Wisconsin Turfgrass Field Day

July 24, 2018

O.J. Noer Turfgrass Research & Education Facility
2502 Hwy M, Verona, WI 53593

UW Extension
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Wisconsin Turfgrass Association

The University of Wisconsin Madison

2018 Wisconsin Turfgrass Field Day

Morning Tour: General Turf Management (9:30 – 11:00 AM)

Flag No.	Topic	Speaker	Pg
1	Diseases of over-watered lawns	Paul Koch	4
2	Calibration of a stand-on sprayer	Kurt Hockemeyer	7
3	Wildlife damage management	David Drake	9
4	Effects of pesticide residue within turfgrass guttation fluid on pollinators	Audrey Simard	12
5	Kentucky bluegrass cultivar evaluation and organic weed control options	Doug Soldat	14
6	Post-emergent control of crabgrass	Nick Bero	20

11:00-1:30pm- Lunch, Trade Show and Networking

Afternoon Tour: Golf Turf Research (1:30 – 3:00 PM)

Topic	Speaker	Pg
Effect of nitrogen and traffic on bentgrass clipping yield and visual quality	Qiyu Zhou and Doug Soldat	24
Wetting agents, biological additives, potassium soil test levels, liquid fertilizer evaluation	Doug Soldat	N/A
Biopesticides for the control of dollar spot on putting greens	Paul Koch and Emma Buczkowski	26
Common Ground Initiative update	Paul Koch	29
Iron sulfate for dollar spot control on fairways	Paul Koch	32
Precision disease management of dollar spot	Kurt Hockemeyer and Paul Koch	38
Effects of pesticide residue within turfgrass guttation fluid on pollinators	Audrey Simard	12

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Editor's Note

We are grateful for and humbled by the tremendous industry support for the UW Turfgrass Program provided by the above sponsors. Without your help, our turfgrass research and educational program would be unable to function at our current and targeted level. While we strive for perfection and attempt to list all our supporters, if we accidentally missed you then you have our sincere apology; please let us know so we may correct the situation in the future. If you have any comment or suggestions for next year's program, please contact me at 608-263-3631 or djsoldat@wisc.edu. References to products in this booklet are intended to convey objective, unbiased information and do not imply an endorsement.

On behalf of the entire UW-Madison Turf Team, thanks again for your support, and we look forward to continuing to provide the industry with research and outreach programs that improve your turf, your bottom line, and the environment.

Sincerely,

Doug Soldat
Professor and Extension Specialist
Dept. of Soil Science
University of Wisconsin-Madison

Diseases of Over-Watered Lawns

Paul Koch, Ph.D.
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University of Wisconsin - Madison

INTRODUCTION

Turfgrass needs water to survive, but many home lawns with in-ground irrigation systems are overwatered. Overwatering obviously wastes water, but it can also weaken the turf in many ways, from poorly developed root systems to poor traffic tolerance. In addition, numerous fungal diseases are more severe on lawns receiving too much (or too frequent) irrigation relative to those receiving less supplemental irrigation.

DISEASES OF OVERWATERED LAWNS IN COOL OR MILD CONDITIONS

Red Thread

Caused by: *Laetisaria fuciformis*

Symptoms: Small, circular patches of tan turf 2-6 inches in diameter. Presence of red/pink threads (sclerotia) may give the patch a slightly reddish color. Can be confused with dollar spot.

What it affects: Leaves

When it infects: In springtime or early summer following extended periods of cool, wet weather. Symptoms typically recover quickly in the drier, warmer summer months.

How to manage: Limit irrigation during prolonged periods of cool weather and provide for adequate surface and subsurface drainage. Proper nitrogen fertility will help the turf ‘grow out’ of the disease. Symptoms typically recover once conditions dry out.

Leaf Spot

Caused by: *Drechslera poae*

Symptoms: Irregular patches of yellow or reddish turf that may be isolated to small areas 1-2 feet in diameter or that can spread over significant expanses. Oftentimes an entire area can have a chlorotic or reddish look.

What it affects: Leaves

When it infects: During prolonged periods of cool, wet weather in the spring, early summer, and fall. Symptoms typically recover in warm, dry conditions in summer.

How to manage: Limit irrigation during prolonged periods of cool weather and provide for adequate surface and subsurface drainage. Excessive spring fertility can increase disease severity.

DISEASES OF OVERWATERED LAWNS IN HOT CONDITIONS

Dollar Spot

Caused by: *Clarireedia jacksonii*

Symptoms: Small, circular patches of tan turf 2-6 inches in diameter. Bleached lesions with dark red or brown borders will be present on infected leaves. Often confused with red thread and can give the turf a ‘droughty’ appearance at first glance.

What it affects: Leaves

When it infects: Optimal conditions are temperatures between 65 and 85°F with high humidity. Dollar spot can infect from May until November in Wisconsin, but is most common in lawns during very warm and humid periods in July and August.

How to manage: Limit irrigation during prolonged periods of warm weather and provide for adequate surface and subsurface drainage. Proper nitrogen fertility will help the turf ‘grow out’ of the disease.

Brown Patch

Caused by: *Rhizoctonia solani*

Symptoms: Roughly circular patches of tan turf 1 to 2 feet in diameter. Bleached lesions with dark red or brown borders will be present on infected leaves but will not result in an hour-glass shape on the leaf. This provides a key diagnostic difference with dollar spot lesions. Often confused with dollar spot and can give the turf a ‘droughty’ appearance at first glance. Brown patch in Wisconsin lawns is most severe on tall fescue.

What it affects: Leaves

When it infects: Optimal conditions are temperatures above 85°F with high humidity. Brown patch can occur on Wisconsin lawns from June through September but is most common during very warm and humid periods in July and August.

How to manage: Limit irrigation during prolonged periods of warm weather and provide for adequate surface and subsurface drainage. Limit fast-release fertilizer during these same periods, which can exacerbate disease symptoms.

Summer Patch

Caused by: *Magnaporthe poae*

Symptoms: Roughly circular patches of tan turfgrass 1 to 3 feet in diameter. Center may fill in with resistant grasses or weeds to form a 'frog-eye' patch.

What it affects: Roots

When it infects: Begins infecting once soil temperatures reach approximately 60°F. Infection progresses and increases as temperature and humidity increase with summer. Symptoms often appear in July and August.

How to manage: Maintain healthy rooting through adequate drainage and oxygen flow to the roots and avoiding overwatering. Once symptoms appear, manage through more frequent irrigations and renovate once cooler temperatures prevail.

GENERAL LAWN IRRIGATION RECOMMENDATIONS

Tell your clients to TURN OFF THE AUTOMATIC TIMERS!!! Turfgrass lawns are not golf course putting greens and, unless they are seedlings, do not need to be watered 3 or more times per week. Rain sensors can be added to most systems that will automatically shut the irrigation program off once a certain amount of rainfall has occurred. But these often still result in overwatering. In my opinion the simplest way to keep lawns from being overwatered and to maintain turf health is to keep the irrigation system turned off until symptoms of drought stress occur, either browning turf or 'footprinting' of the turf. Then turn the irrigation on for a pre-determined amount of time, perhaps repeat again a few days later, and then wait until drought symptoms return. In Wisconsin it is relatively rare to require irrigation on home lawns more than 5 to 10 times in a growing season.

There is also a UW Extension publication by Doug Soldat titled 'Watering Your Lawn' that provides additional information and strategies for responsible lawn irrigation. It can be accessed by going to the UW Extension Learning Store (learningstore.uwex.edu) and typing in publication A3950 into the search bar. The direct web address for the publication can be found here: https://learningstore.uwex.edu/Watering-Your-Lawn-P1496.aspx

Calibration of a Stand-On Sprayer

Kurt Hockemeyer
Department of Plant Pathology
University of Wisconsin - Madison

INTRODUCTION

Calibration is a very important part of any type of application to any turf surface, whether it be granular or liquid. Calibration, done properly, ensures you are doing two things: 1) applying the correct rate of the desired product and 2) applying that product uniformly. Applying the correct rate of product is important for several reasons. Too much product costs you more, can harm desirable plants, or contaminate the environment. Too little product will probably not be effective, and therefore cost you more time and/or money. Uniform applications are also important to avoid dark green streaks in the lawn (when using fertilizer) or to ensure more complete control of a pest. Taking the time to calibrate can save a lot of headaches.

STEPS FOR CALIBRATION

1. Inspect the equipment

Check the machine's filters and nozzles for clogs. Set the pressure to the desired setting and make sure there are no leaks in the system.

2. Lay out your test plot

The test plot should be large enough that you can get a representative sample for your sprayer, but small enough that it does not take too long to cover with your ride-on. Because ride-on sprayers are a little bit larger and motorized, a test plot size of 1000 square feet can be used. You can divide 1000 by the effective spray width of the sprayer to figure out how far you need to drive in a straight line to cover 1000 square feet.

Example: One pass of the sprayer covers 9 feet. $\frac{1000}{9} \approx 111$

Driving 111 feet will cover a rectangle that is 9 feet wide by 111 feet long.

$9\ ft\ x\ 111\ ft \approx 1000\ sq\ ft$

3. Using a stopwatch, time how long it takes for you to drive over your test plot.

Once your test plot is laid out, time how long it takes to cover your test plot at application speeds. Do this 3 times, and average your time

Example: An average of 8 seconds to travel 111 ft.

4. Using a graduated cylinder, collect clean water being sprayed out for the time determined from Step 3.

A ride-on sprayer is going to have multiple nozzles, so you could use multiple graduated cylinders (you'll probably need a few extra sets of hands), or you can do one nozzle at a time and average them. All nozzles outputs should be within +/_

Example: 6 nozzles average 15 fl oz each over 8 seconds.

5. Using all previously collected information, you can determine how much water your sprayer is outputting.

Example: 15 fl oz H2O applied over 1000 sq ft per nozzle. 15 fl oz x 6 nozzles = 90 fl oz
90 fl oz H2O/1000 sq ft = 0.7 gal H2O/1000 sq ft

Adjust speed up or down to apply less or more water per area.

FINAL TIPS FOR SPRAYER CALIBRATION

Calibrating the granular spreader is similar. Using a test plot of known size, uniformly apply granular product. Determine what weight of product was spread over the test plot. Convert the numbers so that you know what weight of product is being applied per 1000 sq ft or per acre. Adjust spreader opening or adjust speed as needed. Take your time as calibration is very important.

Instructions adapted from Landscape Management-March 2018

Wildlife Damage Management

David Drake

Extension Wildlife Specialist / Professor

Dept. of Forest and Wildlife Ecology. Univ. of Wisconsin-Madison

When facing any wildlife damage or nuisance problem, several general considerations will improve your chances of successful resolution, avoid trouble with neighbors or the law, and save effort and money. The first consideration is correctly identifying the species causing the problem. If you incorrectly identify the animal responsible, you might use an inappropriate control method, wasting both time and money. Most importantly, you won't reduce or eliminate the problem. It is rare to catch an animal in the act of causing damage. More commonly, you discover the problem after the damage is done. In such cases, you must do a little wildlife detective work and examine tooth marks, browse patterns, scat droppings, tracks, and other signs. There are many good field guides to help with sign interpretation. Additionally, help is available from wildlife biologists at the Wisconsin Department of Natural Resources (WDNR), University of Wisconsin-Extension, the United States Department of Agriculture-Wildlife Services, and private wildlife control personnel. Once you've correctly identified the animal causing the damage, it is wise to learn all you can about the animal's habits. Knowing what an animal eats, where it hides and when it is active can help you in planning your strategy.

