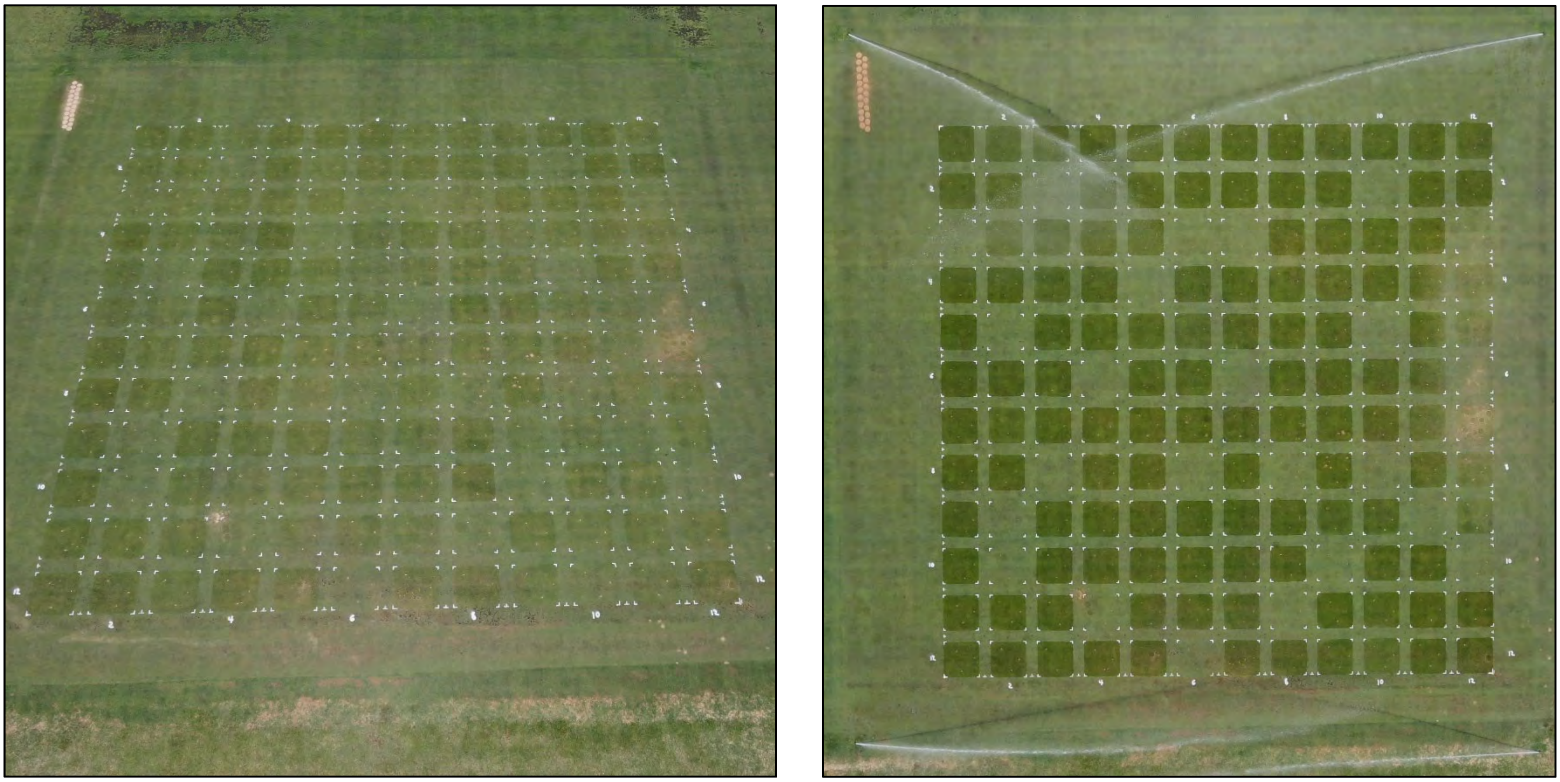


Image 2. Individual plots treated with different wetting agent rates/timings can be clearly seen from drone images (**A**) immediately after application, and even more so (**B**) during post-application irrigation (0.2”).

Dollar Spot Fungicide Trials on a Creeping Bentgrass Putting Green

Wendell Hutchens-Assistant Professor of Turfgrass Science, University of Arkansas

Introduction

Managing diseases on creeping bentgrass putting greens anywhere is a challenge. Managing diseases on a creeping bentgrass putting green in Arkansas, which is in the Transition Zone of the United States, is *extremely* challenging. Dollar spot (*Clarireedia* spp.) is one of the many diseases that can be difficult to control on creeping bentgrass putting greens, especially when environmental conditions are conducive for high disease pressure situations. Monitoring the weather and referencing dollar spot prediction models such as the Smith-Kerns Model are highly beneficial for timing fungicide applications for the disease. Aside from traditional cultural practices, optimizing a fungicide program for dollar spot is critical for adequately suppressing the disease. Thankfully, there are many excellent market-available fungicides as well as fungicides coming down the R&D pipeline that provide good to excellent control of dollar spot. Here, we will review some of those products the University of Arkansas has been testing this year. There are three fungicide trials for dollar spot that will be reviewed below. It is important to note that these trials include both experimental and market-available products.

1) Corteva Dollar Spot Trial

Materials and Methods

A fungicide trial examining 12 different experimental products from Corteva compared to Lexicon (fluxapyroxad + pyraclostrobin) and a nontreated control was conducted in the late spring and summer of 2023 at the University of Arkansas Horticulture Field Lab. Fungicides were first applied on 10 May 2023 and repeat applications were made on 14-day intervals. Plots were assessed weekly for percent dollar spot, dollar spot counts (i.e., the number of dollar spot lesions per plot), and turf quality on a 1-9 scale (1=dead turf; 6=acceptable; 9=excellent). Means were compared for each assessment date and three key dates are presented in Table 1. The plot plan is presented in Figure 1.

Results

To date, all fungicides have performed very well in this trial. The disease pressure was low until new infections began to increase on 5 July 2023. On this rating date, all fungicides reduced dollar spot counts compared to the nontreated control, but no fungicide was different from each other.

Table 1. Corteva Dollar Spot Trial- Means for percent (%) dollar spot, dollar spot counts, and turf quality (1-9) were compared for multiple dates throughout the season. Means within the same column and similar letters are not significantly different (P = 0.05).

Treatment	5/26/2023			6/16/2023			7/5/2023		
	% Dollar Spot	Dollar Spot Counts	Turf Quality	% Dollar Spot	Dollar Spot Counts	Turf Quality	% Dollar Spot	Dollar Spot Counts	Turf Quality
Nontreated Control	0.0a	0.0a	8.0a	0.5a	3.3a	7.0a	0.8a	11.5a	6.5a
A6Q-5-11 (0.63 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.0a	0.0b	6.6a
A6Q-5-11 (1.26 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	6.8a	0.0a	1.5b	6.4a
A6Q-19-1 (0.487 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.3a	3.3b	6.4a
A6Q-19-1 (0.73 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.0a	0.3b	7.0a
A6Q-20-2 (0.586 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.0a	0.0b	6.5a
A6Q-20-2 (0.88 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.0a	0.0b	6.8a
A6Q-20-2 (1.76 fl.oz/M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.3a	2.3b	6.5a
GF-4563 (0.47 fl.oz./M)	0.0a	0.0a	8.0a	0.0a	0.0a	6.5a	0.0a	0.8b	6.1a
GF-4563 (0.47 fl.oz./M) + Fame (0.277 fl.oz./M)	0.0a	0.0a	8.0a	0.3a	1.8a	6.8a	0.0a	0.0b	6.6a
Lexicon (0.094 fl.oz./M)	0.0a	0.0a	8.0a	0.0a	0.0a	6.5a	0.0a	2.5b	6.1a
U8V-2-2 (0.32 fl.oz./M)	0.0a	0.0a	8.0a	0.0a	0.0a	6.8a	0.0a	0.5b	6.6a
U8V-2-2 (0.42 fl.oz./M)	0.3a	1.5a	8.0a	1.5a	1.0a	7.0a	0.3a	0.0b	6.5a
U8V-2-2 (0.63 fl.oz./M)	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.0a	0.0b	6.4a

414: GF-4563 (0.47 fl.oz./1000 sq.ft.) + Fame (0.277 fl.oz./1000)	413: A6Q-20-2 (0.88 fl.oz./1000 sq.ft.)	412: U8V-2-2 (0.32 fl.oz./1000 sq.ft.)	411: U8V-2-2 (0.63 fl.oz./1000 sq.ft.)	410: A6Q-19-1 (0.487 fl.oz./1000 sq.ft.)	409: A6Q-5-11 (0.63 fl.oz./1000 sq.ft.)	408: A6Q-19-1 (0.73 fl.oz./1000 sq.ft.)	407: Nontreated Control	406: Lexicon (0.094 fl.oz./1000 sq.ft.)	405: GF-4563 (0.47 fl.oz./1000 sq.ft.)	404: A6Q-5-11 (1.26 fl.oz./1000 sq.ft.)	403: A6Q-20-2 (0.586 fl.oz./1000 sq.ft.)	402: U8V-2-2 (0.42 fl.oz./1000 sq.ft.)	401: A6Q-20-2 (1.76 fl.oz./1000 sq.ft.)
301: A6Q-5-11 (0.63 fl.oz./1000 sq.ft.)	302: Nontreated Control	303: A6Q-20-2 (0.88 fl.oz./1000 sq.ft.)	304: GF-4563 (0.47 fl.oz./1000 sq.ft.) + Fame (0.277 fl.oz./1000)	305: A6Q-5-11 (1.26 fl.oz./1000 sq.ft.)	306: GF-4563 (0.47 fl.oz./1000 sq.ft.)	307: A6Q-19-1 (0.73 fl.oz./1000 sq.ft.)	308: U8V-2-2 (0.32 fl.oz./1000 sq.ft.)	309: Lexicon (0.094 fl.oz./1000 sq.ft.)	310: A6Q-20-2 (0.586 fl.oz./1000 sq.ft.)	311: A6Q-20-2 (1.76 fl.oz./1000 sq.ft.)	312: A6Q-19-1 (0.487 fl.oz./1000 sq.ft.)	313: U8V-2-2 (0.42 fl.oz./1000 sq.ft.)	314: U8V-2-2 (0.63 fl.oz./1000 sq.ft.)
214: Nontreated Control	213: A6Q-20-2 (1.76 fl.oz./1000 sq.ft.)	212: A6Q-5-11 (1.26 fl.oz./1000 sq.ft.)	211: Lexicon (0.094 fl.oz./1000 sq.ft.)	210: GF-4563 (0.47 fl.oz./1000 sq.ft.) + Fame (0.277 fl.oz./1000)	209: A6Q-19-1 (0.73 fl.oz./1000 sq.ft.)	208: A6Q-19-1 (0.487 fl.oz./1000 sq.ft.)	207: A6Q-5-11 (0.63 fl.oz./1000 sq.ft.)	206: A6Q-20-2 (0.88 fl.oz./1000 sq.ft.)	205: A6Q-20-2 (0.586 fl.oz./1000 sq.ft.)	204: U8V-2-2 (0.63 fl.oz./1000 sq.ft.)	203: U8V-2-2 (0.42 fl.oz./1000 sq.ft.)	202: U8V-2-2 (0.32 fl.oz./1000 sq.ft.)	201: GF-4563 (0.47 fl.oz./1000 sq.ft.)
101: A6Q-20-2 (0.88 fl.oz./1000 sq.ft.)	102: A6Q-5-11 (0.63 fl.oz./1000 sq.ft.)	103: A6Q-20-2 (0.586 fl.oz./1000 sq.ft.)	104: A6Q-5-11 (1.26 fl.oz./1000 sq.ft.)	105: GF-4563 (0.47 fl.oz./1000 sq.ft.)	106: A6Q-20-2 (1.76 fl.oz./1000 sq.ft.)	107: Nontreated Control	108: U8V-2-2 (0.32 fl.oz./1000 sq.ft.)	109: U8V-2-2 (0.63 fl.oz./1000 sq.ft.)	110: GF-4563 (0.47 fl.oz./1000 sq.ft.) + Fame (0.277 fl.oz./1000)	111: A6Q-19-1 (0.487 fl.oz./1000 sq.ft.)	112: Lexicon (0.094 fl.oz./1000 sq.ft.)	113: A6Q-19-1 (0.73 fl.oz./1000 sq.ft.)	114: U8V-2-2 (0.42 fl.oz./1000 sq.ft.)

Figure 1. Plot plan for **Corteva Dollar Spot Trial.**

2) PBI Gordon Dollar Spot Trial

Materials and Methods

A fungicide trial examining two different experimental products and Kabuto from PBI Gordon compared to a nontreated control was conducted in the late spring and summer of 2023 at the University of Arkansas Horticulture Field Lab. Fungicides were first applied on 10 May 2023 and repeat applications were made on 14-day intervals. Plots were assessed weekly for percent dollar spot, dollar spot counts (i.e., the number of dollar spot lesions per plot), and turf quality on a 1-9 scale (1=dead turf; 6=acceptable; 9=excellent). Means were compared for each assessment date and three key dates are presented in Table 2. The plot plan is presented in Figure 3.

Results

In this study, Kabuto (isofetamid) performed exceptionally well, and it was generally the most effective fungicide in the trial. Moreover, there was a clear rate response in the experimental product NB40945 with the high rate performing better than the low rate on 16 June 2023 and 12 July 2023.

Table 2. PBI Gordon Dollar Spot Trial- Means for percent (%) dollar spot, dollar spot counts, and turf quality (1-9) were compared for multiple dates throughout the season. Means within the same column and similar letters are not significantly different (P = 0.05).

