Wisconsin Turfgrass Field Day

July 25, 2017

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

2017 Wisconsin Turfgrass Field Day

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

Flag No.	Topic	Speaker	Pg
1	Evaluation of GameOn, a New Herbicide for 2018	Nick Bero	3
2	Reduced-Risk Weed Management	Kurt Hockemeyer	6
3	2016-2017 Sports Turf Snow Mold Control Evaluation: Wausau West High School	Paul Koch	8
4	Grass Selection and Management Practices Influence Weed Populations	Doug Soldat	10
5	Hose End Sprayer Calibration	Bruce Schweiger	14
6	Mosquito and Other Nuisance Pests Abatement	Chris Williamson	15

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

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

Topic	Speaker	Pg
Potassium requirements, nitrogen sources, wetting agents, Worm Power, "flipped model" GDDs, cost effective liquid fertilizers for fairways	Doug Soldat	20
Biopesticides for the control of dollar spot on putting greens	Emma Buczkowski	23
Common Ground Initiative	Paul Koch	26
Dollar spot control using alternative methods, Effects of dew removal on dollar spot control, and general precision disease management of dollar spot	Paul Koch	29
Impact of nitrogen on dollar spot	Ron Townsend	37
Bentgrass fairway/tee NTEP (2008)	Doug Soldat	41
Questions and answers with Dr. Williamson	Williamson	--

2017 Research Donors and Sponsors

AgraQuest
AMVAC
The Andersons
Arthur Clesen, Inc.
Badgerland Irrigation
Barenbrug
Bayer
BASF
The Bruce Co.
CALS/ARS
Cascade International Seed
CTBT
Cenex/Land O' Lakes
Cherokee CC
Chippewa Valley GC
Cole Grower Service
DHD Tree Products, Inc.
Dow Agrosciences
Exacto, Inc.
FMC
Golf Course Super. Assoc. America
Gowan
Greenwood Hills GC
Hawks Landing GC
Helena
Heritage Seed
Hynite Corporation
Insight FS
Irrigation Protection Services
Jacklin Seed
Jasperson Sod
JW Turf
Keyman Lawn Care
LABServices
Lebanon Seaboard Co.
Lurvey Sod Farm
Marquette CC
Microflo
Milorganite Division, MMSD
Minocqua CC
National Turfgrass Evaluation Program
Nature Safe
Nitragin Inc.
Northern Great Lakes GC Super. Assoc.
Nufarm
Paul's Tree & Turf Nursery
Pennington Seed Inc.
Petro Canada
PBI Gordon
Plant Health Care, Inc.
Pleasant View GC
ProSeeds
Pure-Seed Testing, Inc.
Quali-Pro
Reinders Turf and Irrigation
Rock River Laboratory
Royal St. Patricks GC
Seed Research of Oregon
SePRO
Simplot Partners
Sod Solutions
Spring Valley Turf Products
Stockton Ag
Summit Seed
Syngenta
TerraMax
Timber Ridge GC
Toro Inc.
Turf Merchants Inc.
Turfgrass Producers International
Twin River Turf
U.S. Dept. of Agriculture
United States Golf Association
University Ridge GC
Vital
Watertronics
Waupaca Sand and Gravel
Wausau CC
WeedMan
West Madison ARS
Whispering Pines GC
Wisconsin Dept. of Natural Resources
Wisconsin Golf Course Super. Assoc.
Wisconsin Green Industry Federation
Wisconsin Sod Producers Association

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

Evaluation of GameOn, a New Herbicide for the 2019 Season

Doug Soldat, Ph.D. and Nick Bero MSc.
Dept. of Soil Science
University of Wisconsin-Madison

INTRODUCTION

GameOn is a new herbicide for 2018 by Dow AgroSciences. Our goal was to evaluate the efficacy of GameOn for weed control in Wisconsin compared to some commercial standards.

MATERIALS AND METHODS

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 (Table 1) were designed to evaluate different rates of GameOn against label rates of Trimec and Escalade 2 herbicides. Treatments were applied using a CO_2-powered backpack sprayer calibrated to deliver 86 gallons per acre. Percent plot cover by individual broadleaf weeds was evaluated one, four, six, ten, and fourteen 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 1. Treatments and application rates for the products used in the trial.

Treatment	Rate	Application Date
	pt pr ac^{-1}	
GameOn: 2,4-D choline, fluroxypyr, & halauxifen	3.0	9 May
GameOn: 2,4-D choline, fluroxypyr, & halauxifen	3.5	9 May
GameOn: 2,4-D choline, fluroxypyr, & halauxifen	4.0	9 May
Trimec: 2,4-D, dicamba, mecoprop-p	3.5	9 May
Escalade 2: 2,4-D, dicamba & fluroxypyr	2.5	9 May
Untreated Control	N/A	N/A

RESULTS

Table 1. Percent of dandelion as affected by treatment and date.