Understand wildlife laws! It is important to find out what you can and cannot do with regard to harassing, relocating, or killing any wild animal, no matter what problems or damage it may be causing. State or federal law, or both, protect the vast majority of Wisconsin wildlife, especially birds. Permits, licenses or other forms of permission may be required, and even then some actions may never be allowed for safety, legal or ethical reasons. The fines for illegal control can be substantial. Wildlife laws vary from state-to-state and even within some municipalities. If you have any doubt as to the legality of planned actions, check first with your local Wisconsin Department of Natural Resources conservation officer. Additionally, this fact sheet summarizes laws and regulations pertinent to Wisconsin -
http://wildlifedamage.uwex.edu/pdf/LawsAndRegs.pdf

Wildlife control is very different than weed or insect control. Few chemical pesticides are registered (available) for animal control and "cookbook" solutions – apply X to Y for three days and problem resolved – are rare. Thus, resolution of a problem may require trial and error and the use of several of the following tools/methods in an integrated control program. Two very important parts of an integrated wildlife damage management approach are to use randomness and diversity. Wildlife are creatures of habit and often have the same routine day after day. The more you can upset an animal's daily routine, the less likely an animal will stay in the area. You can prevent animals from feeling safe on your property by randomly employing management methods. For example, don't always use scare tactics at the same time of the day and in the same location. Instead, randomly change how, when and where scare tactics are used. Using more than one management method (diversifying your management approach), especially when using non-lethal tools such as scare tactics, will increase your chance for success in resolving a wildlife damage problem. An example would be to combine a scare tactic using noise with a visual scare tactic. Randomness and diversity reduces the possibility that an animal will become accustomed (habituate) to the method you've chosen to resolve or reduce the damage problem, thereby resolving your problem as quickly and cheaply as possible.

Management Options

EXCLUSION – KEEP THE ANIMAL OUT Examples: A fence, chimney cap, wire or wooden skirt around a deck, plastic mesh net over fruit trees or berry bushes.

REMOVAL – REMOVE THE ANIMAL FROM THE AFFECTED AREA Examples: Alive – capture and relocation via live trap, net, hand capture, etc. NOTE: Relocating live animals to property (public or private) you don't own requires the permission of the property owner upon whose land you are releasing the trapped animal. Dead (usually a last resort) – shooting, toxicants, kill-traps (like a wooden-base rat trap).

REPELLENTS – THE USE OF SUBSTANCES THAT SMELL OR TASTE BAD TO THE ANIMAL Examples: Moth balls (naphthalene) in an attic, thiram or capsaicin-based repellents on landscape plants, commercial repellents sprayed on garden plants.

SCARE TACTICS – FRIGHTEN THE ANIMAL AWAY FROM THE SITE Examples: loud noises, owl decoys, mylar or plastic streamers, "scare-eye" balloons, propane cannons, etc.

HABITAT MODIFICATION – MAKE THE AREA LESS ATTRACTIVE Examples: Remove brush piles that harbor rabbits, mow long grass used by meadow voles, eliminate nest/roost sites in buildings used by pigeons or sparrows. Be aware, however, that as you change habitat to discourage a problem animal, you may also be negatively altering habitat for beneficial wildlife.

CULTURAL CHANGES – CHANGE HUMAN BEHAVIOR Examples: use wildlife-proof trash cans, don't feed wildlife (other than backyard birds), plant gardens using plants less likely to get damaged by wildlife.

INCREASED TOLERANCE – RETHINK THE SITUATION! Examples: The action, sounds, and sights provided by the animal in question may be worth the hassle or loss. Conduct a cost-benefit analysis before implementing control.

With some good information, a little planning, and reliable techniques and equipment, you CAN solve most wildlife problems yourself. Always remember the considerations that we have previously mentioned and rely on proven techniques. Gadgets and gimmicks may seem attractive, especially as solutions for very frustrating problems, but they rarely meet expectations. Also, remember that complete elimination of a given animal population is unlikely and undesirable. Strive for "peaceful coexistence" with the wildlife that shares your space.

Additional Resources

Website that provides more in-depth information about the above and has species-specific factsheets - http://wildlifedamage.uwex.edu/

Books to help identify wildlife –

Bird Tracks and Sign by Mark Elbroch

Mammal Tracks and Sign by Mark Elbroch

Wildlife Identification Guides (Peterson, Audubon Society, Stokes, etc.)

Agency Contacts

Wisconsin Dept. of Natural Resources - https://dnr.wi.gov/topic/WildlifeHabitat/damage.html

USDA – Wildlife Services - https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_reports/sa_informational+notebook/ct_wisconsin_info

Effects of Pesticide Residue within Turfgrass Guttation Fluid on Pollinators

Audrey Simard & R. Chris Williamson PhD.

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INTRODUCTION

Turfgrass guttation fluid harbors concentrated titers of pesticide residues at a lethal dosage to pollinators. The phenomenon where plant foliage exudes droplets containing metabolites, nutrients and most importantly drinkable water can be witnessed in all types of grasses but vary in seasonal availability and quantity. Golf course irrigation practices allows for continuous and bountiful production of turfgrass guttation fluid resulting in an optimal target for pollinators to quench their thirst. Water soluble active ingredients within pesticides can be absorbed and transported systemically via the xylem. Consequently, this xylem sap is released back into the environment in concentrated titers during the guttation fluid release mechanism. We determined the bioactivity of commonly applied Demethylation Inhibitors (DMI) and Strobilurin fungicides, in addition to DMI plant growth regulators (PGRs) in turfgrass guttation fluid and identify the potential hazards they may pose to pollinators (*Apis mellifera*) and other beneficial insects. Guttation fluid was collected daily and was analyzed to quantify the titers of DMI and Strobilurin pesticides in turfgrass guttation fluid over time in putting greens and rough areas where fungicides and PGRs applications are routine. Utilizing collected guttation fluid, we determined the LD50 value of DMI and Strobilurin fungicides and a DMI PGR of European Honey Bee (*Apis mellifera*) when exposed to guttation water from turf treated with the aforementioned pesticides.

MATERIALS AND METHODS

Pesticide Applications and Guttation Fluid Collection

This study is conducted at the O.J. Noer Turfgrass Research and Education Facility in Verona, WI. The experiment consists of two turfgrasses species; Kentucky bluegrass (KBG) and creeping bentgrass (CBG).

Plot schematics are consistent among both grass types, measuring 3x5 feet with 1-foot alleys arrayed in a randomized block design with a total 3 replicates per treatment. Application rates for Banner Maxx (propiconazole) and Heritage TL (azoxystrobin) 2fl oz/1000ft^2 for both KBG and CBG, Tide Paclo (paclobutrazol) 32 fl oz/a KBG and 16 fl oz/a CBG. Two total applications will be made for the study, an early season (June) and a late season (August) in the same plots.

Guttation fluid will be sampled in the morning when guttation is most prevalent (approximately 5:30 AM–7:00 AM CST) at 1- 14 and 21 days after treatment (DAT). Optimal guttation fluid production in KBG and CBG +90% humidity within the temperature range of 60-72 °F or 15-23 °C, any rain or mist during sample collection dilutes the turfgrass guttation fluid resulting in inaccurate data. Using 1000mL pipette tips individual guttation fluid droplets accumulate within the pipette tip via hydrogen bond molecular interactions. Collection time intervals are 2 minutes per plot resulting in minimum of 1.5mL guttation fluid. Analysis of the extracts by liquid chromatography separation interfaced via electrospray ionization to a tandem mass selective detection system (LC-MS/MS) at 1 ppb level of detection. Prior to analysis, authenticated standards of each fungicide, and plant growth regulators provided by Quali-Pro, Syngenta Crop Protection, and Nufarm USA, will be used to create calibration curves. Isotopically labeled internal standards were included in all samples, and we will also extract and analyze blanks as well as spiked field samples.

Effects of Fungicide on Pollinators

Two separate trials will be conducted using honey bees, they will be fed droplets of the guttation fluid collected for the residue analyses. Petri dishes (6.5 cm x 1.5 cm) with no substrate will be provisioned with 3 droplets (5 mL each) of guttation fluid 1 cm apart in a triangular array. A cohort of 3-5 honey bee adults will be added to each Petri dish, will be covered with Parafilm to prevent escape. In addition, to exudates from insecticides, fungicides and a plant growth regulator, guttation fluid from each treated or non-treated plots harvested before or after mowing will be included in each trial. The experimental treatment (application-ready propiconazole, azoxystrobin and paclobutrazol) to confirm droplet-feeding by the honey bees and activity of the fungicides plant growth regulators and as a control treatment (honey water) to mitigate possible food depravation and honey bee survival. The dishes with honey bees and guttation droplets will be placed in a growth chamber (Percival Scientific) set at 25 °C in 24hr darkness. Effects on the honey bees will be evaluated after 24 hours by counting the numbers of individuals in each replicate that are alive and mobile, as opposed to moribund (twitching, unable to move/walk) or dead. All honeybees used for the feeding trials are from the O.J. Noer research colony, established in 2018.

RESULTS

This project is still in its data collection phase, the early season application was conducted, and guttation fluid was collected was successful. Analysis of fungicides and PGR residues within both CBG and KBG will be processed in the near future.

Post Emergent Crabgrass Control and Broadleaf Herbicide Demonstrations

Nick Bero and Doug Soldat
Department of Soil Science
University of Wisconsin-Madison

INTRODUCTION

Undesired plants in a managed turfgrass setting are potential issues for lawn aesthetic and use. Therefore, we present two demonstrations utilizing multiple herbicides with varying chemical composition made for the control of common weeds in a home lawn and golf course fairway settings.

MATERIALS AND METHODS (CRABGRASS)

This field study was conducted at the O.J. Noer Turfgrass research facility on a fescue fairway plot mowed at 0.5 inches planted into a Bativa silt loam. Three replications of six treatments, which consisted of five herbicides with different active ingredients along with a non-treated control, were applied to plots measuring 4 feet wide × 6 feet long in a randomized complete block design. Treatments were applied on 3 July 2018 by CO_2 powered backpack sprayer at a rate of 2 gal/M. Herbicides used were Eject 75DF (quinclorac 75.0%), Onetime (Quinclorac 15.95%, mecoprop 7.98%, and dicamba 2.13%), LastCall (fenoxaprop-p 2.70%, Fluroxypyr 3.89%, and dicamba 2.70%), Q4 (quinclorac 5.69%, sulfentrazone 0.69%, 2,4 D 12.02%, and dicamba 1.38%), and Tenacity (Mesotrione 40.0%). Data were collected by visual inspection of percent living crabgrass, percent weed injury, and percent turf injury on a weekly basis. Data were analyzed by analysis of variance using the JMP 12 statistical software program (SAS Institute Inc., Cary, N.C.). Treatment differences were assessed at the $\alpha = 0.05$ level.

Table 1. Treatments and application rates for the products used in the trial.

Treatment	Rate	Application
Eject 75DF	4 pt ac^{-1}	3 July
OneTime	4 pt ac^{-1}	3 July
LastCall	4 pt ac^{-1}	3 July
Q4	8 pt ac^{-1}	3 July
Tenacity	5 oz ac^{-1}	3 July

RESULTS

Q4 had the greatest effect on visual crabgrass % cover, % control, and weed injury, though not statistically different than Eject 75DF, OneTime, or Last Call. This did come at a cost as Q4 also had significantly greater turf injury which continued through the second week after application. Tenacity, had the least effect on weed injury, and by the second week after application had more return of crabgrass and lesser control.

Table 2. Average Crabgrass visual estimate of plot area, weed and turf injury, and crabgrass control over the course of the data collection period. Different letters indicate statistically significant differences (p = 0.05).