Treatment	5/26/2023			6/16/2023			7/12/2023		
	% Dollar Spot	Dollar Spot Counts	Turf Quality	% Dollar Spot	Dollar Spot Counts	Turf Quality	% Dollar Spot	Dollar Spot Counts	Turf Quality
Nontreated Control	11.9a	52.5a	5.0a	23.8a	225.0ab	6.3bc	42.5a	391.8a	5.1b
NB40945 (200 g ai/ha)	12.3a	89.3a	5.3a	25.0a	264.5a	6.1c	37.5a	359.5a	5.1b
NB40945 (400 g ai/ha)	1.4a	9.0a	6.5a	11.0b	81.0bc	6.5b	25.0ab	279.3a	5.3b
Kabuto (0.5 fl.oz./M)	1.4a	18.0a	6.5a	2.3b	10.8c	6.8a	7.8b	24.0b	6.0a

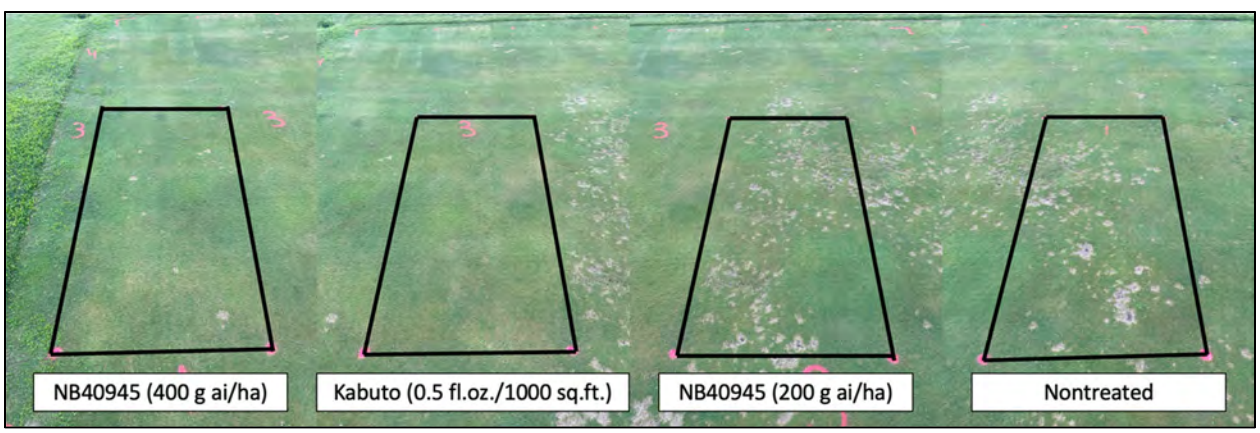


Figure 2. Photos taken on 27 June 2023 exhibiting effect of fungicides on dollar spot control.

404: Kabuto (0.5 fl.oz./1000 sq.ft.)	403: NB40945 (400 g ai/ha)	402: Nontreated Control	401: NB40945 (200 g ai/ha)
301: NB40945 (400 g ai/ha)	302: Kabuto (0.5 fl.oz./1000 sq.ft.)	303: NB40945 (200 g ai/ha)	304: Nontreated Control
204: Kabuto (0.5 fl.oz./1000 sq.ft.)	203: NB40945 (400 g ai/ha)	202: NB40945 (200 g ai/ha)	201: Nontreated Control
101: Nontreated Control	102: NB40945 (200 g ai/ha)	103: Kabuto (0.5 fl.oz./1000 sq.ft.)	104: NB40945 (400 g ai/ha)

Figure 3. Plot plan for **PBI Gordon Dollar Spot Trial**.

3) Prime Source Dollar Spot Trial

<u>Materials and Methods</u>

A fungicide trial comparing nine different fungicides or fungicide + adjuvant combinations and a nontreated control was conducted in the late spring and summer of 2023 at the University of Arkansas Horticulture Field Lab. Fungicides were first applied on 10 May 2023 and repeat applications were either made on 21-day intervals or the fungicides were considered "runout" treatments. "Runout" treatments were tested for how long one application would suppress dollar spot to below-threshold levels with the threshold being 10 spots per plot. Plots were assessed three times per week for percent dollar spot, dollar spot counts (i.e., the number of dollar spot lesions per plot), and turf quality on a 1-9 scale (1=dead turf; 6=acceptable; 9=excellent). Means were compared for each assessment date and three key dates are presented in Table 3. The plot plan is presented in Figure 4.

<u>Results</u>

In this study, a few interesting results were observed. Primarily, Densicor (prothioconazole), Prothioconazole 4L Select (prothioconazole), and Azoxy D Select applied at 21-day intervals were the best fungicides for dollar spot suppression. Additionally, the adjuvant NLS-11 increased the longevity of efficacy of Fluazinam 40SC Select (fluazinam) compared to Fluazinam 40SC Select (fluazinam) alone.

Table 3. Prime Source Dollar Spot Trial- Means for percent (%) dollar spot, dollar spot counts, and turf quality (1-9) were compared for multiple dates throughout the season. Means within the same column and similar letters are not significantly different (P = 0.05).

Treatment	5/26/2023			6/16/2023			7/13/2023		
	% Dollar Spot	Dollar Spot Counts	Turf Quality	% Dollar Spot	Dollar Spot Counts	Turf Quality	% Dollar Spot	Dollar Spot Counts	Turf Quality
Nontreated Control	0.0a	0.0a	8.0a	0.5a	9.8a	7.0a	7.5ab	38.8a	6.0a
Prothioconazole 4L Select (0.195 fl.oz./M) 21-day interval	0.0a	0.3a	8.0a	0.0a	0.3a	7.0a	0.0c	0.8b	6.5a
Densicor (0.195 fl.oz./M) 21-day interval	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.0c	0.5b	6.8a
Azoxy D Select (0.725 fl.oz./M) 21-day interval	0.0a	0.0a	8.0a	0.0a	0.0a	7.0a	0.5c	1.3b	6.4a
Briskway (0.725 fl.oz./M) Curative	–	–	–	–	–	–	–	–	–
Prothioconazole 4L Select (0.195 fl.oz./M) Runout	0.0a	0.0a	8.0a	0.0a	7.3a	7.0a	5.5abc	29.5ab	6.0a
Prothioconazole 4L Select (0.195 fl.oz./M) + F-Value (12.8 fl.oz./100 gal) Runout	0.0a	0.0a	8.0a	0.0a	3.8a	7.0a	8.8a	43.5a	6.3a
Fluazinam 40SC Select (0.5 fl.oz./M) Runout	0.0a	0.0a	8.0a	0.3a	5.3a	7.0a	9.3a	38.3a	6.1a
Fluazinam 40SC Select (0.5 fl.oz./M) + NLS-11 (6 fl.oz./A) Runout	0.0a	0.0a	8.0a	0.0a	1.0a	7.0a	1.8bc	10.5ab	6.6a
Fluazinam 40SC Select (0.5 fl.oz./M) + F-Value (12.8 fl.oz./100 gal) Runout	0.0a	0.0a	8.0a	0.5a	7.5a	7.0a	10.8a	41.8a	6.5a

410: Azoxy D Select (0.725 fl.oz./1000 sq.ft.) 21-day interval	409: Nontreated Control	408: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) Runout	407: Briskway (0.725 fl.oz./1000 sq.ft.) curative	406: Densicor (0.195 fl.oz./1000 sq.ft.) 21-day interval	405: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) Runout	404: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	403: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + NLS-11 (6 fl.oz./Acre) Runout	402: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	401: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) 21-day interval
301: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	302: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) Runout	303: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) Runout	304: Briskway (0.725 fl.oz./1000 sq.ft.) curative	305: Nontreated Control	306: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) 21-day interval	307: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + NLS-11 (6 fl.oz./Acre) Runout	308: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	309: Azoxy D Select (0.725 fl.oz./1000 sq.ft.) 21-day interval	310: Densicor (0.195 fl.oz./1000 sq.ft.) 21-day interval
210: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	209: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) Runout	208: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	207: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) Runout	206: Briskway (0.725 fl.oz./1000 sq.ft.) curative	205: Azoxy D Select (0.725 fl.oz./1000 sq.ft.) 21-day interval	204: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + NLS-11 (6 fl.oz./Acre) Runout	203: Densicor (0.195 fl.oz./1000 sq.ft.) 21-day interval	202: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) 21-day interval	201: Nontreated Control
101: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	102: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) 21-day interval	103: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) + F-Value (12.8 fl.oz./100 gal) Runout	104: Nontreated Control	105: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) Runout	106: Briskway (0.725 fl.oz./1000 sq.ft.) curative	107: Azoxy D Select (0.725 fl.oz./1000 sq.ft.) 21-day interval	108: Prothioconazole 4L Select (0.195 fl.oz./1000 sq.ft.) Runout	109: Fluazinam 40SC Select (0.5 fl.oz./1000 sq.ft.) + NLS-11 (6 fl.oz./Acre) Runout	110: Densicor (0.195 fl.oz./1000 sq.ft.) 21-day interval

Figure 4. Plot plan for **Prime Source Dollar Spot Trial**

DMI Safety Study

Mike Battaglia and Jessy Anders

Introduction

DMI (Demethylation Inhibitors) fungicides are commonly used by turfgrass managers to combat various turfgrass diseases. These fungicides work by inhibiting the biosynthesis of ergosterol in plasma membranes. DMI fungicides are acropetal penetrants, meaning they are absorbed by the plant and move upward through the xylem. This feature allows them to be effective at controlling both root and foliar diseases. The biggest drawback of DMI fungicides is their growth-regulating effects, especially among the older DMI's. These growth-regulating effects are more pronounced during hotter and stressful periods. This is why many superintendents avoid using DMI's during the summer altogether. In fact, DMI fungicides are structurally similar to class B plant growth regulators (PGRs) like paclobutrazol (Trimmit) and flurprimidol (Cutless). Many golf courses already utilize these PGRs for their putting green management.

The combination of DMI's and PGR's can enhance growth-regulating effects and lead to phytotoxicity characterized by a bluish/gray color followed by bronzing and turf thinning. Fortunately, newer DMI's do not have growth-regulating properties like the older DMI's. This has allowed superintendents to use them freely in the summer without worry of unintended consequences. A study is currently being conducted at the University of Arkansas to better categorize the relative safety of each turfgrass DMI fungicide. The data collected from this study will help turfgrass managers make better informed decisions when it comes to which DMI fungicides they utilize at their facility.

Materials and Methods

This study will be conducted at the University of Arkansas research station on a 'Pure Eclipse' creeping bentgrass putting green. A total of six applications will be made at the highest label rate every two weeks beginning June 23rd until September 1st. This study will take place during the summer months to ensure maximum symptom expression due to high temperatures and stressful conditions. There will be 11 total treatments (Table 1) that include every turfgrass DMI fungicide compared to a nontreated control. The experiment is set up as a randomized complete block design with four replications. Applications will be made using a CO_2 pressured sprayer delivering a carrier rate of 2gal/1000sqft. Individual plots measure 3ft by 8ft. Data that will be collected include DGCI (dark green color index), clipping yield, phytotoxicity, and turfgrass quality. DGCI measurements will be taken weekly using light box photos. Clipping yield will be collected, dried, and weighed every week. Phytotoxicity and turfgrass quality will be visually assessed weekly.

Results

- Banner Maxx, Bayleton, and Eagle showed the highest phytotoxicity on July 14th 2023
- Rayora showed significant phytotoxicity on June 27th and July 6th, but not on July 14th
- Bayleton showed the lowest turf quality throughout the first three rating dates.

Table 1: Treatment list

Treatments	Application Rate (oz/1000ft^2)	Active Ingredient
Nontreated control		
Banner Maxx	4.0	propiconazole
Torque	1.1	tebuconazole
Trinity	2.0	triticonazole
Densicor	8.5	prothioconazole
Maxtima	0.8	mefentrifluconazole
Rayora	1.4	flutriafol
Bayleton	1.9	triadimefon
Tourney	0.44	metconazole
Eagle	2.4	myclobutanil
Briskway	1.2	difenoconazole + azoxystrobin

Table 2: Plot Map

Torque 411	**Briskway** 410	**Trinity** 409	**Eagle** 408	**Bayleton** 407	**Banner Maxx** 406	**NTC** 405	**Densicor** 404	**Tourney** 403	**Rayora** 402	**Maxtima** 401
Eagle 301	**NTC** 302	**Rayora** 303	**Maxtima** 304	**Briskway** 305	**Trinity** 306	**Tourney** 307	**Torque** 308	**Bayleton** 309	**Densicor** 310	**Banner Maxx** 311
Briskway 211	**Eagle** 210	**Tourney** 209	**Bayleton** 208	**Rayora** 207	**Maxtima** 206	**Densicor** 205	**Trinity** 204	**Torque** 203	**Banner Maxx** 202	**NTC** 201
Eagle 101	**Banner Maxx** 102	**Torque** 103	**Rayora** 104	**Tourney** 105	**Trinity** 106	**Maxtima** 107	**Densicor** 108	**NTC** 109	**Bayleton** 110	**Briskway** 111

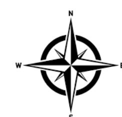


Table 3: Results

	06/27/23		07/06/23		07/14/23	
Treatment	**% Phyto**	**Turf Quality**	**% Phyto**	**Turf Quality**	**% Phyto**	**Turf Quality**
Banner Maxx	3.0 c	5.5 ab	17.5 a	5.5 ab	26.3 a	6.6 c
Bayleton	10.0 b	4.3 b	16.8 a	4.3 b	15.0 b	6.8 bc
Briskway	0.0 c	5.8 a	3.8 cd	5.8 a	5.0 c	7.0 a
Densicor	0.0 c	6.0 a	0.0 d	6.0 a	1.3 c	7.0 a
Eagle	1.5 c	5.5 ab	18.8 a	5.5 ab	15.8 b	6.9 ab
Maxtima	0.0 c	5.9 a	1.3 d	5.9 a	1.3 c	7.0 a
Nontreated	0.0 c	5.5 ab	2.5 cd	5.5 ab	1.3 c	7.0 a
Rayora	16.3 a	5.8 a	14.3 ab	5.8 a	3.8 c	7.0 a
Torque	0.5 c	5.6 a	5.8 cd	5.6 a	5.0 c	6.9 ab
Tourney	1.3 c	5.8 a	5.8 cd	5.8 a	1.3 c	7.0 a
Trinity	0.5 c	5.6 a	8.9 bc	5.6 a	6.3 c	7.0 a

GS3: What Is the USGA's New Technology Tool All About?

Paul Jacobs, agronomist, Central Region

The new GS3 measures green speed, firmness, trueness and smoothness – all with one device.