Treatment	Application Rate	May 9	May 15	June 13	June 20
	pt pr ac^{-1}	---------- percent weed cover ------------			
GameOn	3.0	16.3 a	13.8 ab	2.5 b	2.0 b
GameOn	3.5	20.0 a	14.3 ab	2.0 bc	3.3 b
GameOn	4.0	10.0 a	6.8 b	0.3 c	1.5 b
Trimec	3.5	15.0 a	8.0 b	1.8 bc	2.3 b
Escalade 2	2.5	21.3 a	9.3 ab	2.0 bc	4.5 b
Untreated Control	N/A	17.5 a	16.3 a	13.8 a	16.3 a

Table 2. Percent of clover + black medic as affected by treatment and date.

Treatment	Application Rate	May 9	May 15	June 13	June 20
	pt pr ac^{-1}	---------- percent weed cover ------------			
GameOn	3.0	23.8 a	17.5 a	2.5 b	4.3 b
GameOn	3.5	28.8 a	22.5 a	1.5 b	1.0 b
GameOn	4.0	32.5 a	26.3 a	2.0 b	1.0 b
Trimec	3.5	17.5 a	10.0 a	4.8 b	6.0 b
Escalade 2	2.5	23.8 a	22.5 a	2.0 b	1.3 b
Untreated Control	N/A	21.3 a	20.0 a	36.3 a	37.5 a

Table 3. Percent dandelion control as affected by treatment and date.

Treatment	Application Rate	May 9	May 15	June 13	June 20
	pt pr ac^{-1}	------------- percent weed control --------------			
GameOn	3.0	7.1 a	15.4 a	81.8 b	87.7 ab
GameOn	3.5	-14.3 a	12.3 a	85.5 ab	80.0 ab
GameOn	4.0	42.9 a	58.5 a	98.2 a	90.8 a
Trimec	3.5	14.3 a	50.8 a	87.3 ab	86.2 ab
Escalade 2	2.5	-21.4 a	43.1 a	85.5 ab	72.3 b

Table 4. Percent clover + black medic control as affected by treatment and date.

Treatment	Application Rate	May 9	May 15	June 13	June 20
	pt pr ac^{-1}	------------- percent weed control --------------			
GameOn	3.0	-11.8 a	12.5 a	93.1 ab	88.7 a
GameOn	3.5	-35.3 a	-12.5 a	95.9 a	97.3 a
GameOn	4.0	-52.9 a	-31.3 a	94.5 ab	97.3 a
Trimec	3.5	17.6 a	50.0 a	86.9 b	84.0 a
Escalade 2	2.5	-11.8 a	-12.5 a	94.5 ab	96.7 a

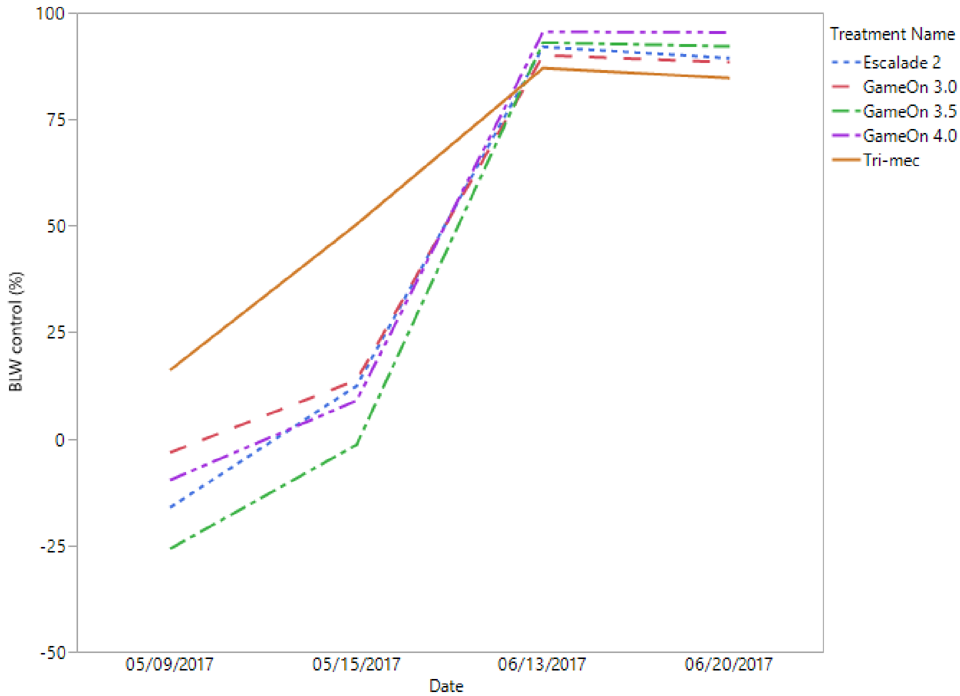


Figure 1. Total broadleaf (Dandelion + clover) weed control for the first four rating dates.