Treatment	Crabgrass	Weed Injury	Turf Injury	Crab Control
	%	1-9, 9 is death		%
Eject 75	0.7bc	5.0 a	1.5 cd	96.4 a
OneTime	0.5 bc	5.7 a	2.2 bcd	97.3 a
Last Call	1.0 bc	5.0 a	2.8 b	94.2 ab
Q4	0.2 c	4.8 a	4.3 a	99.1 a
Tenacity	2.8 b	4.8 a	2.5 bc	84.5 b
Control	15.8 a	1.0 b	1.0 d	n/a

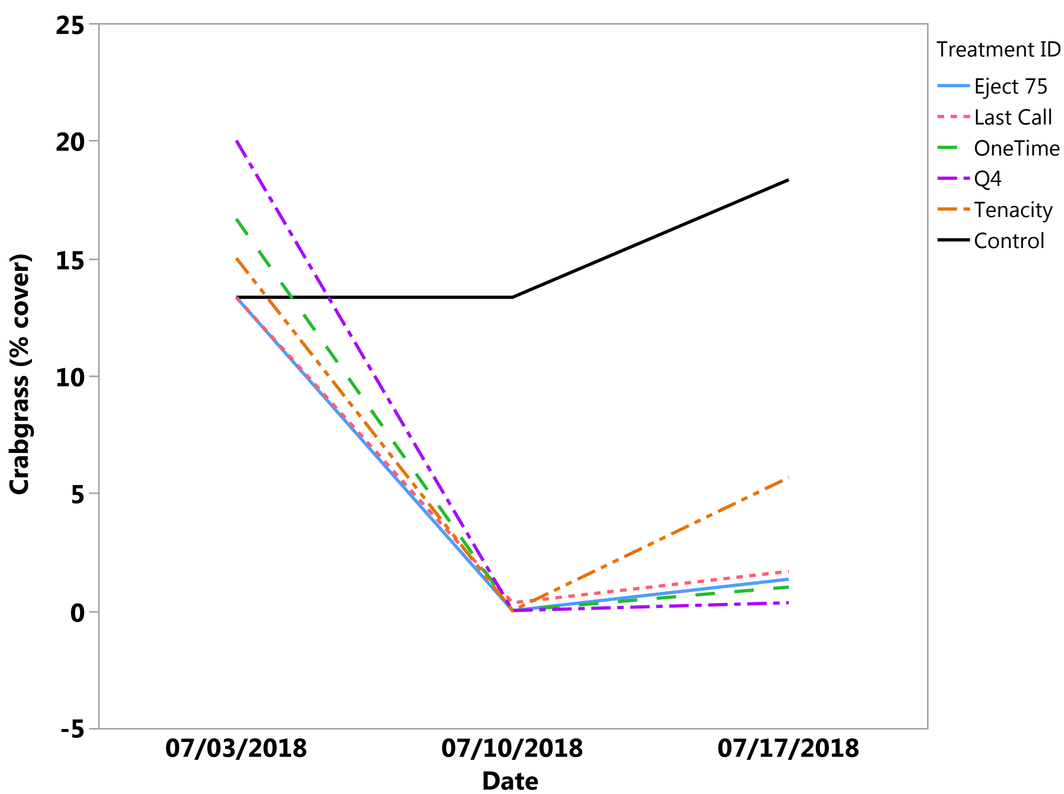


Figure 1. Visual estimate of percent crabgrass cover by date

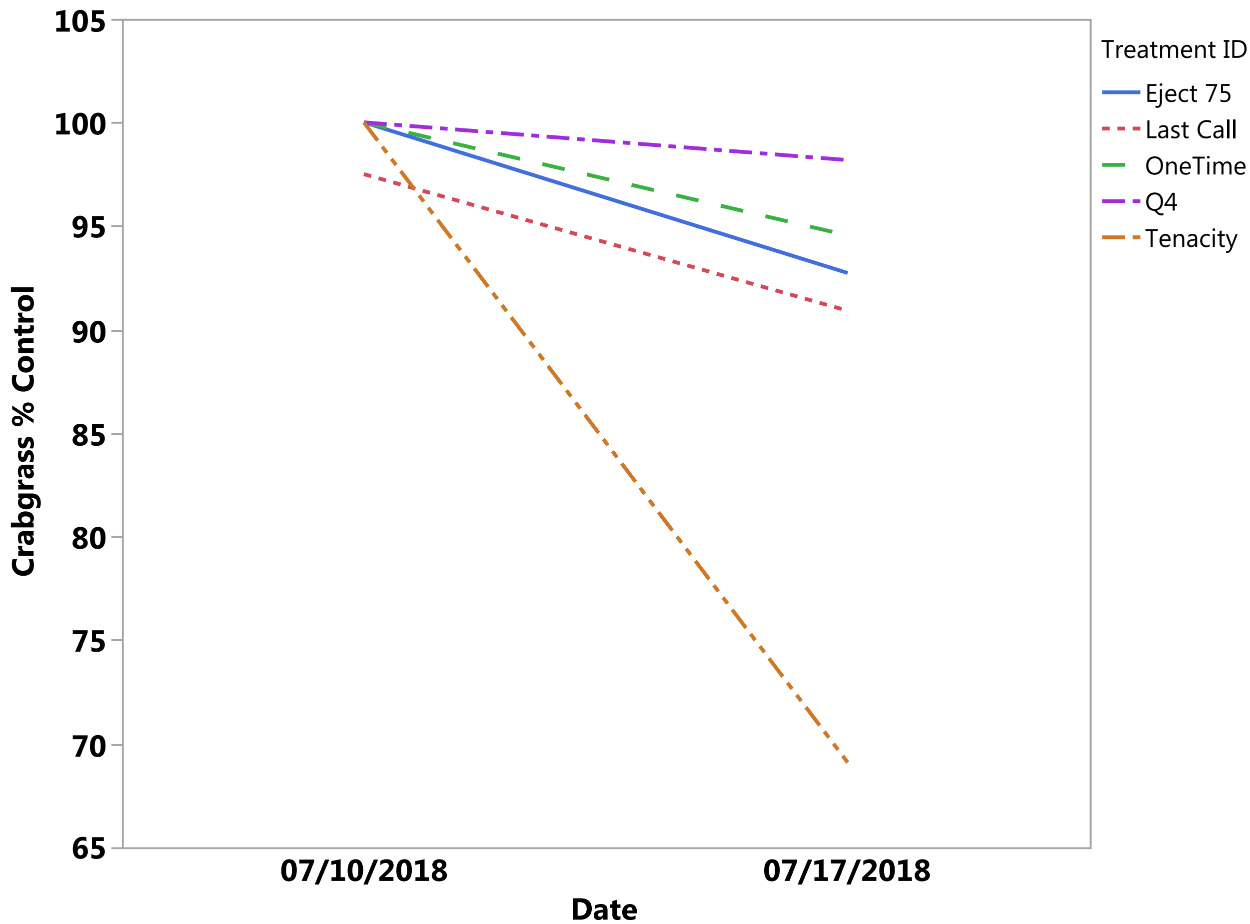


Figure 2. Crabgrass control as compared with untreated plots by date.

MATERIALS AND METHODS (BROADLEAF)

This study was conducted at the O.J. Noer Turfgrass Facility in Madison, WI to evaluate the efficacy of GameOn control on common broadleaf weeds. The study was designed as a randomized complete block design with six treatments and four replications. Individual plots measured 6 x 4 feet. The study site was on a Kentucky bluegrass lawn (2.5 inch mowing height) dominated by dandelion and clover. The treatments were designed to evaluate different rates of GameOn against label rates of Rezlar + Agri-Dex Crop Oil concentrate, Triplet SF and Speedzone herbicides. Treatments were applied using a CO_2-powered backpack sprayer calibrated to deliver 43 gallons per acre. Applications were made on 16 May 2018 at peak dandelion bloom. Injury to weeds and turf was assessed at one and two weeks after application while percent plot cover by individual broadleaf weeds was evaluated four, six, and eight weeks after application. Percent control relative to the non-treated plots was calculated from these data. Treatment means were separated using Fisher's Least Significant Difference at alpha = 0.05.

Table 3. Treatments and application rates for the products used in the trial.

Treatment Description	Rate	Application Date
	pt pr ac^{-1}	
GameOn: 2,4 D, fluroxypyr, & halauxifen	3.0	16 May
GameOn: 2,4 D, fluroxypyr, & halauxifen	3.5	16 May
GameOn: 2,4 D, fluroxypyr, & halauxifen	4.0	16 May
Relzar + Agri-Dex COC: Arylex and florasulam	0.72 (oz dry pr ac^{-1})	16 May
Triplet SF: 2,4 D, Mecoprop-p, Dicamba	3.5	16 May
Speedzone: Carfentrazone ethyl, 2,4 D, Mecoprop-p, Dicamba	4.0	16 May
Untreated Control	n/a	n/a

RESULTS

GameOn at all rates, TripletSF, and Speedzone had the greatest and similar dandelion and total control during the study period. GameOn at the 4.0 pt pr ac^{-1} had the greatest clover control but was statistically similar to GameOn at 3.0 and 3.5 pt pr ac^{-1}, Relzar + Agri-Dex, and Triplet. The Relzar and Agri-Dex treatment saw some return of dandelion and had the least dandelion control.

Table 4. Visual estimate of average percent weed cover and weed and turf injury during the study. Different letters indicate statistically significant differences (p = 0.05)

Treatment	Application Rate	Dandelion	Clover	Total Cover	Weed Injury	Turf Injury
	pt pr ac^{-1}	-------- percent weed cover ----------			1-9, 1 is no injury, 9 is death	
GameOn	3.0	0.6 c	1.6 b	2.2 b	5.8 a	0
GameOn	3.5	0.5 c	0.9 b	1.4 b	6.3 a	0
GameOn	4.0	0.4 c	0.4 b	0.8 b	6.3 a	0
Relzar + Agri-Dex	0.72 (oz pr ac^{-1})	2.6 b	0.9 b	3.5 b	6.1 a	0
Triplet SF	3.5	0.8 bc	0.8 b	1.7 b	5.6 a	0
Speedzone	4.0	0.3 c	1.7 b	1.9 b	6.1 a	0
Untreated	N/A	10.8 a	57.9 a	68.8 a	0.0 b	0

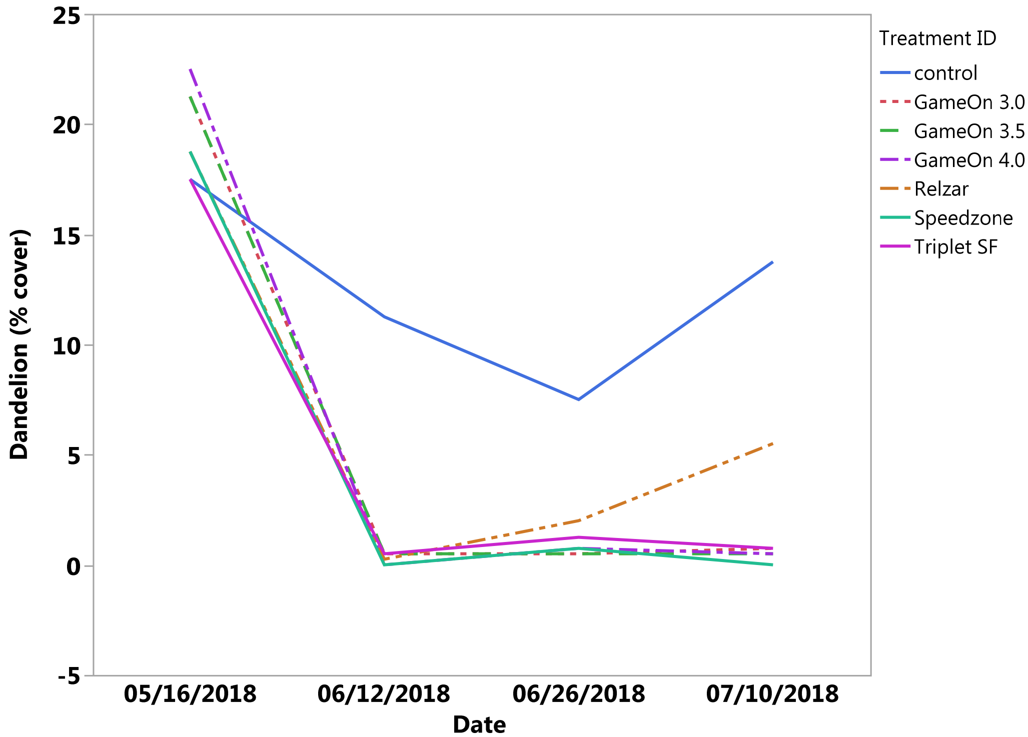


Figure 3. Visual estimate of percent dandelion cover during the first four rating dates.