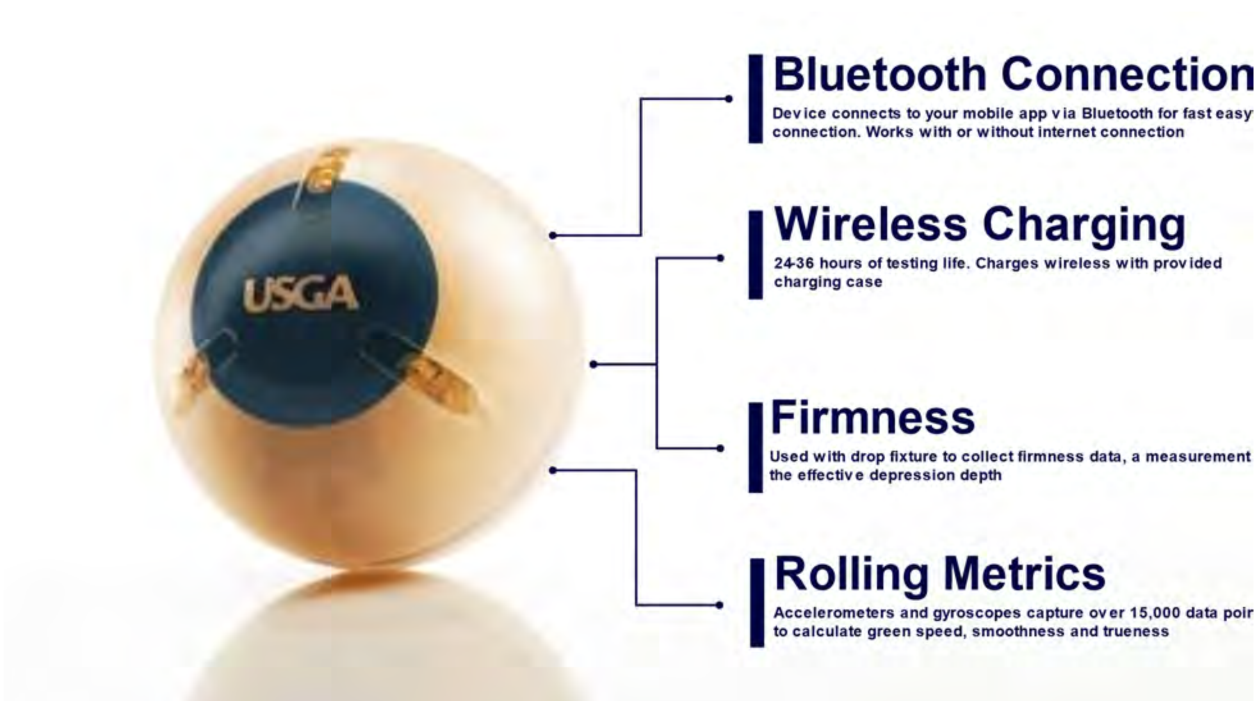
When you think of the USGA Green Section, new product development may not be the first thing that comes to mind. The Green Section has been supporting golf courses through research, course consulting and education for over 100 years, but has developed only a limited number of physical tools or products – most notably the TruFirm and Stimpmeter. Throughout its history, the Green Section has worked hard to provide golf facilities with information and solutions to promote better golf conditions for all to enjoy. The GS3 is an innovative new tool that will help do exactly that. The purpose of the GS3 is to provide data on key putting green performance metrics to help superintendents and decision-makers at a facility better understand how various maintenance practices affect surface performance. To get a better sense of the GS3's capabilities, here are a few key points as to what it is, and what it is not.

The GS3 is:

- A device intended for use by golf facilities to quickly gather key putting green performance metrics.
- Rolled off a Stimpmeter as you normally would when measuring green speed. Three rolls in each direction and the ball will provide green speed, trueness and smoothness values. No more tape measure needed!
- Placed into a drop fixture to measure putting green firmness. A minimum of three readings are recommended for any given green, but more readings, taken in a grid pattern, provide a more accurate average.
- Used in conjunction with the DEACON app, which contains several other features such as surface management data logging and analysis, an application log, hole location sheets and weather insights.

The GS3 is not:

- Going to be used by individual golfers to compare their course to others. The product will not be sold to golfers.
- Designed to be hit with a golf club.
- Meant to promote the pursuit of the fastest green speed possible. Instead, facilities can objectively measure key putting green metrics besides speed and provide benchmarks that tell them how their greens are performing over time.



Progression of Field Metrics: a Case Study
John Reilly, Director of Agronomy, Longboat Key Club


John Reilly with his two assistants, Millie and Wing

11 years ago, we started a transition to Platinum Paspalum on 45 holes of coastal golf courses at the Resort at Longboat Key Club West of Sarasota, Florida. Our main problem with the grass change was the performance of the greens. The trade off before this time was that Paspalum was a great answer to salty irrigation water but the greens would always be slow and slightly bumpy; this was an industry-accepted side effect of installing this salt tolerant grass type. From the start, we refused to accept that fate at Longboat Key, and for several years, we had limited success and many failures. We maintained aggressive bermudagrass cultural practices followed by extremely low HOC's and very high frequency mowings. The word "road rash" was born.

In an effort to build a better mousetrap, we started to use instruments. We had always checked moisture so we upgraded to a web based moisture meter and employed the quality of cut prism daily wrongly surmising the scalping was a combination of moisture anomalies and quality of cut. Over the next few years, we introduced daily clipping yield measurements and the Tru-Firm firmness meter. The perspective shifted from avoiding problem areas to assessing and thus achieving uniformity of the entire green surfaces.

Having 50 plus greens to manage daily on two separate sites and still reacting to post mow field measurements we lacked consistent predictive successes property-wide. Along with language barriers and site differences, we needed something simple and easy to get us all on the same page. Much to my chagrin that tool was the stimpmeter. Generationally I did not consider the stimpmeter to be an agronomic tool and found it an unnecessary evil in the golf industry. Around this time, we had also started to pre-roll to reduce mechanical stress from mowing on our greens after some exposure to the Nickolai studies from Michigan State on greens rolling.

Quickly to my surprise, we ostensibly collapsed all our measurements from the day before into a morning stimp on five "stimpable" areas and were able to make predictive decisions that greatly improved plant health and plant performance. Conceptually it was a radical change in our maintenance practices. We created a mowing matrix based on goal speeds that combined rolling, mowing and frequency of both based on those daily goals. We started to see all kinds of trends based on all possible factors. We started to skip mows more frequently. We started to record stimp readings that were not postable for the golfer. We were able to raise HOC's and increase our daily uniformity and performance.

Conceptually now we employ a plant health equals plant performance philosophy in greens management on our site. The newest change in our daily measurements has been the adoption of the GS3 ball and the Deacon app from the USGA Green Section. Our perspective shift is now somewhat full circle away from the stimp measurements per se to the controllables that produce that value: smoothness, trueness, and firmness. Curiously we think that answer is in the grinding room where we have unknowingly have not promoted uniformity.

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1. Use chart below to determine distance to drive in field. Use nozzle spacing for booms and use row spacing for direct rigs.
2. Set throttle and sprayer pressure to desired level for field spraying. Record time in seconds required to drive the distance indicated in chart for proper nozzle or row spacing.
3. Park sprayer and catch spray for the same number of seconds required to drive the calibration course. Catch from one nozzle on booms and from all nozzles on one row for directed rigs.
4. Measure amount of spray collected in ounces. The number of ounces caught equals gallons per acre of spray solution.
5. Repeat for each nozzle or row to ensure uniform distribution.

Row Width or Nozzle Spacing (in)	Length of Calibration Course (ft)	Row Width or Nozzle Spacing (in)	Length of Calibration Course (ft)
60	68	26	157
40	108	24	170
38	107	22	185
36	113	20	204
34	120	18	227
32	127	16	255
30	136	14	291
28	146	12	340

University of Arkansas, United States Department of Agriculture and County Governments Cooperating.

Gallons per acre (GPA) = $\frac{5,940 \times GPM}{MPH \times W}$

Gallons per minute (GPM) = $\frac{GPA \times MPH \times W}{5,940}$

W = nozzle spacing in inches (or sprayed width)
GPM = gallons per minute (per nozzle)
GPA = gallons per acre
MPH = miles per hour
5,940 = A constant to convert GPM, MPH and inches to gallons per acre

Catch nozzle output for one minute to determine **gallons per minute** or use formula if you are trying to determine what type of nozzle you need based on labeled GPA. **Make sure and convert ounces to gallons by dividing ounces caught by 128 if determining GPM by catching nozzle output.**

Speed calibration:

1. Mark a known distance (100 or 200 ft are convenient) on terrain similar to where you will spray.
2. Use throttle setting and gear that will be used for spraying
3. Have spray tank full of water.
4. Get up to speed and record time needed to travel the course.
5. Plug distance and time into this formula:

$$MPH = \frac{\text{Distance traveled} \times 60}{\text{Seconds to cover distance} \times 88}$$

Calibrating Turf Hose Reel Sprayers

Jason A. Davis
Application Technologist - Agriculture and Natural Resources

Dr. Douglas Karcher
Professor - Turfgrass Soil Specialist

Introduction

Properly calibrating spray equipment is the foundation of any pesticide application. Labeled rates and uniform coverage of turf products are only achieved when equipment output, applicator speed, and appropriate overlap are known and maintained throughout an application. To quote the Purdue Pesticide Program's Dr. Fred Whitford, "There is a science to calibration and an art to application." In other words, it is important to get the math of sprayer output and tank mixing down to a science. It is just as important to have applicators and technicians practice the art of applying pesticides with consistent walking speeds and uniform arm movements. It is this balance of art and science that creates consistently successful turf applications.

Figure 1. Catch test performed using a pre-marked five gallon bucket. Be sure to maintain constant pressure, measure time precisely, and check multiple times to ensure accurate catch test results. Photo credit to Josh Landreth - Ace of Blades, LLC.

Step 1: Calibrating Equipment Output

The first step to hose reel sprayer calibration is to know the sprayer output. This is a simple two-part process of selecting the desired nozzle and then verifying its output with a catch test, which is described below. Nozzles are rated in gallons per minute (GPM) of flow and often color coded. For this example we will assume a nozzle that is rated at 2 GPM is selected.

Verify the 2 GPM flow from this nozzle on your sprayer. Start by marking one gallon increments on the inside of a five gallon bucket. Add exactly one gallon of water to an empty bucket and use a bold sharpie to mark its level. Repeat with two, three, and four gallons of water in the same bucket.

Next, using the sprayer to spray for one minute into the bucket (Figure 1). Be careful to capture all of the spray and time the catch accurately. It is recommended to repeat this step a couple more times to ensure an accurate reading. If the flow captured in the bucket is consistently much lower than the targeted GPM, then increase the spray pressure. If the captured flow is consistently much higher, then decrease the spray pressure.

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Step 2: Pace Yourself by Calibrating Walking Speed

Calibrating an applicator to cover a certain amount of lawn in a specified amount of time takes practice. Start by marking a 24 feet by 42 feet rectangle on a dry parking lot, which will create an approximately 1,000 ft^2 area to spray. Attempt to uniformly spray the 1000 ft^2 area in one minute at a comfortable pace using parallel swaths. Perform this step a few times so that the pace can be increased or decreased as needed to cover the area in one minute. This pace should be able to be maintained throughout actual applications that are much larger than 1000 ft^2. Be careful to only run the stopwatch while spraying. For accuracy, consider stopping the clock while the nozzle is off such as while turning around or adjusting the hose.

Remember that the sprayer has a flow rate in this example of 2 GPM. If the applicator can reliably cover the 1000 ft^2 in one minute, then the application volume would be calibrated at 2 gallons per 1000 ft^2.

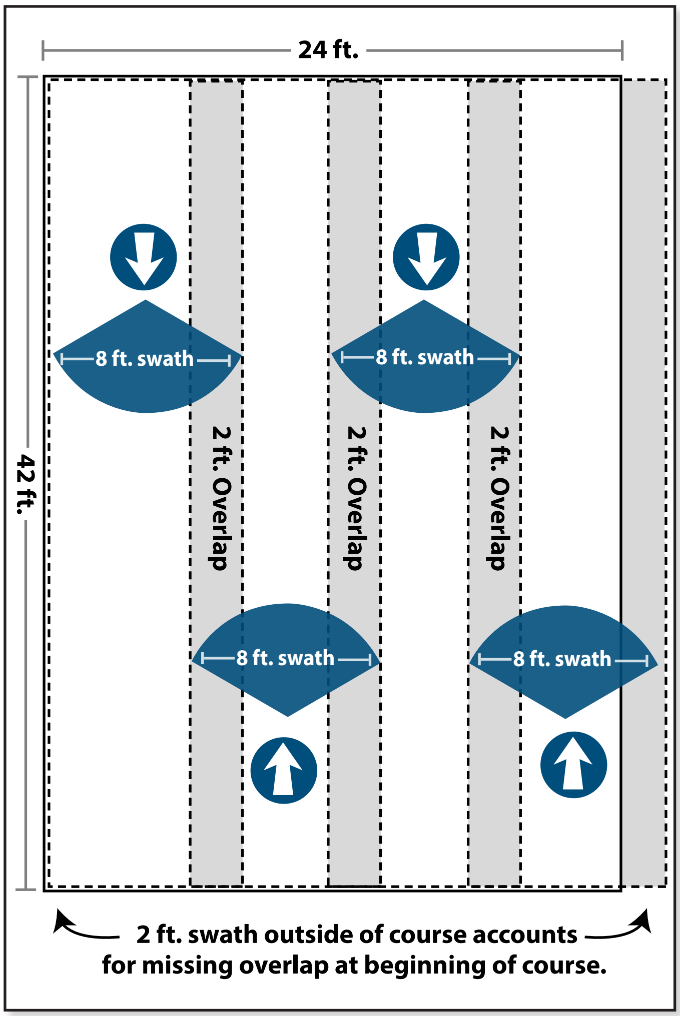

Figure 2. Illustration of 1000 ft^2 spray course used to practice walking pace and uniform overlap. When used on dry pavement, needed adjustments to an applicators technique become evident in how uniformly the surface dries.

Equipment adjustments need to be made if the applicator consistently completes the 1000 ft^2 course faster or slower than one minute. This adjustment is easy to make by noting the length of time required to complete the course and then using this time to repeat step one described above. As an example, if the desired pace only takes 50 seconds to complete the course, then adjust the pump output to deliver the target rate of 2 gallons in 50 seconds instead of one minute. This adjustment results in the same 2 gallons per 1000 ft^2 applied at a pace customized for the applicator.