Reduced-Risk Weed Management

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

OBJECTIVE

To determine the efficacy of various reduced-risk herbicides for the control of various broadleaf weeds in lawn-height turfgrass.

MATERIALS AND METHODS

The study was conducted at the O.J. Noer Turfgrass Research and Education Facility in Madison, WI on lawn-height Kentucky bluegrass/perennial ryegrass mixture with heavy weed infestations. The 2016 trial (Table 1) was initiated in fall 2015 and was repeated for a second year this past spring. The 2017 trial (Table 2) was initiated in fall 2016 and added one new treatment into the treatment list. The individual plots measured 3 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 treatments were agitated by hand and applied in the equivalent of 1.5 gallons of water per 1000 ft^2, except for Adios herbicide, which was applied in 4.5 gallons of water per 1000 ft^2 per the label recommendations. One herbicide application was initiated on 10/21/2016, while the rest were initiated in the spring of 2017 on various dates with various reapplications according to label directions. Weed counts were conducted 2 times in spring/summer of 2017. Results were subjected to an analysis of variance and means were separated using Fisher's LSD ($P = 0.05$). Results are displayed in Tables 1 and 2.

RESULTS AND DISCUSSION

The 2016 trial that was continued from the previous year had differences in weed percentages in each plot most likely due to the different effectiveness of each of the herbicides from the previous year. On the last rating date treatments 2, 3, 6, 7, 8, and 9 significantly lowered the percent of weeds in each plot compared to the nontreated controls.

The 2017 trial that was just initiated last fall did not have any significant differences in percent weeds in each plot. On the last rating date treatments 3, 4, 6, 7, 8, 9, and 10 all reduced weed percentages significantly when compared to the nontreated controls.

Table 1. Mean percent weeds per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI in 2017. Study was initiated in fall 2015.

Treatment		Rate	Application Date	Percent Weed Cover[a]	
				May 26	Jun 23
1	Non-treated control			57.64a	72.91a
2	Fiesta	25.2 fl oz/1000 ft2	5/23, 6/19	31.25ab	22.91b
3	Tenacity Spreader Sticker	5 fl oz/A 3 pts/100 gal	5/23, 6/8	49.30a	27.08b
4	Quicksilver	2 fl oz/A	5/23, 6/8	57.64a	56.25a
5	Adios	192 fl oz/1000 ft2	5/23	49.305a	54.17a
6	Defendor-Spring Spreader Sticker	4 fl oz/A 3 pts/100 gal	4/7, 5/23	5.56b	13.89b
7	Defendor-Fall Spreader Sticker	4 fl oz/A 3 pts/100 gal	10/21	15.278b	20.14b
8	Turflon Ester Ultra	0.5 qts/A	5/23, 6/19	55.56a	31.24b
9	Trimec 1000	1.5 fl oz/1000 ft2	5/23, 6/19	31.94ab	4.86b

[a]Weeds were visually assessed using a 36-point grid and tallying weeds at each point per plot. Means in each column followed by the same letter do not significantly differ (P=.05, Fisher LSD).

Table 2. Mean percent weeds per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI in 2017. Study was initiated in fall 2016.

Treatment		Rate	Application Date	Percent Weed Cover[a]	
				May 26	Jun 23
1	Non-treated control			31.94a	59.72a
2	Fiesta	25.2 fl oz/1000 ft2	5/23, 6/19	37.50a	45.14ab
3	Tenacity Spreader Sticker	5 fl oz/A 3 pts/100 gal	5/23, 6/8	24.30a	25.69bcd
4	Quicksilver	2 fl oz/A	5/23, 6/8	28.47a	30.55bc
5	Adios	192 fl oz/1000 ft2	5/23	37.50a	45.83ab
6	Defendor-Spring Spreader Sticker	4 fl oz/A 3 pts/100 gal	4/7, 5/23	45.83a	14.58cd
7	Defendor-Fall Spreader Sticker	4 fl oz/A 3 pts/100 gal	10/21	48.61a	27.08bcd
8	Turflon Ester Ultra	0.5 qts/A	5/23, 6/19	18.00a	33.33bc
9	Trimec 1000	1.5 fl oz/1000 ft2	5/23, 6/19	39.58a	4.16d
10	Civitas WEEDfree	4 gal/A	5/23, 6/19	45.14a	13.89cd

[a]Weeds were visually assessed using a 36-point grid and tallying weeds at each point per plot. Means in each column followed by the same letter do not significantly differ (P=.05, Fisher LSD).