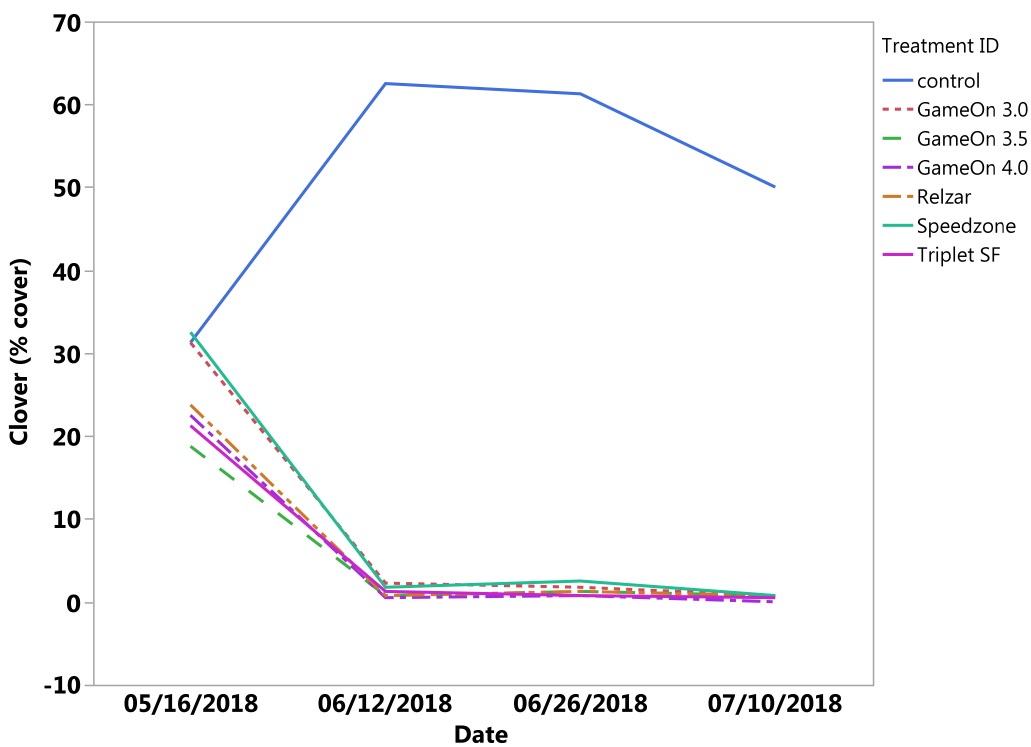


Figure 4. Visual estimate of percent clover cover during the first four rating dates.

Table 5. Visual estimate of average percent weed control during the study. Different letters indicate statistically significant differences (p = 0.05)

#	Treatment	Application Rate	Dandelion	Clover	Total Control
		pt pr ac^{-1}	---------- percent weed control ------------		
1	GameOn	3.0	94.5 a	97.3 b	96.9 a
2	GameOn	3.5	95.1 a	98.4 ab	97.9 a
3	GameOn	4.0	95.5 a	99.3 a	98.8 a
4	Relzar + Agri-Dex	0.72 (oz pr ac^{-1})	77.0 b	98.4 ab	94.7 b
5	Triplet SF	3.5	91.1 a	98.6 ab	97.6 a
6	Speedzone	4.0	96.7 a	97.2 b	97.2 a

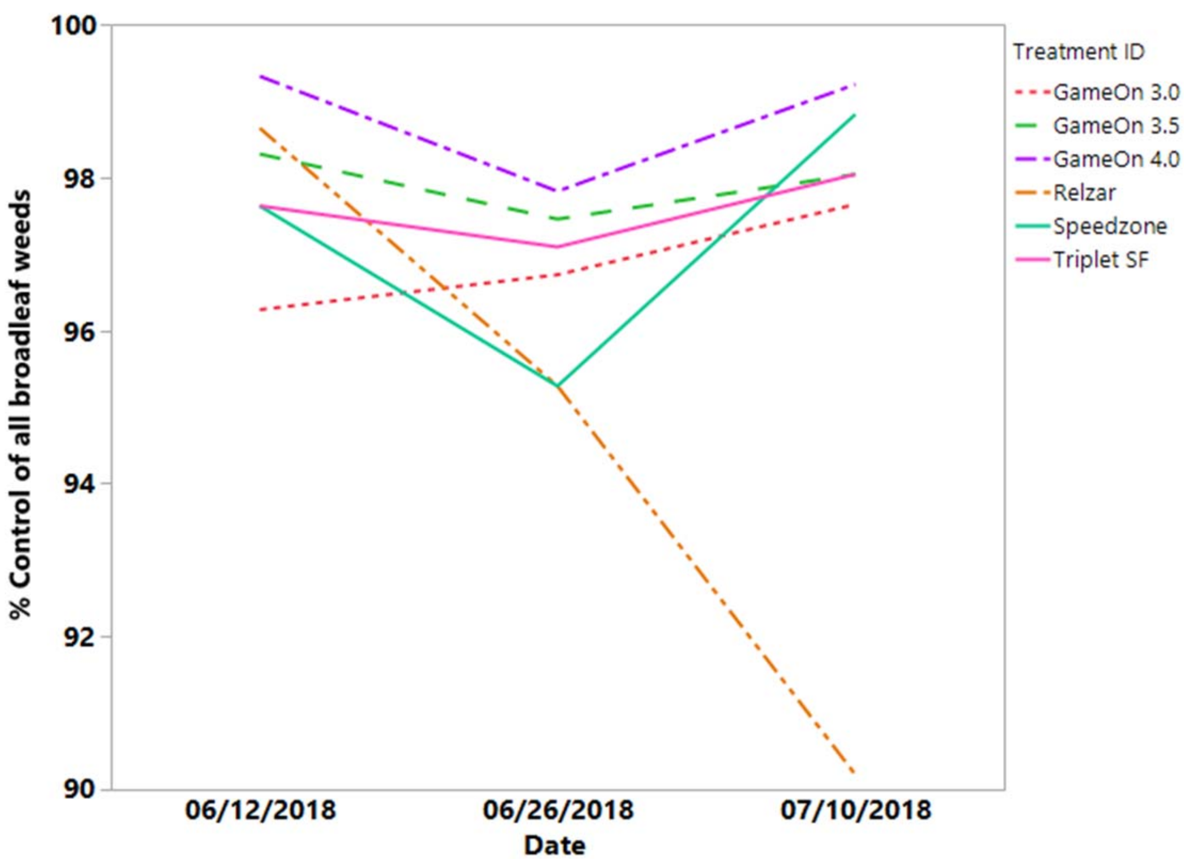


Figure 5. Total control of all broadleaf weeds by date.

Alliance for Low Input Sustainable Turf (A-LIST) Kentucky Bluegrass Evaluation

Doug Soldat and Nick Berol
Department of Soil Science
University of Wisconsin-Madison

OBJECTIVE

To evaluate suitability of Kentucky bluegrass cultivars for use in Wisconsin.

MATERIALS AND METHODS

Twenty-three Kentucky bluegrass cultivars from four different seed companies (listed below) were planted on Sept 12, 2017. The grasses are being evaluated for establishment speed, NDRE, and visual quality using standard methods. The grasses are mowed as needed at 2.25 inches, irrigated, and fertilized at approximately 2 lbs N/1000 square feet per year.

Member	#	Variety
Lebanon	1	Bordeaux
	2	Zinfandel
	3	Champagne
	4	Merlot
	5	LTP-11-41
Landmark	6	Hampton
	7	Bluebank
	8	Fullback
	9	A12-7
	10	NAI-13-14
	11	A11-40
Mtn View	12	A12-34
	13	A11-38
	14	MVS-130
	15	PPG-KB 1320
	16	LEGEND
	17	PPG-KB 1131
DLF PICKSEED	18	SRX 2758
	19	SR 2150 (SRX 5321)
	20	JACKRABBIT
	21	SRX 466
	22	KEENLAND
	23	MARTHA (A06-46)

RESULTS

Establishment rate data have not yet been analyzed. Grasses have demonstrated statistically similar NDRE values.

The grasses with the best quality (having an “A” in the statistical analysis) are listed below. Please note that these ratings have been recorded during establishment, so may be biased towards grasses with a good establishment rate. Results may change as time goes on.

Table 2. Average visual quality scores for the top statistical group of grasses, which accounted for the top 25%.

Grass	Visual Quality (1-9)
Hampton	5.75 A
Fullback	5.69 AB
Jackrabbit	5.69 AB
A11-40	5.38 ABC
LTP-11-41	5.38 ABC
Legend	5.13 ABCD
A12-7	5.00 ABCDE
Merlot	5.00 ABCDE

Organic Lawn Control Options

Doug Soldat[1], Nick Bero[1], Paul Koch[1], and Bruce Branham[2]
[1]University of Wisconsin-Madison
[2]University of Illinois

OBJECTIVE

To evaluate the ability of several organic or alternative herbicides for dandelion and clover control in Wisconsin lawns.

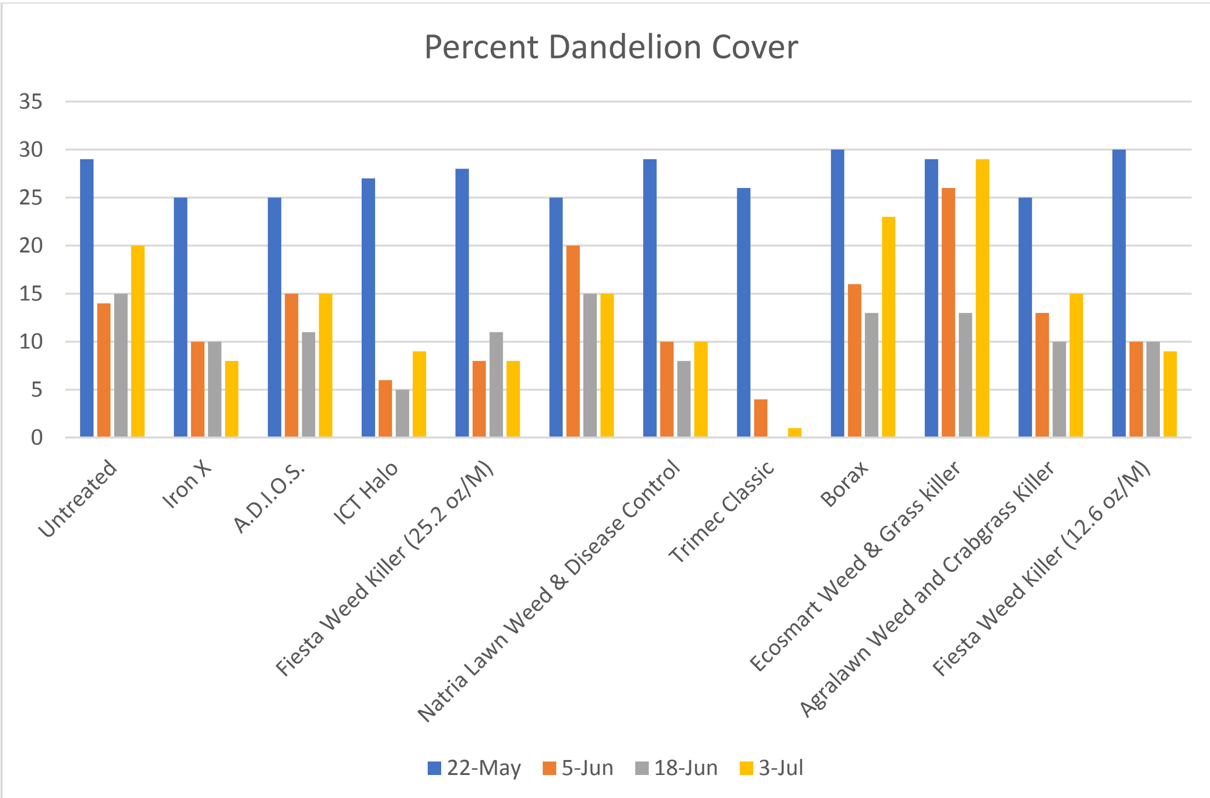
MATERIALS AND METHODS

Weed control products listed in Table 1 below were applied on May 22, and again on June 18, except for Trimec which was applied on May 22 only.