Step 3. Uniformity Through Calibrated Arm Motions

Moving at the calibrated pace may cover the lawn but it does not ensure uniform coverage of products. An applicator's arm motion must apply the spray at a uniform width, pace, and overlap. Similar to walking pace, this takes practice.

Tips for uniform overlap:

- Focus on a point in the distance so that you walk strait.
- Practice holding the spray gun level, out, and spraying forward instead of down at your feet.
- Swing your arm (not wrist) at a brisk pace throwing approximately an 8-foot-wide swath.
- Individual weeds should receive about three swings of product as you walk forward.
- At the end of a pass, take two large steps over (approximately 6 feet) to make the next parallel pass. This should produce approximately 2 feet of overlap between swaths. Figure 2 illustrates a 1000 ft^2 course, traversed with proper overlap using 4 passes producing 2 feet of overlap between swaths.

It is easy to identify if adjustments need to be made by practicing these steps with water on a paved surface. After the practice application is completed, uniformity can be observed as the pavement dries. Areas that dry quickly received a lighter rate than areas that remain wet longer. Look for patterns and tweak techniques to produce a uniform application. Remember that this is a process and it takes practice.

Step 4. Tank Mixing

With a known sprayer output and an applicator that can consistently and uniformly cover the needed ground, we can now determine how much product to mix.

Remember that in this example we are applying 2 gallons of spray solution per 1000 ft^2. If our spray tank can hold 500 gallons of solution then we simply divide tank volume by sprayer output to get the area covered by one tank.

$$\frac{\text{Tank Volume}}{\text{Sprayer Output}} = \text{Area covered by one tank}$$

$$\frac{500 \text{ gal}}{(2 \text{ gal} / 1000 \text{ ft}^2)} = \text{Area covered by one tank}$$

Calculation is simplfied and entered into a calculator as -

$$\frac{500 \text{ gal}}{2 \text{ gal}} \times 1000 \text{ ft}^2 = 250{,}000 \text{ ft}^2$$

Most labels specify how much product to apply per 1000 ft^2. So the next step would be to determine how many 1,000 ft^2 we can cover with one tank. This can be calculated by dividing the "area covered by one tank" by 1,000.

$$\frac{\text{Area covered by one tank}}{1000 \text{ ft}^2} = \# \text{ of } 1000 \text{ ft}^2$$

$$\frac{250{,}000 \text{ ft}^2 \text{ covered}}{1000 \text{ ft}^2} = 250$$

Finally, refer to the product label to determine the rate per 1,000 ft^2. As an example, we'll assume that the rate is 3 oz. per 1000 ft^2. We know that we can cover 250 separate 1000 ft^2 areas and that each of them should receive 3 oz. of product. Therefore, 250 times our rate should give us the total amount of product we should put in the tank in ounces.

$$(\# \text{ of } 1000 \text{ ft}^2 \text{ areas covered}) \times (\text{rate per } 1000 \text{ ft}^2) = \text{product per tank}$$

$$250 \times 3 \text{ oz.} = 750 \text{ oz. of product needed per tank}$$

Ensure proper mixing by filling the tank half full, adding product slowly, agitating the solution and then filling the remainder of the tank. You are now ready to confidently apply the properly mixed spray solution with the science of a calibrated sprayer and the art of a calibrated applicator.

Conclusion

Sprayer calibration in turf is essential to making responsible and economical applications. Hose reel sprayer applications are a balance of art and science that take practice and periodic system checks to ensure accurate and uniform applications. These checks should be repeated throughout the spray season, anytime changes are made to equipment and with new applicators. Over and under applying pesticides can be costly, ineffective, bad for business and environmentally hazardous. Calibrate, practice, and apply with confidence.

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FSA2190-PD-09-2020N

Developing Management Tools for New Greens-Type Zoysiagrasses

Mike Richardson and Hannah Smith

Zoysiagrass is a potentially "new" option for golf course greens, but there is limited knowledge on how best to manage and produce quality putting surfaces. This project will investigate pesticide tolerance and limiting seedhead production to increase playability and aesthetic value. This project is a collaborative effort between three universities (Arkansas, Texas A&M, Tennessee) with expertise in the areas of weed science, turfgrass management, breeding, and extension service. This multi-state collaborative effort will also allow us take advantage of diverse environmental testing locations within the USDA plant hardiness zones 6b, 7a, and 8a and develop region-specific recommendations for golf course superintendents.

Zoysiagrass (*Zoysia spp.*) is a perennial, C4 plant well adapted for use in the transitional and warm climatic zones of the United States and its use on golf greens, while still limited, is slowly becoming more popular. Historically, 'Diamond' [*Z. matrella* (L) Merr] was the only viable cultivar of choice for golf courses choosing to use a zoysiagrass on their putting surface but research from Clemson University determined ball roll speeds were too slow for tournament use (Stiglbauer et al., 2009). More recently, three *Z. matrella* cultivars ['Prizm', 'M85', and 'Trinity'] (Douget et al., 2017) and 'Lazer', the first interspecific hybrid developed between Diamond and *Z. minima* (Chandra et al., 2019) have been released for use on golf greens. For this project, we will focus on Lazer and Prizm zoysiagrass as these two new and improved cultivars are now commercially available and utilized on several golf courses in the U.S.

Diamond was observed to be a prolific seedhead producer in the fall and spring seasons (McCullough et al., 2017). Based on visually rated data from Dallas, TX, seedhead production in Lazer is limited to the spring season with little to no expression in the fall (Chandra et al., 2019). However, Lazer seedhead development in the spring season can significantly impact ball roll and playability of the surface. Seedhead suppression research using plant growth regulators (PGRs) has recently been investigated in *Z. japonica* (Brosnan et al., 2012, Patton et al., 2018), but the efficacy and timing of application should be further investigated in the interspecific hybrid, Lazer and the *Z. matrella* cultivar, Prizm.

Currently, there are no herbicides that are labeled for zoysiagrass golf green use and most herbicides that are labeled for zoysiagrass do not even differentiate between japonica and matrella species. Currently, golf course superintendents planting zoysiagrass on golf greens can only rely on information regarding fairway tolerance to herbicide applications, which may not be appropriate. For example, preliminary work conducted at the University of Tennessee and University of Arkansas highlighted that both Prizm and Lazer are sensitive to applications of fluazifop + triclopyr that are regularly used for bermudagrass suppression in fairways and roughs (McElroy and Breeden, 2006). Both cultivars are sensitive to sulfentrazone, a common active ingredient used to control sedges and kyllinga, whereas foramsulfuron is safe on Prizm but injurious to Lazer. In a trial at Arkansas, Lazer zoysiagrass was also sensitive to the PGRs, trinexapac-ethyl and prohexadione calcium, when applied at label rates (Walton and Richardson, unpublished). Although some of the phytotoxicity associated with PGR use can be reduced via treatment at lower rates, there is no information on current PGR labels that addresses rates or timing of application to zoysiagrass putting greens.

Objectives:

- Determine the tolerance of commonly available herbicides and fungicides for pests on zoysiagrass putting greens.
- Investigate the use of PGRs and herbicides on Lazer and Prizm zoysiagrass for seedhead suppression

Research locations and management: Seedhead suppression and pesticide tolerance work is being performed on Lazer zoysiagrass at Texas A&M Agrilife- Dallas (TAMUD), PGA-Frisco, and the University of Arkansas (UofA) while seedhead suppression is being performed on Prizm at University of Tennessee-Knoxville (UTK), and herbicide tolerance research is being performed on Prizm at UTK and PGA Frisco. Trials at all locations are being conducted in a randomized complete block with four replications of each treatment with individual plots sizes of 3' x 3' for both seedhead suppression and pesticide tolerance. Plots are maintained at 0.125 inch height of cut, fertilized with 0.25 lbs N/1000ft2/growing month, and irrigated as needed.

Seedhead suppression

Seedhead suppression trials have not been initiated, but will be started in September 2023. The treatments to be evaluated are included in Table 1. Plots will be treated at three different timings A) 11.9-12.1-hour photoperiod B) 28d after treatment A C) 11.9-12.1 photoperiod and 28d after. Plots will be irrigated according to the product labels after treatments. Products were chosen based on previous published research and/or current field observations. Klean-pik is a cotton defoliant with efficacy for Poa annua seedhead suppression (Brosnan, unpublished). Data collected will include visual turfgrass quality, phytotoxicity, recovery, and seedhead suppression. Cooling degree days, growing degree days, and daylight hours at the time of each application will be recorded. Seedheads will be counted randomly with three 2-inch PVC pipes when the initial flush is identified and 7, 14, 28, and 42 days after initial flush.

Table 1. Treatments for seedhead suppression trials

TRT NO.	Product	Rate
1	Proxy (ethephon)	5 fl oz/1000ft^2
2	Princep 4L (simazine)	0.8922 lbs ai/A
3	Anuew (prohexadione calcium)	16 oz/A
4	Klean-Pik (thidiazuron)	56 g/ha
5	Untreated control	
Timings		**Approximate Dates**
A	11.9-12.1-hour photoperiod	Sep. 23
B	28d after treatment A	Oct. 21
C	11.9-12.1 photoperiod + 28d after	Sep. 23 and Oct. 1

Pesticide Tolerance

Treatment applications (Table 2) were made on July 20, 2023. Applications were made at the product label rate and 2x labeled rates to take into account overlaps and/or application errors. Data collected will include visual turfgrass quality, phytotoxicity, and recovery from injury. Drone imagery will also be taken for objective data.

Table 2. Products, active ingredients and application rates tested in pesticide tolerance screening.

TRT NO.	Product	Active ingredients	Product Rate
1	Revolver	foramsulfuron	26.2 fl oz/A
2	Revolver	foramsulfuron	52.4 fl oz/A
3	Katana	flazasulfuron	3 oz/A
4	Katana	flazasulfuron	6 oz/A
5	Speedzone EW	carfentrazone, dicamba, mecoprop-p and 2,4-D	4 pt/A
6	Speedzone EW	carfentrazone, dicamba, mecoprop-p and 2,4-D	8 pt/A
7	Kerb SC	pronamide	15 fl oz/A
8	Kerb SC	pronamide	30 fl oz/A
9	PoaCure	methiozolin	0.6 fl oz/1000 ft^2
10	PoaCure	methiozolin	1.2 fl oz/1000ft^2
11	Oxadiazon G	oxadiazon	3 lb ai/A
12	Oxadiazon G	oxadiazon	6 lb ai/A
13	Tribute Total	thiencarbazone, foramsulfuron and halosulfuron	3.2 oz/A
14	Tribute Total	thiencarbazone, foramsulfuron and halosulfuron	6.4 oz/A
15	Recognition + Fusilade II	trifloxysulfuron-sodium and fluazifop	1.95 oz/A + 12 oz/A
16	Recognition + Fusilade II	trifloxysulfuron-sodium and fluazifop	3.9 oz/A + 24 oz/A
17	Fusilade II + Turflon Ester	fluazifop and triclopyr	4 fl oz/A + 32 fl oz/A
18	Fusilade II + Turflon Ester	fluazifop and triclopyr	8 fl oz/A + 64 fl oz/A
19	Arkon	pyrimisulfan	52.5 g ai/ha
20	Arkon	pyrimisulfan	105 g ai/ha
21	Primo Maxx	trinexapac-ethyl	3 fl oz/A
22	Primo Maxx	trinexapac-ethyl	6 fl oz/A
23	Densicor	prothioconazole	8.5 fl oz/A
24	Densicor	prothioconazole	17 fl oz/A
25	Banner Maxx	propiconazole	88 fl oz/A
26	Banner Maxx	propiconazole	176 fl oz/A
27	Untreated Control		

Scotts ProVista Kentucky Bluegrass - The future of turfgrass genetics?

Mike Richardson and John McCalla

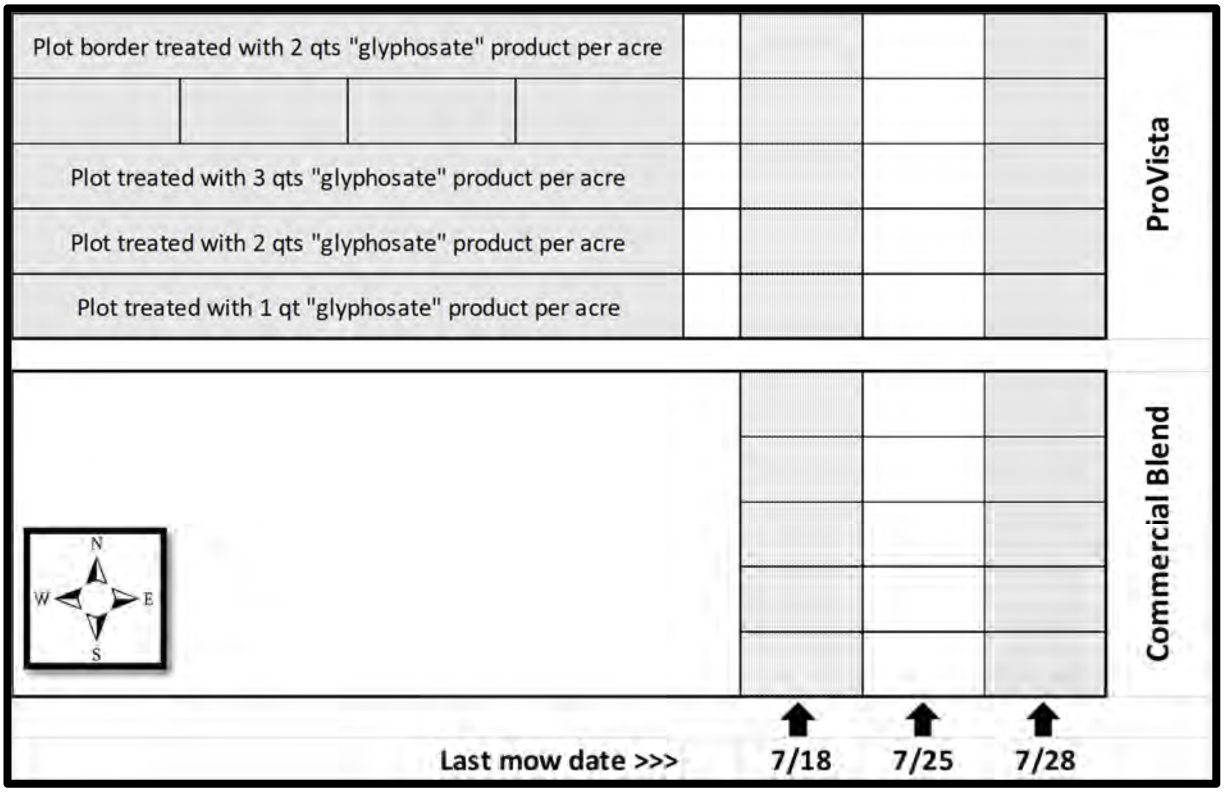
There is a hotly-contested debate in the world of human health and food these days related to the safety and benefits of "GMO" food. GMO is the abbreviation for "genetically modified organism" and if often used to describe a plant that has been altered, through one of several techniques, to introduce genetic material that provides a unique benefit to the plant or possibly the growers of the plant. There have been GMO crops designed to resist insects, impart flavor characteristics, and make plants resistant to specific herbicides like "Roundup".