2016-2017 Sports Turf Snow Mold Control Evaluation: Wausau West High School – Wausau, WI

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

OBJECTIVE

To evaluate fungicides for the control of Typhula blight (caused by *Typhula incarnata*) and Microdochium patch (caused by *Microdochium nivale*) on athletic field turfgrass.

MATERIALS AND METHODS

This evaluation was conducted at Wausau West High School in Wausau, WI on a Kentucky bluegrass (*Poa pratensis*) football field maintained at a height of 3 inches. Individual plots measured 3 ft x 10 ft and were arranged in a randomized complete block design with four replications. Individual liquid treatments were applied at a nozzle pressure of 40 psi using a CO_2 pressurized boom sprayer equipped with two XR Teejet AI8004 VS nozzles. Individual granular treatments were applied using mason jar shakers. All liquid fungicides were agitated by hand and applied in the equivalent of 1.5 gallons of water per 1000 ft^2. Applications were made on 15 Nov 2016. The experimental plot area was not inoculated. There was consistent snow cover on the experimental area from December until mid-March, a total of nearly 90 days. Disease severity, turf quality, and color were measured on March 23, 2017. Disease severity was visually rated as percent area affected, turfgrass quality was visually rated on a 1-9 scale with 6 being acceptable, and chlorophyll content (turfgrass color) was rated using a FieldScout CM 1000 Chlorophyll Meter from Spectrum Technologies, Inc. (Aurora, IL). Treatment means were analyzed using Fisher's LSD method and are presented in Table 1.

RESULTS AND DISCUSSION

Non-treated controls averaged 62.5%, indicating disease pressure on the treatment area was significant in 2016-2017. There was a mix of both *M. nivale* and *T. incarnata* observed on the plots, though the majority of the symptoms were caused by M. nivale. All treatments but two reduced disease severity relative to the non-treated control, though the most effective disease suppression was provided by Banner MAXX, TM 4.5F, Headway, and Tartan. In general, liquid-applied applications were more effective then granular-applied. Phytotoxicity was not observed with any treatment.

Table 1: Mean snow mold severity, turf quality, and turf color were assessed on March 23, 2017 at Wausau West High School in Wausau, WI.

	Treatment	Rate	Application Timing[a]	Disease Severity[b]	Turf Quality[c]	Turf Color[d]
1	Non-treated control			62.5a	3.0f	95.3e
2	Banner Maxx	4 fl oz/1000 ft2	Late	10.0cd	6.3bc	155.3b
3	Trinity	2 fl oz/1000 ft2	Late	61.3a	3.0f	102.5de
4	TM 4.5F	3.5 fl oz/1000 ft2	Late	0.0d	7.8a	150.1b
5	Headway	3 fl oz/1000 ft2	Late	3.0cd	7.3ab	180.8a
6	Tartan	2 fl oz/1000 ft2	Late	0.0d	8.0a	199.3a
7	Velista	0.7 oz/1000 ft2	Late	58.8a	3.3ef	116.4cde
8	Prophesy G	5 lbs/1000 ft2	Late	36.3b	4.3de	104.1de
9	Headway G	5 lbs/1000 ft2	Late	22.5bc	5.0d	131.8bc
10	Pillar G	3 lbs/1000 ft2	Late	18.8bcd	5.3cd	120.1cd
			LSD P=.05	19.9	1.19	24.12

[a]Treatments were applied on Nov 15th, 2016
[b]Mean percent diseased area assessed on March 23rd, 2017.
[c]Quality was visually assessed where 1 = dead, 6 = acceptable, 9 = dark green.
[d]Color was assessed using a FieldScout CM1000 Chlorophyll Meter from Spectrum Technologies, Inc.

Grass Selection and Management Practices Influence Weed Populations

Doug Soldat, Ph.D.
Department of Soil Science
University of Wisconsin-Madison

INTRODUCTION

Survey information indicates that approximately half of all homeowners do not fertilizer their lawns. The other half averages one to two applications of fertilizer per year. However, grass varieties are often bred and developed under higher maintenance conditions. There is a potential disconnect between high performance grasses and the way the typical homeowner intends to manage their lawn. This tour will cover three long-term studies at the O.J. Noer Facility that are investigating how grasses perform under various management practices (from low to high maintenance) in Wisconsin.