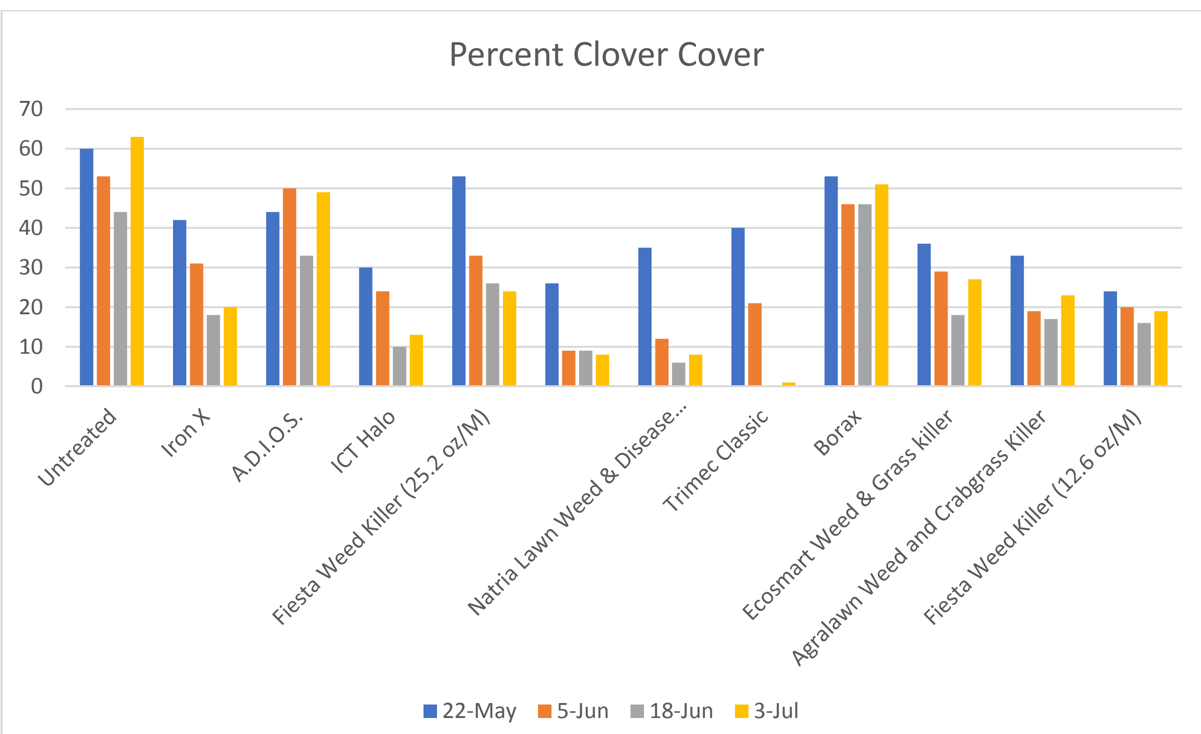
Table 1. List of products tested

Product	Active Ingredient	Application Type	Product Rate	Spray Volume
Untreated Check	--------	--------	--------	
Iron X	26.52% Iron HEDTA	Broadcast Spray	25.2 oz/M	240 GPA
A.D.I.O.S.	Sodium chloride + NIS	Broadcast Spray¶	1 lb pr + 0.25% v/v	240 GPA
ICT Halo	Eugenol, Clove Oil	Broadcast Spray	10 oz Halo/M	87 GPA
Fiesta Weed Killer	26.52% Iron HEDTA	Broadcast Spray	25.2 fl oz/M	240 GPA
Fiesta Weed Killer + Xiameter OFX-0309	26.52% Iron HEDTA + Silicon Adjuvant	Broadcast Spray	12.6 oz pr/M + 0.1% v/v	240 GPA
Natria Lawn Weed and Disease Control	26.52% Iron HEDTA	Broadcast Spray	25.2 fl oz/M	240 GPA
Trimec Classic	2,4-D	Broadcast Spray	4 pts/A	87 GPA
Borax	Boric Acid	Spot Spray†	Spray to runoff	
EcoSmart Weed & Grass Killer	Rosemary Oil	Spot Spray	Spray to runoff	
AgraLawn Weed and Crab Killer	Cinnamon	Spot Shake	Shake onto wet foliage.	
Fiesta Weed Killer	26.52% Iron HEDTA	Broadcast Spray	12.6 fl oz/M	240 GPA

RESULTS



Percent Dandelion Cover
35
30
25
20
15
10
5
0
Untreated
Iron X
A.D.I.O.S.
ICT Halo
Fiesta Weed Killer (25.2 oz/M)
Natria Lawn Weed & Disease Control
Trimec Classic
Borax
Ecosmart Weed & Grass killer
Agralawn Weed and Crabgrass Killer
Fiesta Weed Killer (12.6 oz/M)
22-May
5-Jun
18-Jun
3-Jul



Percent Clover Cover
70
60
50
40
30
20
10
0
Untreated
Iron X
A.D.I.O.S.
ICT Halo
Fiesta Weed Killer (25.2 oz/M)
Natria Lawn Weed & Disease...
Trimec Classic
Borax
Ecosmart Weed & Grass killer
Agralawn Weed and Crabgrass Killer
Fiesta Weed Killer (12.6 oz/M)
22-May
5-Jun
18-Jun
3-Jul

Nitrogen Rate and Golf Foot Traffic Affects Creeping Bentgrass Growth

Qiyu (Ada) Zhou and Doug Soldat, Ph.D.
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University of Wisconsin-Madsion

OBJECTIVE

To assess the effect of different levels of foot traffic and nitrogen rate on clipping yield and performance of a bentgrass putting green.

MATERIALS AND METHODS

This study was conducted at the O. J. Noer Turfgrass Research and Education Facility on two creeping bentgrass putting greens mowed at a height of 0.125 inches. Turfgrass was a 7-year-old stand of 'focus' creeping bentgrass. The experiment was a completely randomized design with three nitrogen rates (0, 0.2, and 0.4 lbs of N/1000 sqft every other week) and three traffic levels (0, 1100, and 2200 steps per week). The traffic was designed to approximate the traffic around the hole on a golf course with 400 (1100 steps) or 800 (2200 steps) round per week. Each treatment combination was applied to 4 feet by 8 feet plot and was replicated three times on two separate root zones. Urea was used as the nitrogen source and was applied at a nozzle pressure of 40 psi using a pressurized boom sprayer equipped with two XR Teejet 8004 VS nozzles. Urea was first applied on May 22 and and subsequent nitrogen treatments were applied every two weeks. Traffic was applied by five humans walking on the plots with golf shoes. Clippings were collected three times a week starting from May 22 with green area of 10.9 ft^2 using Toro 1000 mower. Turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) and color (NDRE index: sensitive to chlorophyll content in grass) were assessed the weeks opposite the urea applications.

RESULTS AND DISCUSSION

Table 1 shows the preliminary results from Jun 14 to July 12. In terms of creeping bentgrass at putting green height, clipping yield is correlated with turfgrass quality; generally, higher clipping yield results in higher turfgrass quality. Some combinations of nitrogen rates and human traffic levels have significant differences in clipping yield and turfgrass performance. The plots treated with the high traffic and high nitrogen rate resulted in the greatest clipping yield, darkest green color and highest turf quality. The plots received no nitrogen and some traffic had the least clipping had the opposite results. However, the plots that received no nitrogen and no traffic had the similar performance and clipping yield with the plots received high nitrogen rate and high traffic, and were similar to the low nitrogen rate and low traffic treatments. These results suggest that clipping yield could be useful for predicting the amount of nitrogen to add, or even if a growth regulator is required.

Table 1. Mean clipping yield and performance of 'Focus' creeping bentgrass ass affected by nitrogen and traffic at putting green height at the O. J. Noer Turfgrass Research and Education Facility from Jun 14 to July 14, 2018.

N rate	Footwear Traffic	Clippings	Color (NDRE)	Quality
lbs/1000ft^2	Steps/week	g		
0.4	0	3.53 a	0.272 a	5.75 a
0.4	1100	3.19 ab	0.236 b	4.92 b
0.2	0	3.18 ab	0.24 b	5.11 b
0	0	2.65 abc	0.216 c	4.25 c
0.4	2200	2.57 abc	0.218 c	4.28 c
0.2	1100	2.31 abc	0.216 c	4.28 c
0.2	2200	2.19 bc	0.209 c	3.83 cd
0	1100	1.95 c	0.209 c	3.94 cd
0	2200	1.84 c	0.204 c	3.56 cd

Biopesticides for the Control of Dollar Spot on Putting Greens

Emma Buczkowski, Kurt Hockemeyer, and Paul Koch, Ph.D
Department of Plant Pathology
University of Wisconsin – Madison

OBJECTIVES

Determine efficacy of multiple biofungicides for their efficacy against dollar spot (*Sclerotinia homeocarpa)* and impact on turf quality on a golf course putting green.

MATERIALS AND METHODS

This study is being conducted at the O.J. Noer Turfgrass Research and Education Facility in Madison, WI. The putting green stand is composed of creeping bentgrass (*Agrostis stolonifera* 'Penncross') and is maintained at a height of 0.125 inches. There are 10 individual 3 ft by 5 ft plots per replicate organized in a randomized block design with four replicates. Emerald is a synthetic fungicide and was included as a positive control. These treatments are applied using a CO_2 pressurized boom sprayer with two XR Teejet AI8004 nozzles at a pressure of 40 psi. All biopesticides are agitated by hand and applied at 1.5 gallons of water per 1000 ft^2. The initial treatment application was done on May 23rd, 2018 and all following applications were either made at 14 or 28 day intervals. There will be a total of 7 applications done for this study with 4 currently completed. Number of dollar spot infection centers, chlorophyll content, and turfgrass quality (1-9 scale, 9=excellent and 6=acceptable) measurements were taken immediately prior to biopesticide applications. The taken measurements were subjected to an analysis of variance and means separation test using Fisher's LSD (P=0.05). Results can be found in tables 1, 2, and 3 below.

RESULTS AND DISCUSSION

Disease data shows a movement toward two distinct levels of control: high (a) and low (c). Timorex gold treated plots have the highest amount of disease and Emerald treated plots have the least amount of disease. The other treatments are moving toward these extremes but are still considered to be close to the middle (ab/abc/bc). This may be due to flooding of the plot earlier in the summer on 6/15/18 and 6/26/18, killing or temporarily inhibiting *Sclerotinia homeocarpa* growth. It is predicted that as this study progresses treatments will move to either high or low disease presence with little to no treatments in the middle. The turfgrass quality data is very similar to the dollar spot infection centers data on the July 3rd date. For the first two dates the turfgrass quality is statistically the same for all plots. On July 3rd there is separation and Emerald-treated plots have the highest turfgrass quality (a) and Timorex gold and Double Nickel LC-treated plots have the lowest turfgrass quality (b). The biopesticide treatments are not independently effective in controlling dollar spot but some treatments, like Civitas Pre-M1xed and Zio, could be used in a tank mix or replace a couple conventional fungicide sprays during the growing season.

Table 1. Mean dollar spot infection centers per trt on creeping bentgrass maintained at putting green height at the OJ Noer Turf Research Facility in Madison, WI during 2018.