Although GMO crops such as soybean, corn, and cotton are widely grown in the USA and Arkansas, there are only a handful of crops, like papaya and sweet corn that have GMO cultivars and are consumed directly by humans. However, that has not stopped people from implying that their products are "safer" because they do not contain GMO products. One of my favorite examples is the Simply juice company that states on the package that their orange juice or lemonade is "Non-GMO". The funny part about that is that there are no GMO oranges or lemons in production, so all fresh orange juice and lemonade products are technically non-GMO!

Genetically-modified turfgrasses have also been in the pipeline for well over 25 years. University and corporate scientists have been working to identify genes that impart traits such as disease or insect resistance, herbicide resistance, heat and drought stress, etc. Although it was established many years ago that genetic modification of turfgrasses was feasible, there was a long (and often contentious) process of government and corporate wrangling before the first GMO turfgrasses were approved and commercialized.

The ScottsMiracle-Gro Co. has been the most active participant in the world of genetically-modified turfgrasses and have introduced and patented several genetic lines that are either commercialized or in the process of commercialization (Harriman et al., 2019). Their initial focus has been on two traits – resistance to non-selective, glyphosate herbicides such as Roundup and a gene which reduces the amount of gibberellic acid the plant produces, which reduces the elongation and growth rate of the grass and can reduce mowing requirements. Both of these traits have been introduced into two turfgrass species, including Kentucky bluegrass (*Poa pratensis*) and St. Augustine (*Stenotaphrum secundatum*) and is marketed under the trade name of ProVista.

The University of Arkansas received Kentucky bluegrass seed samples from the ScottsMiracle-Gro. Company in the summer of 2020 and established two demonstration areas, one with the genetically modified variety (ProVista) and the other with a standard commercial blend of Kentucky bluegrass containing four cultivars (Gaelic, Jumpstart, Avalanche, and Abbey). The trial areas were seeded in the fall of 2020 and have been maintained using standard lawn practices since that time. Since this is the first field day we have had held since the trials were established, we have not conducted any studies or performed any demonstrations with the plots.



Strips were treated with varying rates of glyphosate (1,2,3, qt product / acre) on 7/21/23, approximately 10 days prior to the event. In addition, mowing was ceased on strips either 2 weeks prior to the event (7/18), one week prior to the event (7/25) and 4 days prior to the event (7/28). The implications of these demonstrations will be discussed.

Harriman, R., Lee, L., Stalker, D., & Torisky, R. (2019). Plants comprising events PP009-401, PP009-415, PP009-469, compositions, sequences, and methods for detection thereof. (PatentNumber10,501,753). U.S. Patent and Trademark Office.

Safety of Recognition and Fusilade II during establishment of a seeded zoysiagrass

Mike Richardson and Hannah Smith

Recognition is a new herbicide that was commercialized for turf use by Syngenta in 2023. The active ingredient in Recognition is trifloxysulfuron-sodium, but it also includes a "safener", metcamifen, that allows it to be tank-mixed with high rates of Fusilade II and safely applied to zoysiagrass, St. Augustine and kikuyugrass. This combination will be a key tool moving forward to control bermudagrass in those turf species, as well as other problematic grassy weeds such as dallisgrass, goosegrass, and crabgrass.

Recognition + Fusilade II has been widely tested on zoysiagrass and is safe on both *Zoysia japonica* and *Zoysia matrella* maintained at lawn and fairway heights of cut, as well as even demonstrating good safety on putting green zoysiagrasses such as 'Lazer'. Because of the rates of Fusilade II (up to 24 oz/acre) that can be safened by Recognition, the combination has shown to be more effective at controlling bermudagrass than other safener combinations such as Fusilade + Turflon Ester.

One aspect of turf safety that has not been tested is whether Recognition + Fusilade can be used during the establishment of zoysiagrass from seed. The objective of this trial is to look at various combinations of Recognition and Fusilade II, applied at 7 or 14 days after seedling emergence (Table 1).

Table 1. Treatments applied to Zenith zoysiagrass at 7 or 14 days after seedling emergence

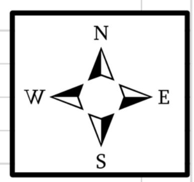
Treatment	Product 1	Product 2
1	Untreated control	
2	Recognition (1.29 oz/a)	
3	Recognition (1.95 oz/a)	
4	Recognition (1.29 oz/a)	Fusilade II (12 fl oz/a)
5	Recognition (1.29 oz/a)	Fusilade II (24 fl oz/a)
6	Recognition (1.95 oz/a)	Fusilade II (12 fl oz/a)
7	Recognition (1.95 oz/a)	Fusilade II (24 fl oz/a)
8	Turflon Ester (32 oz/a)	Fusilade II (5 fl oz/a)
9	Fusilade II (12 fl oz/a)	
10	Fusilade II (24 fl oz/a)	

Some additional details about the trial

- Two sites
    - Fayetteville - Milo J. Shult Agricultural Research & Extension Center
    - Hope – Southwest Research and Extension Center
- Zenith zoysia – seeded at 2.0 lb / 1000 ft^2
- Prepared seedbed – seed was covered with a germination blanket
- Two application timings – 14 and 28 days after emergence
    - Repeat application to all treatments at 28 days after first application
- Data collection will include phytotoxicity and turf quality ratings throughout the study and weed control ratings will be assessed based on resident weed populations at each site

Figure 1 – trial map for the Recognition safety study on Zenith zoysiagrass

4	5	8	1	10	9	6	2	3	7	14 days after emergence	REP 4
810	809	808	807	806	805	804	803	802	801		
4	5	8	1	10	9	6	2	3	7	28 days after emergence	
701	702	703	704	705	706	707	708	709	710		
10	9	8	7	6	5	4	3	2	1	28 days after emergence	REP 3
610	609	608	607	606	605	604	603	602	601		
10	9	8	7	6	5	4	3	2	1	14 days after emergence	
501	502	503	504	505	506	507	508	509	510		
9	2	1	3	10	4	6	7	5	8	28 days after emergence	REP 2
410	409	408	407	406	405	404	403	402	401		
9	2	1	3	10	4	6	7	5	8	14 days after emergence	
301	302	303	304	305	306	307	308	309	310		
7	1	2	8	5	10	9	3	4	6	14 days after emergence	REP 1
210	209	208	207	206	205	204	203	202	201		
7	1	2	8	5	10	9	3	4	6	28 days after emergence	
101	102	103	104	105	106	107	108	109	110		



Refer to Table 1 for herbicides associated with various treatment numbers

Recognition + Fusillade Efficacy on Bermudagrass Demonstration

These plots were established to demonstrate zoysiagrass tolerance and bermudagrass control in zoysiagrass following an application of the newly available herbicide, Recognition that contains the safener metcamifen, plus Fusillade II. Recognition + Fusillade II at various rates were applied and compared to a reduced rate of Fusillade II + Turflon Ester Ultra (Table 2). Treatments were applied to El Toro zoysiagrass and both common bermudagrass and a bermudagrass variety. Treatments were applied on July 12, 2023 at 40 GPA

Table 2. Herbicide treatments applied to control bermudagrass in zoysiagrass.

Treatment	Product and Rate
1	Untreated
2	Recognition (1.29 oz/A) + Fusillade II (12 fl oz/A) + NIS (0.25 % v/v)
3	Recognition (1.29 oz/A) + Fusillade II (18 fl oz/A) + NIS (0.25 % v/v)
4	Recognition (1.29 oz/A) + Fusillade II (24 fl oz/A) + NIS (0.25 % v/v)
5	Fusillade II (5 fl oz/A) + Turflon Ester Ultra (32 fl oz/A) + NIS (0.25 % v/v)

Additional Demo Information

- Treatments were applied on July 12, 2023 at 40 GPA
- These demo plots were also established at the Southwest Research and Extension Center in Hope, AR and Gipson Bros Farm in Houston, AR
- Herbicide treatments will be applied every 4 weeks for 3 months to fully control bermudagrass
- Data collection will include visual injury of the zoysiagrass and control of bermudagrass

Brown Patch Fungicide Trials on Tall Fescue Lawns

Wendell Hutchens-Assistant Professor of Turfgrass Science, University of Arkansas

Introduction

Patch diseases on both cool- and warm-season grasses are challenging to manage. One particularly problematic patch disease on cool-season grasses, especially tall fescue, is brown patch (*Rhizoctonia solani*). There are many cultural practices that can be deployed to reduce brown patch on tall fescue lawns. Namely, applying appropriate amounts of nitrogen fertilization, mowing at the proper height, irrigating adequately and not prolonging the leaf wetness period, wetting agent applications, etc. However, fungicides are the most efficacious means of suppressing brown patch on tall fescue. This report highlights two ongoing fungicide trials for brown patch in tall fescue conducted by the Hutchens Lab at the University of Arkansas. Both trials are at an off-site location but results are highlighted in this report and will be discussed during field day.

1) Envu Brown Patch Trial

Materials and Methods

A fungicide trial was conducted at an off-site location beginning in the summer of 2023 examining: 1) Armada (trifloxystrobin + triadimefon) applied at 1.1 oz./1000 sq.ft. on a 28-day interval, 2) Armada (trifloxystrobin + triadimefon) applied at 1.5 oz./1000 sq.ft. on a 28-day interval, 3) Heritage (azoxystrobin) applied at 0.4 oz./1000 sq.ft. on a 28-day interval, 4) Pillar SC (pyraclostrobin + triticonazole) applied at 1 fl.oz./1000 sq.ft. on a 28-day interval, and 5) a nontreated control. Initial applications were made on 2 June 2023. Plots were assessed weekly for percent brown patch and turf quality on a 1-9 scale (1=dead turf; 6=acceptable; 9=excellent). Means were compared for each assessment date and three key dates are presented in Table 1.

Results

All fungicides have suppressed brown patch compared to the nontreated control. No treatments have differentially suppressed brown patch. However, to date, brown patch pressure was only low-moderate in these trials so differences may be exacerbated as disease pressure intensifies throughout the summer.

Table 1. Envu Brown Patch Trial- Means for percent (%) brown patch and turf quality (1-9) were compared for multiple dates throughout the season. Means within the same column and similar letters are not significantly different (P = 0.05).

Treatment	6/15/2023		7/6/2023		7/13/2023	
	% Brown Patch	Turf Quality	% Brown Patch	Turf Quality	% Brown Patch	Turf Quality
Nontreated Control	0.6a	6.5a	4.1a	6.0b	14.9a	5.8b
Armada (1.1 oz./1000 sq.ft.)	0.4a	6.5a	0.3b	6.6a	0.2a	6.8a
Armada (1.5 oz./1000 sq.ft.)	0.4a	6.6a	0.2b	6.8a	0.1a	6.8a
Heritage (0.4 oz./1000 sq.ft.)	0.6a	6.6a	0.2b	6.8a	0.1a	6.9a
Pillar SC (1 fl.oz./1000 sq.ft.)	0.3a	6.9a	0.2b	6.9a	0.1a	7.0a

1) Harrell's Brown Patch Trial

Materials and Methods

A fungicide trial was conducted at an off-site location beginning in the summer of 2023 examining: 1) ProtectMAX Fluoxastrobin (fluoxastrobin) applied at 0.09 oz./1000 sq.ft. on a 21-day interval, 2) ProtectMAX Fluoxastrobin (fluoxastrobin) applied at 0.18 oz./1000 sq.ft. on a 28-day interval, 3) ProtectMAX Fluoxastrobin (fluoxastrobin) applied at 0.24 oz./1000 sq.ft. on a 28-day interval, 4) ProtectMAX Azoxy (azoxystrobin) applied at 0.55 oz on a 28-day interval, and 5) a nontreated control. Initial applications were made on 2 June 2023. Plots were assessed weekly for percent brown patch and turf quality on a 1-9 scale (1=dead turf; 6=acceptable; 9=excellent). Means were compared for each assessment date and three key dates are presented in Table 2. Visual treatment differences are further highlighted in Figure 1.

<u>Results</u>

All fungicides have suppressed brown patch and had higher turf quality compared to the nontreated control. No treatments have differentially suppressed brown patch. However, to date, brown patch pressure was only low-moderate in these trials so differences may be exacerbated as disease pressure intensifies throughout the summer.

Table 2. Harrell's Brown Patch Trial- Means for percent (%) brown patch and turf quality (1-9) were compared for multiple dates throughout the season. Means within the same column and similar letters are not significantly different (P = 0.05).