MATERIALS AND METHODS

The Home Lawn Demonstration plots were seeded in May 2007 with ‘Victory II’ Chewings fine fescue, ‘Kenblue’ Kentucky bluegrass, ‘Grande II’ tall fescue, Scotts Contractors Mix, ‘Kingfisher’ Kentucky bluegrass, and ‘Jiffe II’ perennial ryegrass under uniform grow-in conditions that included starter fertilizer, irrigation, and post-emergent control of grassy and broadleaf weeds. Beginning in 2008, differential mowing and fertility treatments were applied and weed control ceased. The mowing heights were 1.5, 2.5, and 3.5 inches, and the fertility treatments were 0, 2, or 4 applications of fertilizer each year using urea at a rate of 1 lb N/M. Turfgrass was evaluated on a 1-9 scale with 9 representing the highest possible turf quality. Weeds were periodically estimated using visual and point-intersect methods.

The Wisconsin Sod Producers Low Maintenance Species Trial was established in 2011. Seeded treatments included tufted hairgrass, fine fescue, Kentucky bluegrass + Microclover, Microclover, and a velvet bentgrass/fine fescue mixture. The sodded treatments included Kentucky bluegrass and Kentucky bluegrass + Microclover from Lurvey Turf Nursery; tall fescue, and Kentucky bluegrass from Pauls Turf and Tree Nursery, and Kentucky bluegrass from Twin River Turf. Since establishment, the only input to these plots has been mowing. Visual quality and weeds are evaluated approximately monthly.

RESULTS

<u>Home Lawn Demonstration (10 years after establishment)</u>

In general, increasing the mowing height and increasing fertility decreased weed populations in all the grasses. However, there have been enormous differences in each individual grass response to fertilization, with high fertilization resulting in the disappearance of tall fescue, which persisted best under low fertility, to the disappearance of ‘Kingfisher’ Kentucky bluegrass with no fertilizer. Fine fescue was exhibited the lowest weed pressure under all fertility regimes. Perennial ryegrass did not persist at high levels in any of the fertility programs.

Wisconsin Sod Producers Low Input Trial

Sodded microclover treatments and sodded tall fescue have consistently held the greatest turfgrass quality. Both of these treatments have resisted dandelion invasion relative to other treatments. Despite high levels of clover, the uniformity of its distribution creates an acceptable appearance compared to treatments with similar levels of clover but with sporadic distribution.

Table 1. Average annual turfgrass quality from 2011 – 2017, 1 to 9 scale, 9=best

Species	2011	2012	2014	2015	2016	2017
Tufted Hairgrass from seed	1.50 E	2.83 D	2.54 E	3.0 F	2.9 D	2.8 F
Fine Fescue from seed	5.72 C	5.50 B	4.38 A	5.2 B	4.1 B	4.5 B
Kentucky bluegrass from sod (Lurvey Turf Nursery)	6.24 B	5.15 B	3.08 D	3.7 E	3.1 CD	3.2 EF
Microclover + Kentucky bluegrass from sold (Lurvey Turf Nursery)	6.67 A	7.30 A	4.42 A	5.7 A	5.0 A	5.1 A
Microclover + Kentucky bluegrass from seed	1.56 E	5.35 B	4.00 B	4.6 CD	4.3 B	4.3 B
Microclover from seed	1.61 E	3.55 C	2.96 D	3.6 E	3.3 CD	3.3 EF
Tall Fescue from sold (Paul's Turf and Tree)	6.53 AB	7.20 A	4.67 A	4.9 BC	4.4 B	4.6 AB
Kentucky bluegrass from sold (Twin River Turf)	3.89 D	5.40 B	3.88 BC	4.3 D	3.5 C	3.7 DE
Velvet bentgrass + fine fescue from seed	1.33 E	3.30 C	3.54 C	4.4 CD	4.0 B	3.8 CD

Table 2. Average annual percentage of dandelion in the plots from 2014 – 2017.

Species	**2014**	**2015**	**2016**	**2017**
	------------% dandelion cover-------------			
Tufted Hairgrass from seed	24.8 A	27.9 A	35.8 A	35.8 A
Fine Fescue from seed	4.5 D	6.1 D	9.1 DE	8.9 D
Kentucky bluegrass from sod (Lurvey Turf Nursery)	28.2 A	32.0 A	36.3 A	37.1 A
Microclover + Kentucky bluegrass from sod (Lurvey Turf Nursery)	4.2 D	5.3 D	3.6 E	4.9 D
Microclover + Kentucky bluegrass from seed	4.8 D	7.7 CD	7.6 DE	6.8 D
Microclover from seed	17.1 B	19.6 B	27.5 B	22.1 B
Tall Fescue from sold (Paul's Turf and Tree)	3.0 D	4.8 D	6.9 DE	9.2 D
Kentucky bluegrass from sold (Twin River Turf)	8.3 CD	13.3 BC	17.8 C	17.5 BC
Velvet bentgrass + fine fescue from seed	11.8 BC	10.4 CD	13.5 CD	11.3 CD