	Treatment	Application Rate	App Interval	App Dates[b]	Dollar Spot Infection Centers[a]		
					June 6	June 20	July 3
1	Non-treated control	N/A	N/A		5.3 bc	5.8 ab	39.0 ab
2	Emerald	0.18 oz/1000 ft^2	28 Day	DHL	0.8 c	0.8 b	0.3 c
3	Nortica	(1[st]) 12.9 oz/1000 ft^2 (rest) 6.4 oz/1000 ft^2	28 Day	DHL	6.5 bc	4.0 ab	20.5 bc
4	Timorex gold	0.314 fl oz/1000 ft^2	14 Day	DFHJL	18.3 a	12.8 a	56.3 a
5	Double Nickel LC	4 fl oz/1000 ft^2	14 Day	DFHJL	9.5 abc	4.3 ab	38.8 ab
6	Rhapsody	10 fl oz/1000 ft^2	14 Day	DFHJL	12.8 ab	3.3 b	28.0 abc
7	Civitas Pre-M1xed	8 fl oz/1000 ft^2	14 Day	DFHJL	5.0 bc	0.8 b	16.0 bc
8	Actinovate AG Revolution	0.275 oz/1000 ft^2 6 fl oz/1000 ft^2	14 Day	DFHJL DHLP	6.0 bc	4.5 ab	26.0 abc
9	Zio	1.84 oz/1000 ft^2	14 Day	DFHJL	3.0 bc	2.3 b	22.3 bc
10	Serenade OPTI	0.459 oz/1000 ft^2	14 Day	DFHJL	5.8 bc	9.3 ab	37.8 ab

[a]Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application dates: D=5/23, F=6/6, H=6/20, J=7/3

Table 2. Mean chlorophyll content per trt on creeping bentgrass maintained at putting green height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2018.

	Treatment	Application Rate	App Interval	App Dates[b]	Chlorophyll Content[a]		
					June 6	June 20	July 3
1	Non-treated control	N/A	N/A	N/A	233.3 ab	340.3 a	236.8 a
2	Emerald	0.18 oz/1000 ft^2	28 Day	DHL	228.5 ab	333.5 a	243.3 a
3	Nortica	(1[st]) 12.9 oz/1000 ft^2 (rest) 6.4 oz/1000 ft^2	28 Day	D HL	240.5 a	341.5 a	235.3 ab
4	Timorex gold	0.314 fl oz/1000 ft^2	14 Day	DFHJL	224.3 ab	331.0 a	235.3 ab
5	Double Nickel LC	4 fl oz/1000 ft^2	14 Day	DFHJL	230.5 ab	328.3 a	230.8 ab
6	Rhapsody	10 fl oz/1000 ft^2	14 Day	DFHJL	229.5 ab	336.8 a	222.8 ab
7	Civitas Pre-M1xed	8 fl oz/1000 ft^2	14 Day	DFHJL	231.8 ab	341.0 a	227.8 ab
8	Actinovate AG Revolution	0.275 oz/1000 ft^2 6 fl oz/1000 ft^2	14 Day	DFHJL DHLP	219.3 b	310.5 a	215.5 b
9	Zio	1.84 oz/1000 ft^2	14 Day	DFHJL	225.8 ab	323.0 a	228.8 ab
10	Serenade OPTI	0.459 oz/1000 ft^2	14 Day	DFHJL	223.5 ab	326.5 a	226.8 ab

[a]Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application dates: D=5/23, F=6/6, H=6/20, J=7/3

Table 3. Mean turfgrass quality per trt on creeping bentgrass maintained at putting green height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2018.

	Treatment	Application Rate	App Interval	App Dates[b]	Turfgrass Quality[a]		
					June 6	June 20	July 3
1	Non-treated control	N/A	N/A	N/A	7.0 a	8.0 a	7.3 ab
2	Emerald	0.18 oz/1000 ft^2	28 Day	DHL	7.3 a	8.0 a	8.0 a
3	Nortica	(1st) 12.9 oz/1000 ft^2 (rest) 6.4 oz/1000 ft^2	28 Day	D HL	7.3 a	7.8 a	7.5 ab
4	Timorex gold	0.314 fl oz/1000 ft^2	14 Day	DFHJL	7.0 a	7.8 a	6.8 b
5	Double Nickel LC	4 fl oz/1000 ft^2	14 Day	DFHJL	6.5 a	7.8 a	6.8 b
6	Rhapsody	10 fl oz/1000 ft^2	14 Day	DFHJL	6.8 a	7.5 a	7.3 ab
7	Civitas Pre-M1xed	8 fl oz/1000 ft^2	14 Day	DFHJL	7.3 a	7.5 a	7.8 ab
8	Actinovate AG Revolution	0.275 oz/1000 ft^2 6 fl oz/1000 ft^2	14 Day	DFHJL DHLP	6.8 a	7.8 a	7.5 ab
9	Zio	1.837 oz/1000 ft^2	14 Day	DFHJL	6.8 a	8.0 a	7.5 ab
10	Serenade OPTI	0.459 oz/1000 ft^2	14 Day	DFHJLNP	6.8 a	7.8 a	7.3 ab

[a]Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application dates: D=5/23, F=6/6, H=6/20, J=7/3

Common Ground Initiative

Shane Sommers, Kurt Hockemeyer, and Paul Koch, Ph.D.
University of Wisconsin - Madison
Department of Plant Pathology

OBJECTIVE

To evaluate different fungicide programs based off of the statewide average pesticide usage.

MATERIALS AND METHODS

The study was conducted at the O.J. Noer Turfgrass Research and Education Facility in Madison, WI. The study was conducted on creeping bentgrass (*Agrostis stolonifera* 'Pencross') maintained at a 0.5 inch cutting height. The individual plots measured 6 ft X 10 ft and were arranged in a randomized complete block design with four replications. Individual treatments were applied at a nozzle pressure of 40 p.s.i using a CO_2 pressurized boom sprayer equipped with XR Teejet AI8004 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 1.5 gallons of water per 1000 ft^2. Four fungicide programs were tested in addition to the non-treated control. One was 100% of the statewide average pesticide usage, the others were 75%, 50%, and 25% of the first treatment. Number of dollar spot infection centers per plot, turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) were assessed every two weeks. Results were subjected to an analysis of variance and means were separated using Fisher's LSD ($P = 0.05$). Disease severity and turfgrass quality from each location can be found in the following tables.

RESULTS AND DISCUSSION

Dollar spot pressure has been low so far this season with non-treated controls averaging less than one dollar spot foci per plot on all rating dates. No statistical differences have been observed among any of the treatments so far this season.

Table 1. Hazard quotient and cost of all four fungicide programs.

Program	Hazard Quotient	Cost/Acre	Cost/30 Acres
100%	28,650	$1,750	$52,000
75%	21,820	$1,600	$48,000
50%	13,784	$1,300	$39,000
25%	6,465	$1,300	$39,000

Table 1. Mean number of dollar spot infection centers per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI in 2018.

		Treatment	Rate	Application Date	Dollar spot severity[a]	
					Jun 14	**Jun 29**
1		Non-treated control			0.3 -	0.8 -
2	25 % of State average	Xzemplar Banner Maxx Velista Secure	0.26 fl oz/1000 ft2 2 fl oz/1000 ft2 0.5 oz/1000 ft2 0.5 fl oz/1000 ft2	May 17 June 14 June 28 Jul 10	0.3 -	0.0 -
3	50 % of State average	Xzemplar Secure Secure Secure	0.26 fl oz/1000 ft2 0.5 fl oz/1000 ft2 0.5 fl oz/1000 ft2 0.5 fl oz/1000 ft2	May 17 July 5 June 28 Jul 10	0.0 -	0.0 -
4	75 % of State average	Secure Xzemplar Banner Maxx Heritage TL	0.5 fl oz/1000 ft2 0.26 fl oz/1000 ft2 1 fl oz/1000 ft2 1 fl oz/1000 ft2	May 17 June 14 July 3 July 3	0.0 -	0.0 -
5	100 % of State average	Banner Maxx Banner Maxx 26 GT Renown	2 fl oz/1000 ft2 1 fl oz/1000 ft2 4 fl oz/1000 ft2 3.53 fl oz/1000 ft2	May 17 May 31 June 14 July 3	0.0 -	0.0 -

[a]Dollar spot was visually assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 2. Mean turf quality ratings per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI in 2018.

		Treatment	Rate	Application Date/Interval	Turf Quality[a]	
					May 30	Jun 14
1		Non-treated control			7.0 -	7.0 -
2	25 % of State average	Xzemplar Banner Maxx Velista Secure	0.26 fl oz/1000 ft2 2 fl oz/1000 ft2 0.5 oz/1000 ft2 0.5 fl oz/1000 ft2	May 17 June 14 June 28 Jul 10	7.0 -	7.0 -
3	50 % of State average	Xzemplar Secure Secure Secure	0.26 fl oz/1000 ft2 0.5 fl oz/1000 ft2 0.5 fl oz/1000 ft2 0.5 fl oz/1000 ft2	May 17 July 5 June 28 Jul 10	7.0 -	7.0 -
4	75 % of State average	Secure Xzemplar Banner Maxx Heritage TL	0.5 fl oz/1000 ft2 0.26 fl oz/1000 ft2 1 fl oz/1000 ft2 1 fl oz/1000 ft2	May 17 June 14 July 3 July 3	7.0 -	7.0 -
5	100 % of State average	Banner Maxx Banner Maxx 26 GT Renown	2 fl oz/1000 ft2 1 fl oz/1000 ft2 4 fl oz/1000 ft2 3.53 fl oz/1000 ft2	May 17 May 31 June 14 July 3	7.0 -	7.0 -

[a]Turfgrass quality was visually assessed on 1-9 scale, with 9 being excellent, 6 being acceptable, and 1 bare dirt. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Iron Sulfate and Urea Interactions for Dollar Spot Control

Shane Sommers[1], Kurt Hockemeyer[1], Doug Soldat[2], Ph.D. and Paul Koch[1], Ph.D.
[1]Department of Plant Pathology
[2]Department of Soil Science
University of Wisconsin - Madison

OBJECTIVE

To determine how applications of iron sulfate interact with applications of urea for controlling dollar spot caused by the fungus *Sclerotinia homoeocarpa* on fairway-height creeping bentgrass.

MATERIALS AND METHODS

The study was conducted at the O. J. Noer Turfgrass Research and Education Facility on a stand of creeping bentgrass (*Agrostis stolonifera*) maintained at 0.5 inches. Individual plots measured 3 feet by 10 feet and were arranged in a randomized complete block design with four replications. Treatments were applied at a nozzle pressure of 40 psi using a CO_2 pressurized boom sprayer equipped with two XR Teejet 8004 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 1.5 gallons of water per 1000 ft^2. All treatments were initiated on May 17th and subsequent applications were made at 7, 14, 28, or 42-day intervals. Number of dollar spot foci per plot and turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) were visually assessed every 2 weeks. Turf quality and disease severity were subjected to an analysis of variance and means separated using Fisher's LSD ($P = 0.05$). Results of disease severity and turfgrass quality ratings can be found in table 1 and 2, respectively.

RESULTS AND DISCUSSION

Dollar spot pressure has been moderate so far this season with non-treated controls averaging 25.5 and 34.3 dollar spot infections centers per plot. Treatments containing the fungicide standard have significantly reduced dollar spot severity except where the application interval was stretched to 42 days. All treatments containing iron sulfate have also significantly reduced dollar spot severity when compared to the nontreated control. Applications of iron sulfate have also resulted in darker green color and turf quality ratings have increased due to the color change.

Table 1. Mean number of dollar spots per treatment at greens height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2018.