Treatment	6/15/2023		7/6/2023		7/13/2023	
	% Brown Patch	Turf Quality	% Brown Patch	Turf Quality	% Brown Patch	Turf Quality
Nontreated Control	0.6a	6.6a	9.2a	6.1a	10.3a	6.0b
ProtectMAX Fluoxastrobin (0.09 oz./1000 sq.ft) 21-day interval	0.7a	6.5a	0.2a	7.0a	0.1a	7.0a
ProtectMAX Fluoxastrobin (0.18 oz./1000 sq.ft) 28-day interval	0.6a	6.5a	0.3a	6.9a	0.1a	6.9a
ProtectMAX Fluoxastrobin (0.24 oz./1000 sq.ft) 28-day interval	0.3a	6.8a	0.4a	6.9a	0.1a	7.0a
ProtectMAX Azoxy (0.55 oz./1000 sq.ft) 28-day interval	0.5a	6.8a	0.3a	6.8a	0.1a	6.9a

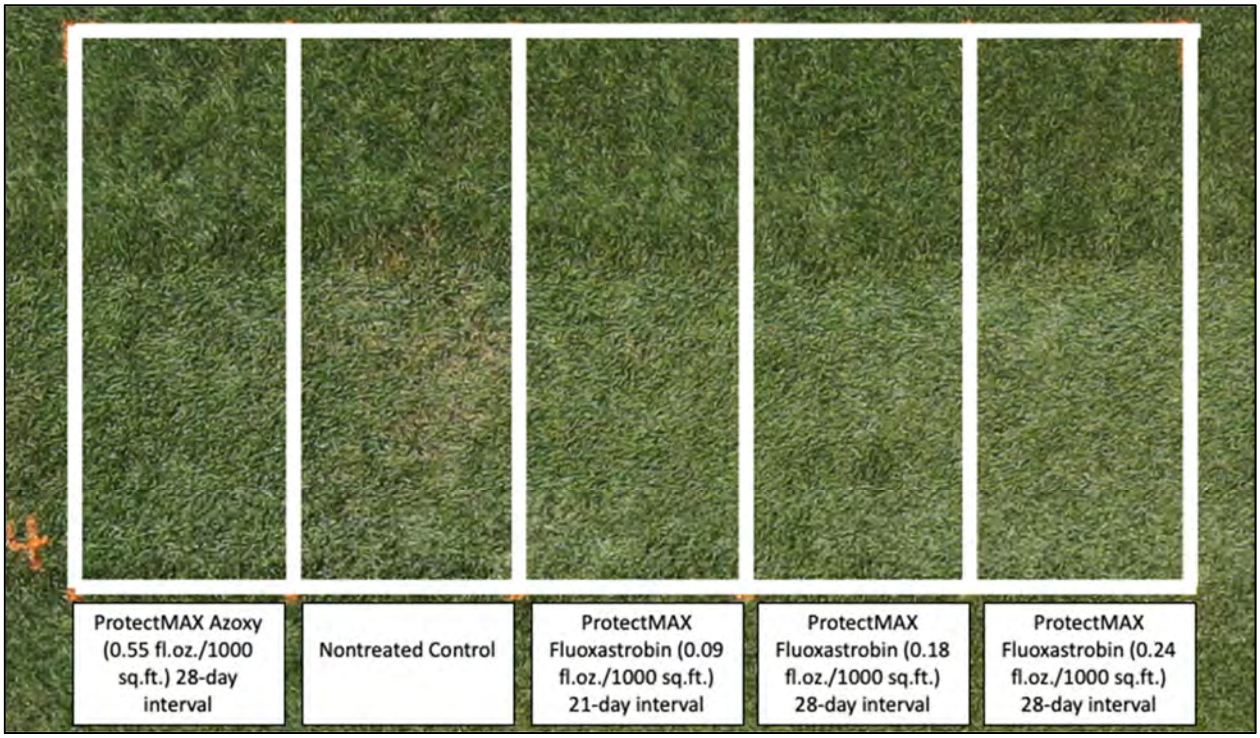


Figure 1. Photo take on 13 July 2023 of **Harrell's Brown Patch Trial**.

Control of Difficult Broadleaf Weeds
Hannah Wright-Smith

There are many herbicide options to control broadleaf weeds in turf, with the most common being synthetic auxin herbicides. Synthetic auxins are a group of herbicides (WSSA Group 4) that mimic naturally occurring plant hormones that regulate various plant functions. Often, visual symptoms like epinasty (twisting and curling) and stem swelling are observed on broadleaf weeds following an application of an auxin herbicide. Most broadleaf weeds in turf are easily controlled through applications of a 3-way mixture of 2,4-D, dicamba, and MCPP or MCPP. However, difficult to control broadleaf weeds, like Virginia buttonweed, may take multiple applications of 3-way mixtures or an ALS-inhibiting herbicide like metsulfuron or trifloxysulfuron (Recognition).

Halauxifen-methyl (Arylex™ active) and florpyrauxifen-benzyl (Rinskor™ active) are new herbicide active ingredients from Corteva Agriscience that have demonstrated excellent control of difficult weeds in other crops. Arylex is available for commercial turf use in GameOn and Relzar herbicides, while Rinskor is expected to be released later. Multiple applications made 4 to 8 weeks apart are still recommended for complete control of broadleaf weeds in turf.

The objective of this study was to compare herbicides for broadleaf weed control and evaluate how new herbicides performed compared to currently used herbicides.

Table 1. Herbicide treatments

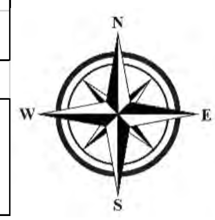
Treatment	Herbicide	Active Ingredients	Product Rate/A
1	GameOn Specialty Herbicide	2,4-D choline + fluroxypyr-meptyl + halauxifen-methyl	3.5 pt
2	Unnamed Herbicide 1	Florpyrauxifen-benzyl + fluroxypyr-meptyl	3 pt
3	Unnamed Herbicide 2	Penoxsulam + florpyrauxifen-benzyl	2 pt
4	Relzar Specialty Herbicide + COC	Florasulam + halauxifen-methyl + crop oil concentrate (COC)	0.72 oz + 0.5% v/v
5	GameOn Specialty Herbicide + Defendor	2,4-D choline + fluroxypyr-meptyl + halauxifen-methyl + florasulam	3 pt + 3 fl oz
6	Speedzone Southern	2,4-D + carfentrazone + dicamba + mecoprop	4 pt
7	Surge	2,4-D + dicamba + mecoprop + sulfentrazone	3.25 pt
8	Nontreated		

Additional trial information

- Initial application was made June 1, 2023 and a second application was made July 12, 2023
- All applications were made at 40 GPA using TeeJet 8004VS nozzles and there were 4 replications
- Turf was maintained at lawn height
- Data collection included visual injury of desired turf species and percent control of dandelion and common lespedeza

Figure 1. Trial map with plot number (top) and treatment number (bottom). Refer to Table 1 for herbicide treatment numbers.

401	402	403	404	405	406	407	408
4	7	5	2	6	3	8	1
301	302	303	304	305	306	307	308
8	1	6	4	2	7	5	3
201	202	203	204	205	206	207	208
2	6	8	1	7	3	4	5
101	102	103	104	105	106	107	108
1	2	3	4	5	6	7	8
Buffalograss strip							



Technology in Commercial Turfgrass Management: Rethinking What It Means & How to Use It

Daniel O'Brien

These days, *technology* is such a broad, wide-ranging, and widely-used term, it can mean completely different things to different people. To the general public, it is often associated with the latest cutting-edge digital devices or artificial intelligence. Yet, it is important to recognize that technology – in the full sense of the word, can also include so much more. As we examine technology for turfgrass management and for lawn care specifically, we need to consider the different forms it can take.

A standard definition for technology is: *the application of scientific knowledge for practical purposes*. In the context of turfgrass management, in addition to obvious examples such as **autonomous mowers** and **soil moisture sensors**, scientific knowledge is also built into the ***genetics*** of the grasses themselves, the ***best management practices*** we use to maintain them, and the ***chemistry*** of the products applied to them. The *practical purposes* (for which this scientific knowledge is used) include some of the biggest challenges currently impacting the turfgrass industry.

Among the greatest challenges facing turfgrass professionals are ***water, labor,*** and ***negative perceptions*** about natural grass. Examples include: financial incentives being offered to homeowners for removing turfgrass lawns in the name of water conservation (Utah Water Savers, 2023), regulations banning the use of gas-powered engines for lawn equipment (Hughes, 2023), and local restrictions on pesticides (Montgomery County Government, 2023) and fertilizer applications (Newborn, 2023). Consequently, lawn care operators often find themselves on the front lines of these issues.

The goal of this presentation is to help lawn care operators expand their notion of technology and identify potential *tools for their toolbox* that can meet both current and future challenges to the turfgrass industry.

National Turfgrass Evaluation Program

Responsible turfgrass management starts with the turfgrass itself. Selecting grasses that are well-suited for the growing conditions goes a long way in affecting the other inputs (water, fertilizer, pesticides) and labor required to properly maintain them. Arkansas' location within the transition zone means that different turfgrass species have different regions of adaptation throughout the state, as well as their own strengths and weaknesses (Patton & Boyd, 2007). Taking it a step further, identifying specific cultivars (***culti****vated* ***var****ieties*) within each species can enhance the selection process.

For over 40 years, the National Turfgrass Evaluation Program (NTEP) has conducted research comparing turfgrass cultivars across the United States, including numerous trials here at the University of Arkansas. Within a given species, top performing varieties can be identified at each location. Data are publicly available and can be accessed using the Turfgrass Trial Explorer on NTEP's website www.ntep.org.

Minimum Level of Sustainable Nutrition

Fertilization of home lawns has become a focal point for many turfgrass opponents. While it may be impossible to satisfy all critics, the *minimum level of sustainable nutrition* (MLSN) is a framework for providing both economic and environmental benefits by avoiding unnecessary fertilizer applications (PACE Turf, 2023). The MLSN guidelines revisit the basic question – *how much fertilizer do turfgrasses truly need?* Using data from thousands of soil samples of well-performing turfgrass, it was determined that quality turfgrass could be achieved and maintained with less fertilizer than previously recommended. Extensive information on MLSN is available on the PACE Turf website www.paceturf.org.

Wetting Agents and Plant Growth Regulators

Additional strategies for managing home lawns include the use of wetting agents, also known as soil surfactants. These products are regularly-used on golf courses for managing water movement and retention. Research has also shown their ability to increase turfgrass uptake of nutrients in the soil, while minimizing nutrient losses due to leaching (Fidanza, 2022). As water and fertilizer become more costly, and in some cases more restricted, wetting agents may provide lawn care operators the ability to do more with fewer inputs.

Similarly, the plant growth regulator (PGR) trinexapac-ethyl is capable of moderating turfgrass vertical growth, effectively reducing mowing frequency / clipping yield. Improved shade tolerance is among other benefits commonly cited (Kammerer, 2019). In recent years, generic options have lowered the cost per application. These products are not fertilizers, but rather compounds that control the production of the plant hormone gibberellic acid. Given the current labor challenges throughout the turfgrass industry, PGRs may provide lawn care operators the ability to do more with less manpower.

Autonomous Mowers & Soil Moisture Sensors

To bring this discussion full-circle, technology in the turfgrass world also includes innovative devices such as autonomous mowers and soil moisture sensors. Developments in autonomous mowers have eliminated the need to physically install perimeter boundary wire around a property. Instead, satellite GPS signals are used to quickly define operating areas which can be systematically mowed while available crew members focus on other tasks.

Wireless communication also plays a key role for soil moistures sensors which can be installed throughout a property, operating off batteries with a life of up to 20 years. Water use is a core driver of negative perceptions of turfgrass, and soil moisture sensors may be able to help homeowners adopt a *MLSN-style* approach to irrigation. Instead of simply applying predetermined amounts of irrigation on a calendar-based -schedule, turfgrass quality can be viewed alongside actual, available water in the soil to develop site-specific thresholds and avoid unnecessary irrigation events.

Conclusion

Taking a broader view of technology offers opportunities to address economic pressures and environmental scrutiny facing home lawn care. Lawn care operators are in a unique position to help educate homeowners and demonstrate to the general public how these technologies are part of a larger narrative of responsible turfgrass management. Ultimately, the *application of scientific knowledge for practical purposes* must also include intentional efforts to communicate the benefits of turfgrass (Beard and Green, 1994; Brosnan et al., 2020).

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Assessing Tallgrass Prairie Species for Roadside Vegetation in Arkansas

Sarah Paschal

The Arkansas Department of Transportation has funded a project to assess the viability of native tallgrass prairie species as main roadside vegetation along state managed roadsides. There are four locations throughout the state that consist of different treatments of tallgrass, shortgrass, and forbs. Arkansas, generally known as a biodiversity hotspot, has diverse landscapes, and several native flowering plants are available to pollinators throughout the season. Enhancing unused landscapes such as roadside areas with native pollinator plantings and milkweed plants may help pollinator and monarch butterfly populations by providing season-long floral resources, nesting, and breeding habitats. Four locations throughout the state represent four of the six ecoregions.