Mow ht.	Lawn Ecology Plot Map																	
1.5 "																		
2.5"																		
3.5"																		
	Fine Fescue			Kenblue KBG			Tall Fescue			Contractors Mix			Kingfisher KBG			Perennial Ryegrass		
Fert Apps/yr	0	2	4	0	2	4	4	0	2	0	4	2	0	4	2	0	4	2

Hose End Sprayer Calibration

Bruce Schweiger
Station Superintendent
O.J. Noer Turfgrass Research and Education Facility
University of Wisconsin-Madison

INTRODUCTION

Turf managers often times are using hose end sprayers for applying various pesticides. The key to applying pesticides correctly starts with the calibration of the sprayer and the sprayee. During this presentation we will discuss why to calibrate and how to calibrate this type of sprayers. There will be hands on demonstrations and a visual aids. The keys to success start here!

METHODS AND MATERIALS

We will use a hand gun sprayer with a two hundred gallon sprayer for demonstration purposed. The discussion will involve the methods recommended for this type of sprayer to ensure that pesticides are applied properly attaining the correct rate, reduce cost of over sprays and provide the best chance for success.

Mosquito and Other Nuisance Pests Abatement

R. Chris Williamson, Ph.D.
Department of Entomology
University of Wisconsin-Madison

INTRODUCTION

Mosquitoes and other nuisance pests including black flies, horse flies, deer flies and others insects can be quite annoying or bothersome. Many of these insects inflict "bites" that often result in skin irritation, swelling, hives, infections and other symptoms. Additionally, some insect species (i.e., mosquitoes) can transmit diseases to humans and other animals. There are more than 2500 species of mosquitoes around the world, about 200 different species can be found in the U.S. and Canada. Forty-three of these species can carry the West Nile Virus, the most common mosquitoes in the Midwest Region that are carriers of West Nile Virus include: 1) *Culex pipiens*; 2) *Culex quinquefasciatus*; 3) *Culex restuans*; and 4) *Aedes vexans.* Two mosquito species can carry the Zika virus, they include: 1) *Aedes aegypti* and 2) *Aedes albopictus*, neither species has been detected in Wisconsin! More than 25 species of black flies occur in Wisconsin, black flies are often referred to as gnats or buffalo gnats. They can be a serious problem because of their ability to bite, they slash the skin and feed on the blood. However, not all black flies bite, some species are merely a nuisance. Fortunately, black flies are not known to transmit diseases to humans. Horse and deer flies can also be a nuisance as a result of their annoying biting behavior. They are considered "true" flies, there are an estimated 335 species of horse and deer flies in the continental U.S. Of these, more than 40 species of horse flies and 30 species of deer flies occur in Wisconsin. Most horse flies are in the genera *Tabanus* and *Hybomitra* and nearly all deer flies are in the genus *Chrysops.* Only female horse and deer flies take a blood meal, and they mainly feed during the daytime. Female horse flies primarily feed on large, stationary hosts and they typically bite on the legs and body, rarely on the head whereas female deer flies feed on moving (active) hosts, they typically bite on the shoulders and head. No species of horse or deer flies have been reported to transmit diseases in Wisconsin. Understanding the biology (e.g., life cycle, behavior, ecology, etc.) is the most important component to effectively managing a pest! Effective management first begins with accurate identification of the pest (i.e., insect). Once the pest is identified, obtaining information on the biology of the organism is essential to developing and implementing an appropriate and effective management strategy.

Biology of Mosquitoes

Mosquitoes are true flies (Dipterans) in the family Culicidae. Adult mosquitoes are readily distinguished from other flies by the long proboscis (mouthpart) and scales on the margins and veins of their wings. Males differ from females by having feathery antennae and their mouthparts are not able to pierce skin.

Mosquitoes have four distinct life stages: 1) egg; 2) larva; 3) pupa: and 4) adult. Only adult females feed on blood, which is an important source of protein for egg development. Males and females feed on plant nectar as a source of carbohydrates.