	Treatment	Rate	Application Interval	Application Code[b]	Dollar Spot Severity[a]	
					Jun 14	Jun 29
1	Non-treated control				25.5 a	34.3 a
2	Urea	0.1 lb N/1000ft2	7 day	CDEFGHIJK	21.5 a	18.3 abc
3	Urea	0.2 lb N/1000ft2	14 day	CEGIK	8.3 b	16 bcd
4	Urea Emerald	0.2 lb N/1000ft2 0.18 oz/1000ft2	14 day 28 day	CEGIK CGK	0.8 b	2.8 cd
5	Urea Emerald	0.2 lb N/1000ft2 0.18 oz/1000ft2	14 day 42 day	CEGIK CI	1.0 b	4.3 cd
6	Iron Sulfate	6 oz/1000ft2	7 day	CDEFGHIJK	0.3 b	0.8 d
7	Iron Sulfate	6 oz/1000ft2	14 day	CEGIK	4.0 b	3.8 cd
8	Iron Sulfate Emerald	6 oz/1000ft2 0.18 oz/1000ft2	14 day 28 day	CEGIK CGK	9.8 b	8.8 bcd
9	Iron Sulfate Emerald	6 oz/1000ft2 0.18 oz/1000ft2	14 day 42 day	CEGIK CI	1.8 b	4.5 cd
10	Urea Iron Sulfate	0.1 lb N/1000ft2 6 oz/1000ft2	7 day 7 day	CDEFGHIJK CDEFGHIJK	0.8 b	0.0 d
11	Urea Iron Sulfate	0.2 lb N/1000ft2 6 oz/1000ft2	7 day 7 day	CEGIK CEGIK	1.5 b	8.3 cd
12	Urea Iron Sulfate Emerald	0.2 lb N/1000ft2 6 oz/1000ft2 0.18 oz/1000ft2	14 day 14 day 28 day	CEGIK CEGIK CGK	1.3 b	2.3 cd
13	Urea Iron Sulfate Emerald	0.2 lb N/1000ft2 6 oz/1000ft2 0.18 oz/1000ft2	14 day 14 day 42 day	CEGIK CEGIK CI	0.0 b	1.0 d
14	Emerald	0.18 oz/1000ft2	28 day	CGK	2.8 b	2.8 cd
15	Emerald	0.18 oz/1000ft2	42 day	CI	8.0 b	25.5 ab

[a]Dollar spot rated as number of dollar spot infection centers. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application Code C=May 17th, D=May 23rd, E=May 31st, F=June 5th, G=June 12th, H=June 19th, I=June 28th, J=July 3rd, K=July10th

Table 2. Mean turfgrass quality per treatment at greens height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2018.

	Treatment	Rate	Application Interval	Application Code[b]	Turfgrass Quality[a]	
					May 30	Jun 14
1	Non-treated control				7.0 -	5.8 cd
2	Urea	0.1 lb N/1000ft2	7 day	CDEFGHIJK	7.0 -	5.5 d
3	Urea	0.2 lb N/1000ft2	14 day	CEGIK	7.0 -	6.5 bcd
4	Urea Emerald	0.2 lb N/1000ft2 0.18 oz/1000ft2	14 day 28 day	CEGIK CGK	7.0 -	7.3 ab
5	Urea Emerald	0.2 lb N/1000ft2 0.18 oz/1000ft2	14 day 42 day	CEGIK CI	7 -	7.0 ab
6	Iron Sulfate	6 oz/1000ft2	7 day	CDEFGHIJK	7.3 -	7.5 ab
7	Iron Sulfate	6 oz/1000ft2	14 day	CEGIK	7.0 -	7.0 ab
8	Iron Sulfate Emerald	6 oz/1000ft2 0.18 oz/1000ft2	14 day 28 day	CEGIK CGK	7.3 -	6.5 bcd
9	Iron Sulfate Emerald	6 oz/1000ft2 0.18 oz/1000ft2	14 day 42 day	CEGIK CI	7.0 -	7.5 ab
10	Urea Iron Sulfate	0.2 lb N/1000ft2 6 oz/1000ft2	7 day 7 day	CDEFGHIJK CDEFGHIJK	7.5 -	7.5 ab
11	Urea Iron Sulfate	0.2 lb N/1000ft2 6 oz/1000ft2	7 day 7 day	CEGIK CEGIK	7.0 -	7.5 ab
12	Urea Iron Sulfate Emerald	0.2 lb N/1000ft2 6 oz/1000ft2 0.18 oz/1000ft2	14 day 14 day 28 day	CEGIK CEGIK CGK	7.3 -	7.5 ab
13	Urea Iron Sulfate Emerald	0.2 lb N/1000ft2 6 oz/1000ft2 0.18 oz/1000ft2	14 day 14 day 42 day	CEGIK CEGIK CI	7.0 -	8.0 a
14	Emerald	0.18 oz/1000ft2	28 day	CGK	7.0 -	6.8 bc
15	Emerald	0.18 oz/1000ft2	42 day	CI	7.0 -	5.8 cd

[a]Turfgrass quality was rated visually on a 1 – 9 scale with 6 being acceptable. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application Code C=May 17th, D=May 23rd, E=May 31st , F=June 5th, G=June 12th, H=June 19th, I=June 28th, J=July 3rd, K=July10th

Iron Sulfate and Water Volume Interactions for Turf Quality

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OBJECTIVE

To determine how applications of iron sulfate interact with water carrier volume for controlling dollar spot caused by the fungus *Sclerotinia homoeocarpa* on fairway-height creeping bentgrass.

MATERIALS AND METHODS

The study was conducted at the O. J. Noer Turfgrass Research and Education Facility on a stand of creeping bentgrass (*Agrostis stolonifera*) maintained at 0.5 inches. Individual plots measured 3 feet by 5 feet and were arranged in a randomized complete block design with four replications. Treatments were applied at a nozzle pressure of 40 psi using a CO_2 pressurized boom sprayer equipped with either two XR Teejet 8004 or 80025 VS nozzles, depending on the spray volume. All fungicides were agitated by hand and applied in the equivalent of either 3, 1.5, or 0.75 gallons of water per 1000 ft^2. All treatments were initiated on May 17th and subsequent applications were made at 7 or 14-day intervals. Number of dollar spot foci per plot and turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) were visually assessed every 2 weeks. Turf quality and disease severity were subjected to an analysis of variance and means separated using Fisher's LSD (P = 0.05). Results of disease severity and turfgrass quality ratings can be found in table 1 and 2, respectively.

RESULTS AND DISCUSSION

Dollar spot pressure has been non-existent on this plot up to this point in the year. No differences were observed among any of the treatments in terms of dollar spot severity. The highest rate of iron sulfate at all water carrier volumes has resulted in a decline in turf quality.

Table 1. Mean number of dollar spots per treatment at fairway height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2018.

	Treatment	Rate	Application Interval	Water Volume	Dollar Spot Severity[a]	
					Jun 14	Jun 29
1	Non-treated control				0.0 -	0.0 -
2	Iron Sulfate	3 oz/1000 ft2	7 day	0.75 gal/1000 ft2	0.0 -	0.0 -
3	Iron Sulfate	3 oz/1000 ft2	7 day	1.5 gal/1000 ft2	0.0 -	0.0 -
4	Iron Sulfate	3 oz/1000 ft2	7 day	3.0 gal/ 1000 ft2	0.0 -	0.0 -
5	Iron Sulfate	6 oz/1000 ft2	7 day	0.75 gal/1000 ft2	0.0 -	0.0 -
6	Iron Sulfate	6 oz/1000 ft2	7 day	1.5 gal/1000 ft2	0.0 -	0.0 -
7	Iron Sulfate	6 oz/1000 ft2	7 day	3.0 gal/ 1000 ft2	0.0 -	0.0 -
8	Iron Sulfate	12 oz/1000 ft2	7 day	0.75 gal/1000 ft2	0.0 -	0.0 -
9	Iron Sulfate	12 oz/1000 ft2	7 day	1.5 gal/1000 ft2	0.0 -	0.0 -
10	Iron Sulfate	12 oz/1000 ft2	7 day	3.0 gal/ 1000 ft2	0.0 -	0.0 -
11	Iron Sulfate	3 oz/1000 ft2	14 day	0.75 gal/1000 ft2	0.0 -	0.0 -
12	Iron Sulfate	3 oz/1000 ft2	14 day	1.5 gal/1000 ft2	0.0 -	0.0 -
13	Iron Sulfate	3 oz/1000 ft2	14 day	3.0 gal/ 1000 ft2	0.0 -	0.0 -
14	Iron Sulfate	6 oz/1000 ft2	14 day	0.75 gal/1000 ft2	0.0 -	0.0 -
15	Iron Sulfate	6 oz/1000 ft2	14 day	1.5 gal/1000 ft2	0.0 -	0.0 -
16	Iron Sulfate	6 oz/1000 ft2	14 day	3.0 gal/ 1000 ft2	0.0 -	0.0 -
17	Iron Sulfate	12 oz/1000 ft2	14 day	0.75 gal/1000 ft2	0.0 -	0.0 -
18	Iron Sulfate	12 oz/1000 ft2	14 day	1.5 gal/1000 ft2	0.0 -	0.0 -
19	Iron Sulfate	12 oz/1000 ft2	14 day	3.0 gal/ 1000 ft2	0.0 -	0.0 -
20	Non-treated control 2				0.0 -	0.0 -

[a]Dollar spot rated as number of dollar spot infection centers. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 2. Mean turfgrass quality per treatment at fairway height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2018.

	Treatment	Rate	Application Interval	Water Volume	Turfgrass Quality[a]	
					May 30	Jun 14
1	Non-treated control				7.0 d	7.0 ab
2	Iron Sulfate	3 oz/1000 ft2	7 day	0.75 gal/1000 ft2	7.0 d	8.0 a
3	Iron Sulfate	3 oz/1000 ft2	7 day	1.5 gal/1000 ft2	7.0 d	8.0 a
4	Iron Sulfate	3 oz/1000 ft2	7 day	3.0 gal/ 1000 ft2	7.5 bc	8.0 a
5	Iron Sulfate	6 oz/1000 ft2	7 day	0.75 gal/1000 ft2	7.5 bc	8.0 a
6	Iron Sulfate	6 oz/1000 ft2	7 day	1.5 gal/1000 ft2	7.8 ab	7.3 ab
7	Iron Sulfate	6 oz/1000 ft2	7 day	3.0 gal/ 1000 ft2	7.3 cd	7.3 ab
8	Iron Sulfate	12 oz/1000 ft2	7 day	0.75 gal/1000 ft2	7.8 ab	5.8 cd
9	Iron Sulfate	12 oz/1000 ft2	7 day	1.5 gal/1000 ft2	8.0 a	5.8 cd
10	Iron Sulfate	12 oz/1000 ft2	7 day	3.0 gal/ 1000 ft2	8.0 a	5.0 d
11	Iron Sulfate	3 oz/1000 ft2	14 day	0.75 gal/1000 ft2	7.0 d	7.3 ab
12	Iron Sulfate	3 oz/1000 ft2	14 day	1.5 gal/1000 ft2	7.0 d	7.8 a
13	Iron Sulfate	3 oz/1000 ft2	14 day	3.0 gal/ 1000 ft2	7.0 d	8.0 a
14	Iron Sulfate	6 oz/1000 ft2	14 day	0.75 gal/1000 ft2	7.0 d	8.0 a
15	Iron Sulfate	6 oz/1000 ft2	14 day	1.5 gal/1000 ft2	7.0 d	8.0 a
16	Iron Sulfate	6 oz/1000 ft2	14 day	3.0 gal/ 1000 ft2	7.0 d	8.0 a
17	Iron Sulfate	12 oz/1000 ft2	14 day	0.75 gal/1000 ft2	7.0 d	6.5 bc
18	Iron Sulfate	12 oz/1000 ft2	14 day	1.5 gal/1000 ft2	7.3 cd	6.5 bc
19	Iron Sulfate	12 oz/1000 ft2	14 day	3.0 gal/ 1000 ft2	7.0 d	5.0 d
20	Non-treated control 2				7.0 d	7.0 ab

[a]Turfgrass quality was rated visually on a 1 – 9 scale with 6 being acceptable. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Precision Disease Management of Dollar Spot

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OBJECTIVE

To determine if using different weather stations on the same golf course can result in different fungicide application timings when using the Smith-Kerns dollar spot prediction model.

MATERIALS AND METHODS

The study was replicated at 3 locations: the O.J. Noer Turfgrass Research and Education Facility in Madison, WI and the 7th and 14th holes at University Ridge Golf Course in Madison, WI. At all sites the study was conducted on creeping bentgrass (*Agrostis stolonifera* 'Pencross') maintained at a 0.5 inch cutting height. The individual plots measured 6 ft X 10 ft and were arranged in a randomized complete block design with four replications. Individual treatments were applied at a nozzle pressure of 40 p.s.i using a CO_2 pressurized boom sprayer equipped with XR Teejet AI8004 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 1.5 gallons of water per 1000 ft^2. Two fungicide programs were tested in addition to the non-treated control. One was a standard fungicide program based off the program of a local golf course, and the second based the application timing on the Smith-Kerns dollar spot prediction model using fungicides from the previous fungicide program. Number of dollar spot infection centers per plot, turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) were assessed every two weeks. Results were subjected to an analysis of variance and means were separated using Fisher's LSD (P = 0.05). Disease severity and turfgrass quality from the OJ Noer location can be found in the following tables.