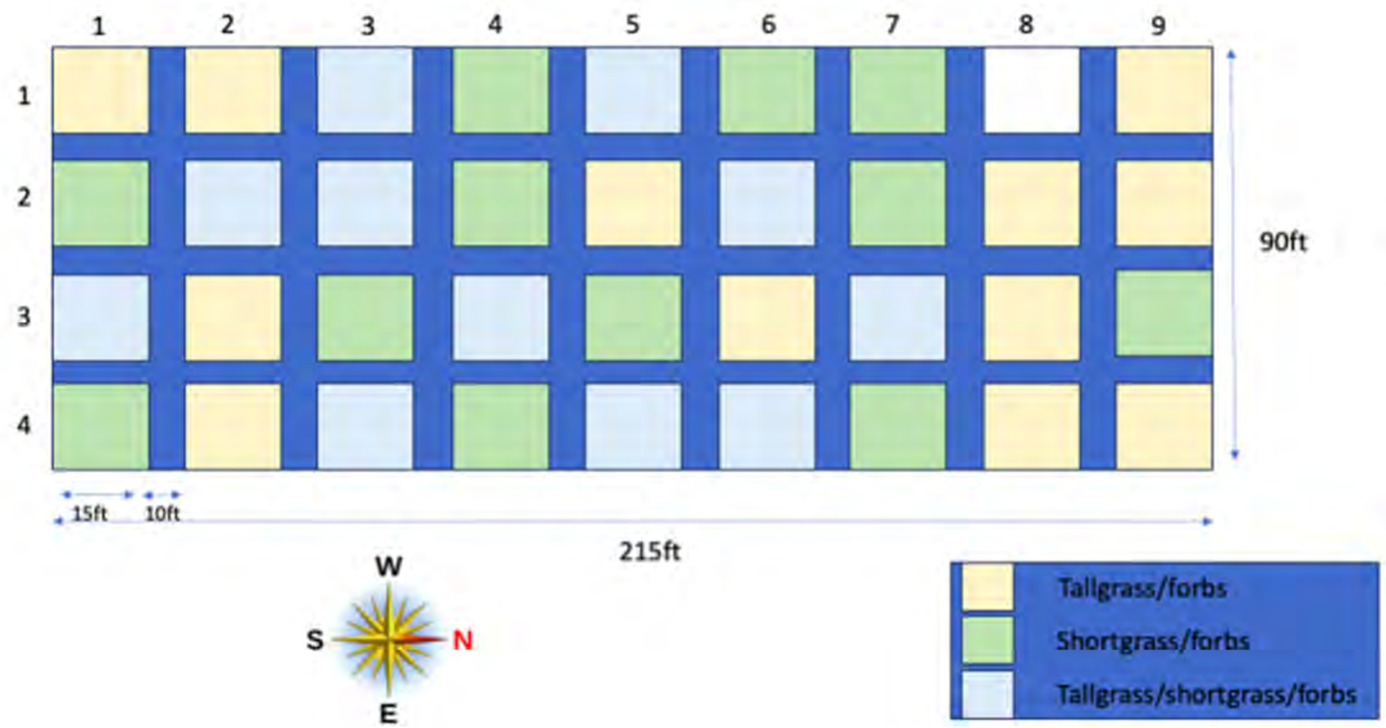
- Ozark Mountains- Huntsville
- Ouachita Mountains- Mansfield
- Arkansas River Valley- Clarksville
- Mississippi Alluvial Plains- Newport

Establishment of native prairie species on roadsides as main vegetation has not been attempted in Arkansas and has great potential to serve many beneficial aspects to the state. Bees and other pollinators generally feed on nectar and pollen from numerous flowering plants. Both nectar and pollen provide nutrients that are considered vital in their development and can influence overall health and development of offspring. Native flowering plants including wild species provide a variety of nectar and pollen resources to bees, and thus support pollinator health. Diversity of bees positively correlates with the diversity of flowering plants in the landscape surrounding pollinator habitats.

Native plants provide protection for endangered species, assist in erosion control, promote biodiversity, and improve water quality. In addition, they have the potential to be more cost-effective than current roadside vegetation management with an annual fall mowing occurring after seeds have set and nesting season for wildlife has come to an end.

The long-term goals of this research project are to create a sustainable management plan for plantings of native grasses and wildflowers along the roadside. Native grasses and forbs will be used as vegetation for this study because of their natural ability to establish biodiverse plant and animal communities and their resilience to the climate. Within those goals, it remains critical that these vegetative approaches also provide safety to the traveling public, maintain proper water diversion for excess storm water, protect from wind and soil erosion, and provide an esthetically pleasing right of way to the traveling public.

Plot plan for ArDOT project:



Species mixtures being tested in the ArDOT project

Scientific Name	Common Name	Scientific Name	Common Name
Short Grasses		**Forbs (cont.)**	
Buchloe dactyloides	buffalograss	*Echinacea purpurea*	purple Coneflower
Schizachyrium scoparium	little bluestem	*Eryngium yuccifolium*	rattlesnake-Master
Bouteloua curtipendula	sideoats grama	*Helianthus mollis*	ashy (downy) sunflower
Tall Grasses		*Liatris pycnostachya*	prairie blazing star
Andropogon gerardii	big bluestem	*Pycnanthemum tenuifolium*	slender Mountain-Mint
Panicum virgatum	switchgrass	*Ratibida columnifera*	Mexican hat plant
Sorghastrum nutans	indiangrass	*Rudbeckia hirta*	black-eyed Susan
Forbs		*Lespedeza virginica*	slender lespedeza
Asclepias tuberosa	butterfly milkweed	*Echinacea pallida*	pale purple coneflower
Baptisia alba	white wild indigo	*Amorpha fruticosa*	desert false indigo
Baptisia australis	blue wild indigo	*Asclepias incarnata*	swamp milkweed
Dalea purpurea	purple prairie clover	*Asclepias syriaca*	common milkweed
Desmanthus illinoensis	Illinois bundleflower	*Chamaecrista fasciculata*	partridge pea

Incorporating Natives into Landscapes

Sarah Paschal

Prior to European settlement, it is estimated that Arkansas once had 800,000 acres of native tallgrass prairie. Today, less than 0.5% (4000 acres) of these ecosystems remain, making them the most endangered ecosystem in the state. In recent years there has been an increasingly popular movement to revert landscapes, lawns, medians, and roadsides back to tallgrass ecosystems. Luckily for insects and wildlife this has created opportunities for food, protection, and reproduction. In landscapes, tallgrasses and forbs are low-maintenance, drought tolerant and add many benefits to the landscape including:

- Wildlife habitat
- Filtration of pollutants
- Soil stabilization and erosion control
- Uses in ornamental landscape
- Lower the use of pesticides

Landscaping choices have meaningful effects on the population of birds and the insects they need to survive. Landscapers, homeowners, and local policy makers can assist in wildlife conservation by selecting native, locally adapted plants when making their landscape decisions.

Native species require little to no human intervention to thrive. They have also adapted to local conditions over thousands of years, meaning they are more resistant to pest problems, reducing the use of pesticides. Due to their extensive root systems, natives require little to no additional irrigation. Native tallgrass prairies can absorb 9 inches of rainfall per hour before any kind of runoff occurs, and one acre of established prairie will intercept as much as 53 tons of water during a one inch per hour rain event.

In general, once you have planted native perennials in an ornamental landscape area you can expect the plants to take up to three years to flourish. First-year plants will focus on root growth and will put on a relatively small amount of vegetative growth. Second-year plants will put on more vegetative growth and some may begin to bloom. Third-year plants put on strong vegetative growth, bloom and set seed. This will create more plants that will establish and come back for many years. However, there are some native perennials that can bloom on first-years growth, like black-eyed susan (Rudbeckia hirta). This is a great plant to pair with other perennials that can take up to three years to bloom such as purple cone flower (Echinacea purpurea). Purchasing and installing mature plants will significantly reduce time to establish in a landscape, giving way to earlier blooms that would otherwise not be found within the first two years.

Some common native landscape plant recommendations for Arkansas:

Shrubs	
Scientific Name	**Common Name**
Amelanchier spp.	serviceberry
Hamamelia virginiana	witchhazel
Cephalanthus occidentalis	buttonbush
Aesculus pavia	red buckeye
Ilex decidua	possumhaw
Callicarpa americana	beautyberry

Forbs	
Scientific Name	**Common Name**
Echinacea purpurea	purple cone flower
Dryopteris erythrosora	autumn fern
Baptisia australis	blue wild indigo
Asclepias tuberosa	butterfly milkweed
Eryngium yuccifolium	rattlesnake master
Liatris pycnostachya	prairie blazing star

Grasses	
Scientific Name	**Common Name**
Andropogon gerardii	big bluestem
Schizachyrium scoparium	little bluestem
Sorghastrum nutans	indiangrass
Panicum virgatum	switchgrass
Bouteloua curtipendula	sideoats grama
Buchloe dactyloides	buffalograss

2019 NTEP Bermudagrass Trial

Mike Richardson, John McCalla, and Sarah Paschal

The National Turfgrass Evaluation Program (NTEP) is an organization within the United States Department of Agriculture that administers turfgrass cultivar evaluation experiments at various sites throughout the U.S. and Canada each year. Each commonly-used turfgrass species is tested on a four to five year cycle at sites throughout the growing region for that particular species. The University of Arkansas has been an active participant in the NTEP for over 2 deacdes and currently has trial locations for the 2019 Bermudagrass Trial and 2019 Zoysiagrass Trial. We will only be reviewing the bermudagrass trial (Fig. 1) in today's program, but a map of the zoysiagrass trial (Fig. 2) is available for viewing on your own and some data on zoysiagrass winterkill is also presented in this article (Table 2).

These trials were established in June 2019 using plugs planted on one foot centers (vegetative bermudagrass entries) or by seeding at 1 lb. pure live seed per 1000 ft^2 (seeded bermudagrass entries). The bermudagrass trial included 24 vegetative entries and 15 seeded entries (Table 1). Of these, there are 7 vegetative entries and 5 seeded entries that are currently commercially available (Table 1). Each variety was planted in three replicate plots (Fig. 1). The trial is maintained at a 0.5 inch height of cut with 3-5 lb. N / 1000 ft2 applied each year. The trial has been evaluated for establishment rate, winterkill, overall quality, density, color, spring green up, and fall color retention.

Significant winterkill was observed on both bermudagrasses and zoysiagrasses throughout the region in the spring of 2023. These trials also were injured by the winter conditions. Although it is never exactly clear which period of time during the winter may have been most damaging, the general thought is that many of the warm-season grasses in the region had not fully gone into dormancy when we experienced a significant low temperature period just prior to Christmas 2022. An unusually cool spring also slowed emergence of the warm-season grasses.

Data on turfgrass cover was collected on May 3, 2023, and many bermudagrass cultivars appeared to either be completely dead or were just very slow in recovering in Fayetteville AR (Table 1). Some of the best commercial entries on that rating date were Tiftuf, Tahoma 31, Tifway, and Pure Pro Blend (seeded). While the performance of Tahoma 31 is not surprising, the recovery of the TifTuf and Tifway was somewhat peculiar, as these grasses have not been historically considered highly freeze tolerant. One possible explanation is that TifTurf and Tifway are some of the earliest cultivars to go into dormancy each year and they may have been more acclimated before the early winter freeze event. As you will see in the plots today, most cultivars have now recovered fully.

Over the first few years of the trial, several entries have performed well (Table 1). As is typically the case with bermudagrass trials, vegetative entries such as TifTuf, Tahoma 31, and Latitude 36 have generally produced higher turfgrass quality than seeded entries. Of the seeded types, Monaco has performed the best at this location and others, but there are several other seeded entries that have had comparable performance.

Plot maps for the bermudagrass and zoysiagrass trials are below (Fig. 1 and 2) so that you may walk over the experimental areas and determine which varieties that you find most appealing. Data from these trials will be available at www.ntep.org.

Fig. 1. Plot plan for 2019 NTEP Bermudagrass Trial.

NATIONAL TURFGRASS EVALUATION PROGRAM 2019 BERMUDAGRASS TRIAL

ROW									
13	JSC 2013-8S	Arden 15	JSC 2013-12S	OKS2015-7	Riviera	Sun Queen	JSC 2013-10S	Monaco	OKS2015-3
12	JSC 2013-5S	DLF-460/3048	PST-R6TM	Pure Pro Blend	JSC 2013-7S	OKS2015-1	Monaco	Sun Queen	JSC 2013-8S
11	PST-R6TM	Pure Pro Blend	JSC 2013-12S	JSC 2013-7S	OKS2015-3	JSC 2013-5S	DLF-460/3048	Arden 15	OKS2015-1
10	OKS2015-7	Riviera	JSC 2013-10S	DLF-460/3048	JSC 2013-8S	PST-R6TM	Arden 15	JSC 2013-10S	OKS2015-3
9	Monaco	JSC 2013-5S	OKS2015-7	Sun Queen	JSC 2013-12S	Riviera	OKS2015-1	Pure Pro Blend	JSC 2013-7S
				^ Seeded bermudagrass entries ^					
8	JSC 77V	MSB-1050	MSB-1017	North Bridge	MSB-1026	MSB-1075	Astro	OKC1682	OKC1406
7	Tahoma 31	OKC1876	JSC 80V	Tiftuf	OKC1873	MSB-1048	Tifgrand	MSB-1042	Latitude 36
6	FB 1628	FB 1902	Tifway	FB 1630	FB 1903	OKC1666	Tifgrand	OKC1876	Tahoma 31
5	MSB-1026	Latitude 36	JSC 77V	FB 1903	OKC1682	OKC1666	FB 1630	Tifway	OKC1406
4	OKC1873	MSB-1075	MSB-1050	FB 1628	MSB-1017	MSB-1042	MSB-1048	Astro	JSC 80V
3	Tifgrand	Latitude 36	MSB-1017	OKC1406	Tiftuf	Tifway	Tiftuf	North Bridge	FB 1902
2	MSB-1026	FB 1630	MSB-1075	FB 1902	OKC1666	OKC1682	OKC1876	MSB-1050	FB 1628
1	MSB-1048	North Bridge	MSB-1042	Astro	JSC 80V	OKC1873	FB 1903	JSC 77V	Tahoma 31
				^ Vegetative bermudagrass entries ^					
PLOT >>	1	2	3	4	5	6	7	8	9

Shaded cells are commercially-available entries

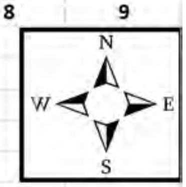


Table 1. Spring turf coverage at Fayetteville AR in 2023 and turfgrass quality ratings from the 2021 dataset available at www.ntep.org

		Turfgrass Cover	Turfgrass Quality (2021)		
Name	**Type**	**5/3/2023**	**Fayetteville**	**Stillwater**	**National Avg.**
Tiftuf	Vegetative	78.3	6.7	6.1	6.5
Tahoma 31	Vegetative	76.7	6.5	5.8	6.2
Tifway	Vegetative	46.7	6.4	5.8	6.0
MSB-1042	Vegetative	46.7	6.1	5.7	5.8
Pure Pro Blend	Seeded	46.7			
MSB-1026	Vegetative	45.0	6.0	5.5	5.6
OKC1876	Vegetative	36.7	6.5	5.7	6.0
OKC1666	Vegetative	30.0	5.0	5.2	5.0
JSC 77V	Vegetative	26.7	6.1	5.5	5.9
OKC1682	Vegetative	21.7	5.8	5.2	5.5
JSC 2013-5S	Seeded	20.0	5.9	5.2	5.5
Arden 15	Seeded	18.3			
FB 1902	Vegetative	16.7	5.6	5.1	5.4
Astro	Vegetative	13.3	6.3	5.6	5.8
OKC1406	Vegetative	12.3	5.7	5.4	5.6
OKC1873	Vegetative	10.7	6.5	5.7	5.9
PST-R6TM	Seeded	10.7	5.0	4.9	5.1
JSC 2013-10S	Seeded	10.0	5.6	5.3	5.8
JSC 2013-12S	Seeded	10.0	5.7	5.3	5.8
FB 1628	Vegetative	9.0	6.7	5.9	6.4
Latitude 36	Vegetative	8.3	6.3	5.8	6.2
FB 1903	Vegetative	8.3	5.2	4.9	5.6
Monaco	Seeded	8.0	5.7	5.3	5.8
OKS2015-7	Seeded	8.0	5.7	5.1	5.5
Riviera	Seeded	7.3	5.5	5.1	5.6
PST-R6MM	Seeded	7.3	5.1	4.8	5.1
Tifgrand	Vegetative	6.7			
JSC 2013-7S	Seeded	5.7	5.8	5.2	5.7
OKS2015-3	Seeded	5.7	5.7	5.3	5.6
DLF-460/3048	Seeded	5.7	5.3	4.9	5.2
OKS2015-1	Seeded	5.7	5.3	4.9	5.2
JSC 80V	Vegetative	5.0	5.8	5.7	5.9
JSC 2013-8S	Seeded	5.0	5.9	5.3	5.7
MSB-1017	Vegetative	4.0	6.6	5.5	5.7
Northbridge	Vegetative	4.0			
MSB-1075	Vegetative	3.7	4.4	3.9	4.3
MSB-1050	Vegetative	3.0	6.2	5.1	5.2
MSB-1048	Vegetative	2.3	6.4	5.4	5.6
FB 1630	Vegetative	2.0	5.7	5.3	5.7
	LSD (0.05)	***22.1***	***0.7***	***0.7***	***0.7***

Standards added to the trial at the Fayetteville location

Fig. 2. Plot plan for 2019 NTEP Zoysiagrass Trial.