There are three basic types of mosquito eggs: 1) those laid singly on the water surface, each egg being buoyed by floats; 2) eggs laid on the water surface in groups or rafts; and 3) eggs laid singly out of the water on a surface that will subsequently flood. Mosquitoes that lay their eggs on the water surface are commonly known as permanent water breeders and include the genera *Anopheles*, *Coquillettidia*, *Culex* and *Culiseta*. Floodwater mosquitoes lay their eggs on a moist substrate, out of the water, female floodwater mosquitoes are attracted by chemical stimuli to oviposition sites and are not dependent on water for oviposition, thus weather has much less impact on the reproductive success of floodwater species than on permanent water breeders. Floodwater mosquitoes include *Aedes*, *Ochlerotatus* and *Psorophora*.

All mosquito larvae are aquatic, they are adapted to a wide range of larval habitats, including swamps, marshes, tree holes, septic ditches, rock pools, etc. All of the breeding sites have a common characteristic of stagnant pools not subject to significant wind or wave action or water flow. Additionally, the breeding sites generally have a low or non-existent population of parasites or predators that prey on mosquito larvae. Flowing streams, tidal creeks, large ponds, lakes and other large water bodies are not typical mosquito breeding sites. Larvae feed on microorganisms and particles of organic matter. Mosquito larvae must have access to atmospheric oxygen, which is obtained by means of a siphon tube that penetrates the water surface or, in some species, pierces the roots of aquatic plants. The larval stage lasts from four to several days and contains four separate developmental periods know as instars.
The pupal stage is also aquatic, but the pupa can complete development on a moist surface. It is during the pupal phase that the transformation from an aquatic larva to an adult, the pupal stage lasts only a few days.

Adult female mosquitoes mate once during their lifetime, this occurs shortly after emergence. The blood feeding habits of the female vary between species, some are general feeders while others feed only on specific groups of vertebrates such as birds or reptiles. The flight habits are also variable, with some species rarely flying more than several hundred feet from their breeding sites and others flying 20 miles or more.

Biology of Black Flies

Female black flies lay eggs directly onto the water or on the leaves of aquatic plants and objects in rivers, streams, and other running water. After the eggs hatch, the larvae attach themselves to stones, grass, branches, leaves and other objects submerged under the water in rivers and streams. The larvae develop under water for 10 days to several weeks depending on water temperature, after pupation the adults typically emerge in about a week. Adults live for about three to six weeks, they can fly about 10 miles from their breeding source and they can be carried considerably further distances with air currents.

The more common black fly species include:

- *Simulium venustum* is an aggressive biter that develops in smaller streams. It has one generation in the spring (late April/early May to early to June).
- *Simulium johannseni* is a moderately aggressive biter that develops primarily in the Crow river. It has one generation in the spring at about the same time as S. venustum.

- *Simulium meridionale* can bite people but is less aggressive than the species described above. It develops in the Minnesota and Crow rivers and has three to six generations (May, late June, July).
- *Simulium luggeri* is primarily a nuisance (flying around your head). It develops primarily in the Mississippi and Rum rivers and has five to six generations a year.
- *Simulium vittatum* can bite people but is generally less aggressive. It develops in smaller streams and to a lesser degree in the Mississippi and Rum rivers. It occurs throughout spring and summer.

Both males and females can feed on nectar for flight energy, but only females bite to take a blood meal. Black flies are most active a couple of hours after sunrise and a couple of hours after sunset. Although they are strong fliers, they are less of a nuisance on windy days and in open areas than on calm days and in sheltered areas (e.g., wooded areas).

Black flies typically swarm around a person's head because they are attracted to carbon dioxide released by breathing. Black flies are also attracted to dark colors such as black and navy blue. Bites are concentrated on exposed areas of skin, especially along the hairline, feet, ankles and arms. The bites can produce a wide range of skin reactions from little or no irritation to considerable irritation and swelling, sensitivity varies from person to person.

Biology of Horse flies and Deer Flies

The life cycle of horse and deer flies begins with the emergence of adults from late spring into summer, depending on the species. After adult emergence, both sexes feed on energy-rich sugars in nectar, plant sap, or honey dew produced by sap-sucking insects such as aphids and scale insects. Mating of the few species of that have been observed takes place in flight. Females of some species are capable of developing an initial batch of eggs without taking a blood meal, otherwise blood is required for the development of eggs. Eggs are typically laid in masses (100-800 eggs) on the underside of leaves or along the stems of emergent vegetation growing in wetlands. Hatching occurs in approximately 2-3 days, and newly emerged larvae drop down into water or saturated soil in which they feed and develop. Most species complete one generation per year. However, small species of deer flies can complete 2-3 generations per year and very large species of horse flies require 2-3 years in which to complete larval development. The sites in which horse fly and deer fly larvae develop are known for only about 1/3 of the species. Deer fly larvae appear to be limited to aquatic habitats, including marshes, ponds, and streams. Developmental sites of horse fly larvae are more varied. Larvae of most species are found in freshwater and saltwater marshes, some in streams, some in moist forest soils, and a few in moist decomposing wood.