RESULTS AND DISCUSSION

Dollar spot pressure has been higher at the golf course locations than at the research station. The Smith-Kerns dollar spot prediction model has been above the spray threshold all summer long, which means that the application timings of treatments 2 and 3 are exactly the same. In general, only numerical differences have been observed in dollar spot counts conducted so far, but statistical significance has been observed only in turf quality ratings. The two fungicide treatments are statistically higher than the nontreated control in turf quality ratings.

Table 1. Mean number of dollar spot infection centers per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI in 2018.

		Treatment	Rate	Application Date/Interval	Dollar spot severity[a]	
					Jun 14	Jun 29
1		Non-treated control			23.8 -	4.5 b
2	Standard Program	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	May 17 June 14 July 5	10.8 -	6.3 a
3	Smith-Kerns model: Standard	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	28 day 21 day 14 day	4.8 -	5.5 ab

[a]Dollar spot was visually assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 2. Mean turf quality ratings per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI in 2018.

		Treatment	Rate	Application Date/Interval	Turf Quality[a]	
					Jun 14	Jun 29
1		Non-treated control			4.5 b	5.3 -
2	Standard Program	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	May 17 June 14 July 5	6.3 a	6.8 -
3	Smith-Kerns model: Standard	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	28 day 21 day 14 day	5.5 ab	6.0 -

[a]Turfgrass quality was visually assessed on 1-9 scale, with 9 being excellent, 6 being acceptable, and 1 bare dirt. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 1. Mean number of dollar spot infection centers per treatment at University Ridge GC on the 7th fairway in Madison, WI in 2018.

		Treatment	Rate	Application Date/Interval	Dollar spot severity[a]	
					Jun 14	Jun 29
1		Non-treated control			23.8 -	87.8 -
2	Standard Program	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	May 17 June 14 July 5	10.0 -	43.5 -
3	Smith-Kerns model: Standard	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	28 day 21 day 14 day	4.8 -	- 15.0 -

[a]Dollar spot was visually assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 2. Mean turf quality ratings per treatment at University Ridge GC on the 7th fairway in Madison, WI in 2018.

		Treatment	Rate	Application Date/Interval	Turf Quality[a]	
					Jun 14	Jun 29
1		Non-treated control			6.0 -	5.5 b
2	Standard Program	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	May 17 June 14 July 5	6.0 -	6.5 a
3	Smith-Kerns model: Standard	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	28 day 21 day 14 day	7.0 -	7.0 a

[a]Turfgrass quality was visually assessed on 1-9 scale, with 9 being excellent, 6 being acceptable, and 1 bare dirt. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 1. Mean number of dollar spot infection centers per treatment at University Ridge GC on the 14th fairway in Madison, WI in 2018.

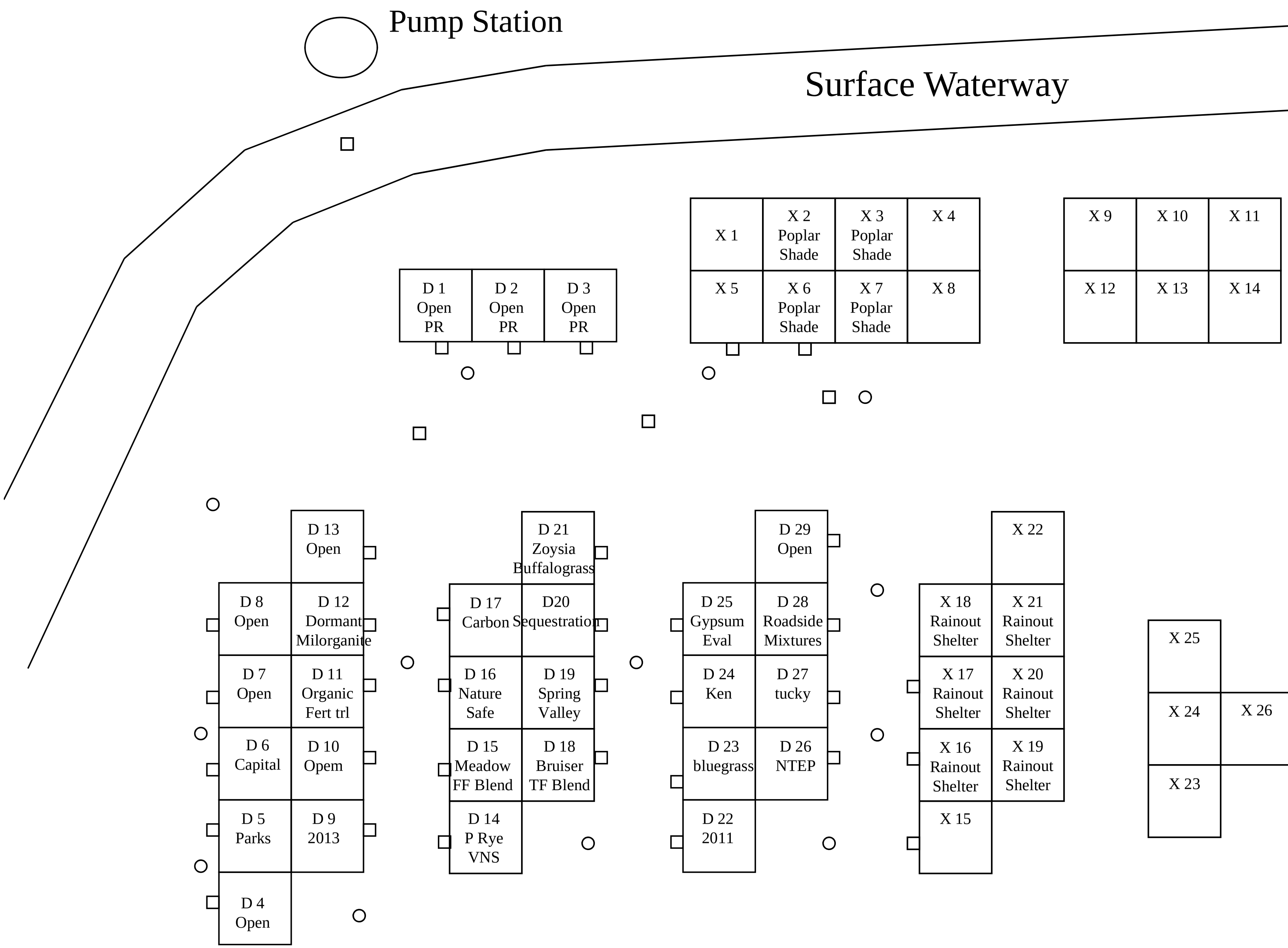
		Treatment	Rate	Application Date/Interval	Dollar spot severity[a]	
					Jun 14	Jun 29
1		Non-treated control			5.3 -	42.5 -
2	Standard Program	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	May 17 June 14 July 5	6.0 -	11.3 -
3	Smith-Kerns model: Standard	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	28 day 21 day 14 day	6.0 -	20.3 -

[a]Dollar spot was visually assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).

Table 2. Mean turf quality ratings per treatment at University Ridge GC on the 14th fairway in Madison, WI in 2018.

		Treatment	Rate	Application Date/Interval	Turf Quality[a]	
					Jun 14	Jun 29
1		Non-treated control			5.3 -	5.3 b
2	Standard Program	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	May 17 June 14 July 5	6.0 -	6.8 a
3	Smith-Kerns model: Standard	Emerald Banner Maxx Interface	0.18 oz/1000 ft2 2 fl oz/1000 ft2 4 fl oz/1000 ft2	28 day 21 day 14 day	6.0 -	6.5 a

[a]Turfgrass quality was visually assessed on 1-9 scale, with 9 being excellent, 6 being acceptable, and 1 bare dirt. Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).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D 17 Carbon
D20 Sequestration
D 16 Nature Safe
D 19 Spring Valley
D 15 Meadow FF Blend
D 18 Bruiser TF Blend
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D 25 Gypsum Eval
D 28 Roadside Mixtures
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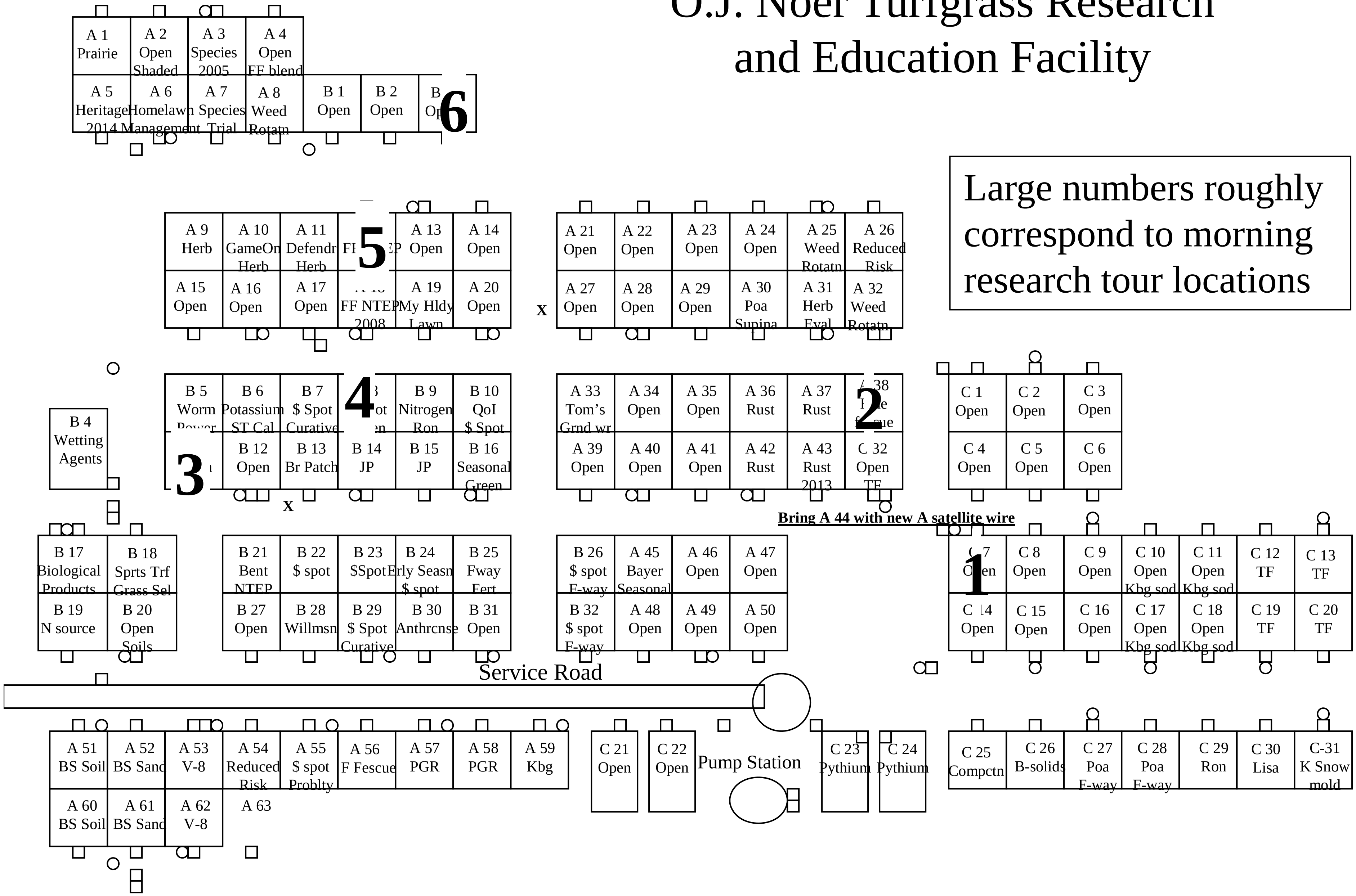
O.J. Noer Turfgrass Research and Education Facility



Large numbers roughly correspond to morning research tour locations