ROW	NATIONAL TURFGRASS EVALUATION PROGRAM 2019 ZOYSIAGRASS TRIAL								
13	FZ 1723	Empire	FZ 1367	DALZ 1408	DALZ 1707	DALZ 1802	Meyer	16-TZ-12783	FZ 1327
12	FZ 1721	DALZ 1311	DALZ 1601	DALZ 1614	Emerald	FZ 1422	DALZ 1808	Zeon	DALZ 1603
11	DALZ 1701	16-TZ-13463	FZ 1728	DALZ 1409	FZ 1732	FZ 1436	UGA GZ 17-4	FZ 1410	FAES 1319
10	DALZ 1613	FZ 1407	FZ 1368	DALZ 1714	15-TZ-11715	FZ 1727	FZ 1722	DALZ 1806	FAES 1335
9	DALZ 1601	DALZ 1311	FZ 1327	16-TZ-12783	FZ 1723	DALZ 1701	FZ 1440	DALZ 1713	DALZ 1807
8	Zeon	FZ 1721	DALZ 1603	DALZ 1614	FZ 1368	DALZ 1807	Meyer	DALZ 1409	DALZ 1713
7	UGA GZ 17-4	DALZ 1806	FZ 1436	FZ 1440	FZ 1410	FZ 1422	FZ 1367	Empire	FZ 1727
6	15-TZ-11715	DALZ 1802	DALZ 1707	Emerald	DALZ 1808	FZ 1722	DALZ 1613	FZ 1407	FZ 1728
5	DALZ 1701	FZ 1722	DALZ 1806	16-TZ-13463	FZ 1732	FAES 1319	DALZ 1714	DALZ 1408	FAES 1335
4	15-TZ-11715	FZ 1723	DALZ 1614	Meyer	DALZ 1613	FZ 1422	DALZ 1808	DALZ 1807	FZ 1367
3	DALZ 1707	UGA GZ 17-4	FAES 1319	FZ 1368	DALZ 1311	FZ 1732	Zeon	16-TZ-13463	DALZ 1802
2	Emerald	FAES 1335	FZ 1728	DALZ 1408	FZ 1721	FZ 1727	FZ 1407	FZ 1436	FZ 1410
1	FZ 1440	DALZ 1714	Empire	DALZ 1409	DALZ 1713	FZ 1327	DALZ 1603	16-TZ-12783	DALZ 1601
PLOT>>	1	2	3	4	5	6	7	8	9

Shaded cells are commercially-available entries

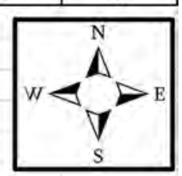
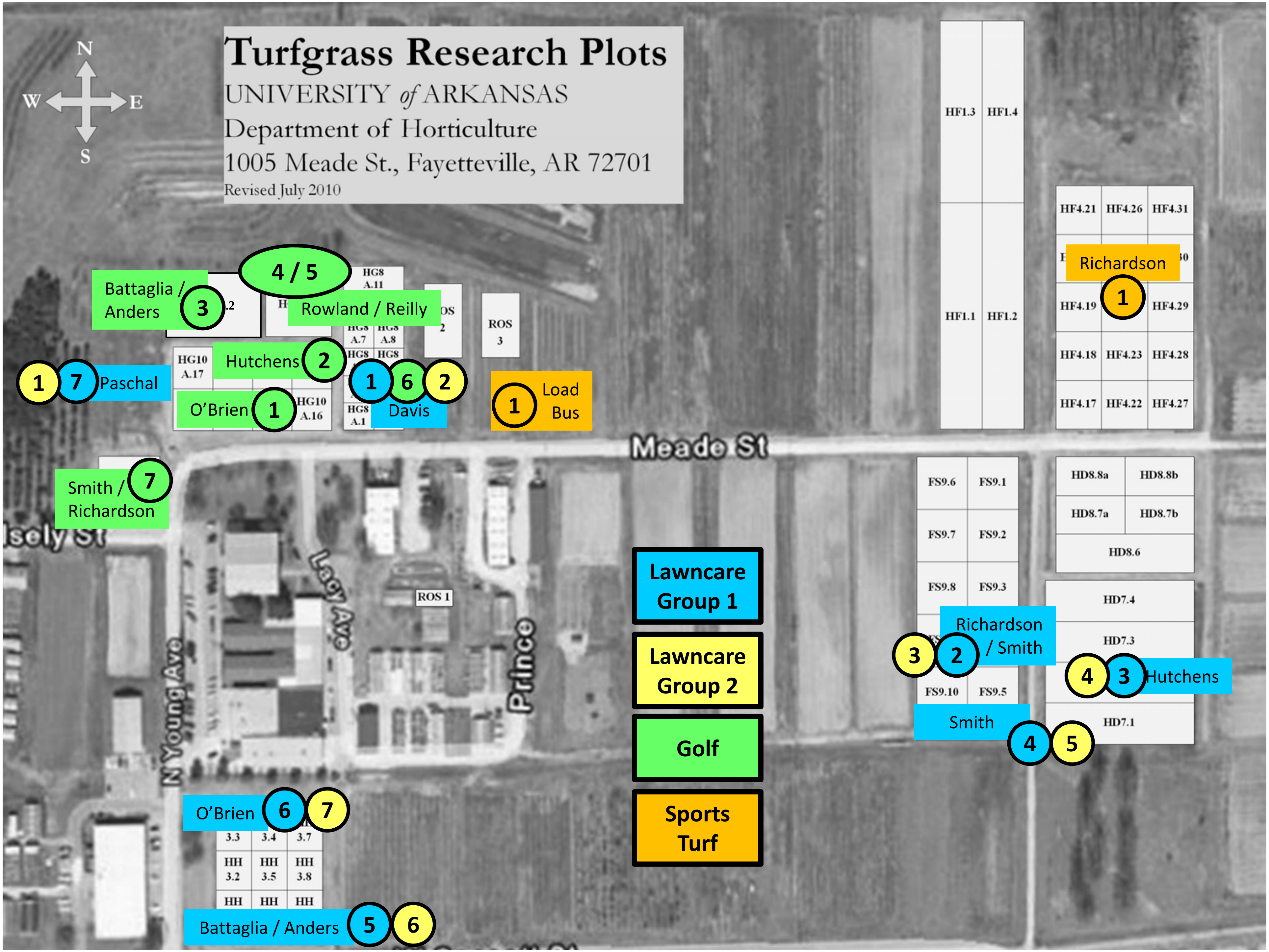


Table 3. Winterkill data on the 2019 NTEP zoysiagrass trial in Manhattan KS (2022 data) and Fayetteville AR (2023 data)

Entry	% winterkill (KS)	%winterkill (AR)	%winterkill (AVG)
DALZ 1808	0.0	18.2	9.1
Meyer	6.7	17.1	11.9
DALZ 1701	8.3	21.4	14.9
FZ 1327	10.0	23.5	16.8
FZ 1410	0.0	34.8	17.4
FAES 1319	8.3	27.1	17.7
DALZ 1603	0.0	35.6	17.8
DALZ 1707	0.0	40.2	20.1
DALZ 1601	0.0	41.9	21.0
DALZ 1311	6.7	36.2	21.5
Zeon	15.0	29.7	22.3
Empire	10.0	39.4	24.7
Emerald	33.3	16.5	24.9
FZ 1407	25.0	38.0	31.5
FZ 1422	26.7	42.3	34.5
15-TZ-11715	51.7	30.3	41.0
FZ 1722	75.0	14.0	44.5
16-TZ-13463	76.7	15.0	45.9
DALZ 1614	70.0	22.1	46.0
FZ 1723	50.0	48.1	49.0
FZ 1727	80.0	19.1	49.6
FZ 1732	80.0	27.2	53.6
FZ 1721	75.0	34.1	54.5
16-TZ-12783	81.7	30.4	56.0
DALZ 1802	83.3	29.0	56.1
FZ 1436	93.3	23.8	58.6
DALZ 1806	88.3	28.8	58.6
DALZ 1807	80.0	38.7	59.4
DALZ 1613	83.3	35.9	59.6
DALZ 1408	93.3	26.3	59.8
DALZ 1714	90.0	30.9	60.4
FAES 1335	83.3	38.1	60.7
FZ 1728	93.3	29.9	61.6
FZ 1440	93.3	30.2	61.8
FZ 1368	92.7	33.3	63.0
DALZ 1713	90.0	38.3	64.2
UGA GZ 17-4	94.7	35.3	65.0
FZ 1367	95.0	40.3	67.7
DALZ 1409	90.0	49.5	69.7
LSD (0.05)	***18.9***	***12.6***	Not applicable
Commercially-available entries			



Turfgrass Research Plots
UNIVERSITY of ARKANSAS
Department of Horticulture
1005 Meade St., Fayetteville, AR 72701
Revised July 2010
N
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Meade St
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HF4.28
HF4.17
HF4.22
HF4.27
HD8.8a
HD8.8b
HD8.7a
HD8.7b
HD8.6
HD7.4
HD7.3
HD7.1
FS9.6
FS9.1
FS9.7
FS9.2
FS9.8
FS9.3
FS9.10
FS9.5
ROS 1
ROS 3
HG8 A.11
HG10 A.17
HG10 A.16
HG8 A.1
HG8 A.7
HG8 A.8
HH 3.2
HH 3.5
HH 3.8
Battaglia / Anders 3
4 / 5
Rowland / Reilly
Hutchens 2
1 7 Paschal
O'Brien 1
1 6 2 Davis
1 Load Bus
Richardson 1
Smith / Richardson 7
Richardson / Smith 3 2
4 3 Hutchens
Smith 4 5
O'Brien 6 7
Battaglia / Anders 5 6
Lawncare Group 1
Lawncare Group 2
Golf
Sports Turf

Agenda for 2023 Turfgrass Field Day - Fayetteville AR, August 1st, 2023

Registration: 7:00 - 9:00 am

Trade Show and Breakfast: 7:30-8:40 am

Opening comments: 8:40-9:00 am

FIELD TOURS (9:00-11:30 am)

Golf	Topic	Start	End	Flag Colors & Numbers Red w/ White Nos.
Daniel O'Brien	GCSAA wetting agent trials	9:00	9:20	1
Wendell Hutchens	Putting green disease trials and Tif3D green	9:20	9:40	2
Mike Battaglia and Jessy Anders	DMI regulation and safety on creeping bentgrass	9:40	10:00	3
John Rowland and John Reilly	USGA updates and the new GS3 technology	10:00	10:20	4
John Reilly and John Rowland	New technologies for golf course maintenance	10:20	10:40	5
Jason Davis	Application technology and precision turf management	10:40	11:00	6
Hannah Smith and Mike Richardson	Zoysiagrass putting green herbicide/PGR tolerance	11:00	11:20	7

Lawncare - Group 1	Topic	Start	End	White w/ Red Nos.
Jason Davis	Applicator issues / sprayer technology	9:00	9:20	1
Mike Richardson	Recognition and establishment of seeded zoysiagrass	9:20	9:40	2
Wendell Hutchens	Patch disease management on lawn grasses	9:40	10:00	3
Hannah Wright Smith	Herbicide trials	10:00	10:20	4
Mike Battaglia and Jessy Anders	Interactive stop: What's the damage from?	10:20	10:40	5
Daniel O'Brien	Utility of technology in lawn management	10:40	11:00	6
Sarah Paschal	Assessing tall grass prairie species for roadside vegetation	11:00	11:20	7

Lawncare - Group 2	Topic	Start	End	Yellow w/ Black Nos.
Sarah Paschal	Assessing tall grass prairie species for roadside vegetation	9:00	9:20	1
Jason Davis	Applicator issues / sprayer technology	9:20	9:40	2
Mike Richardson	Recognition and establishment of seeded zoysiagrass	9:40	10:00	3
Wendell Hutchens	Patch disease management on lawn grasses	10:00	10:20	4
Hannah Wright Smith	Herbicide trials	10:20	10:40	5
Mike Battaglia and Jessy Anders	Interactive stop: What's the damage from?	10:40	11:00	6
Daniel O'Brien	Utility of technology in lawn management	11:00	11:20	7

Sports Turf	Topics	Start	End	
Mike Richardson	NTEP bermudagrass trial	9:00	9:20	1
	Tour of Razorback Athletics	9:30	11:30	2

Innovative equipment demonstrations (12:15-1:30 pm)

Zach Severns (GreenSight) - Autonomous Mower

Alex Little (P&K) Equipment

Pesticide recertification (1-2 pm)
Located across Hwy 112 / Garland Avenue in the new Don Tyson Center for Agricultural Sciences

Regulatory Updates (20 min) - Seth Dunlap

Pesticide Stewardship and Safety (20 min) - Hannah Wright Smith