MANAGEMENT

Mosquito Management

Mosquito management has enhanced the integral components of Integrated Pest Management (IPM) and has evolved into its own management approach named Integrated Mosquito Management (IMM). IMM is a comprehensive mosquito prevention/control strategy that utilizes all available mosquito control methods singly or in combination to exploit the known vulnerabilities of mosquitoes in order to reduce their numbers to tolerable levels while maintaining a quality environment. IMM does not emphasize mosquito elimination or eradication. Integrated mosquito management methods are specifically tailored to safely counter each stage of the mosquito life cycle. Prudent mosquito management practices for the control of immature mosquitoes (larvae and pupae) include such methods as the use of biological controls (native, noninvasive predators), source reduction (water or vegetation management or other compatible land management uses), water sanitation practices as well as the use of EPA-registered larvicides. When source elimination or larval control measures are not feasible or are clearly inadequate, or when faced with imminent mosquito-borne disease, application of EPA-registered adulticides by applicators trained in the special handling characteristics of these products may be needed. Adulticide products are chosen based upon their demonstrated efficacy against species targeted for control, resistance management concerns and minimization of potential environmental impact.

Larvicides

Larvicides are typically the primary control method in natural or man-made wetlands (woodland pools, freshwater marshes, meadow swales, roadside ditches, stormwater management ponds, etc.). These can also be a primary control method in locations where mosquito populations are determined to be arising from defined, concentrated sources in urban areas. As a result of continuous movement of adult mosquitoes from outlying areas, larviciding programs may have limited visible effect on mosquito populations.

Several larvacidal products in various formulations registered by EPA are labeled for mosquito larviciding. Choosing an active ingredient and formulation depends on site- specific factors and resistance management. There are two primary types of larvacides: 1) biologically based (e.g., microbial, insect growth regulators, etc.) and 2) chemically based (e.g., insecticides, petroleum and mineral-based oils).

Adulticides

Adulticides are applied so as to target a mosquito in flight or at rest on vegetation. Adulticiding success is based on an effective sampling and monitoring.

Adulticides are typially applied as an Ultra-Low-Volume (ULV) spray where small amounts of insecticide are dispersed. There are a variety of ULV application technologies that are commercially available. Adulticides may also be applied via “thermal fogs”, utilizing heat to atomize droplets. Adult mosquitoes may also be targeted by “barrier treatments”, which involve application of a residual insecticide to vegetation where mosquitoes are typically found resting. For additional information on IMM visit: http://www.mosquito.org/assets/Resources/PRTools/Resources/bmpsformosquitomanagement.pdf

Black Fly Management

It is very difficult to prevent black flies from biting, especially when they are abundant. Because they can move into an area from up to 10 miles away or more, there is no practical control to prevent black flies from migrating into an area. When you are out in an area where black flies are present, there are several strategies to try to reduce their bites.

When possible, avoid areas with high black fly populations, such as lowlands, areas with dense vegetation or sheltered and shady areas. Also, try to avoid times when black flies are most active, generally at dawn, and dusk.

Wear white or brightly colored clothing, which is less attractive to the flies than dark-colored clothing. Cover up bare skin with shoes, socks, long sleeves shirts, long pants, and hats. You can also try wearing a nylon head net, similar to a bee keepers veil. You can find them in outdoor stores and gardening catalogs.

The use of insect repellents, such as those with DEET (N,N-diethyl-m-toluamide) but may provide some relief. Products containing a moderate amount of DEET (35%-60%) are as effective as those with a high content (90%-95%).

Horse and Deer Fly Management

Controlling horse and deer flies in nearly impossible, the use of insecticides to kill larvae is not an option because most species develop in natural habitats where insecticides can’t be applied due to environmental concerns. The use of insecticides against adults in also not a realistic option.

When using pesticides, always read and follow the label!

Determining Soil Potassium Requirements of Sand-Based Putting Greens

Doug Soldat, Ph.D.
Dept. of Soil Science, University of Wisconsin-Madison

INTRODUCTION

Potassium is an essential primary macronutrient required in relatively large quantities by turfgrass plants. Potassium does not have any structural role in the plant, but plays important roles in regulating osmotic pressure and facilitating enzymatic reactions. Potassium fertilization is thought to reduce many environmental stresses including heat, cold, and drought stress. It has also been associated with both increased and decreased disease pressure. Despite all these claims and associations, very few research studies have carefully examined how the soil and tissue levels of potassium influence turfgrass quality, growth, and disease pressure. The handful of studies that have addressed these topics often do not report soil test levels or tissue potassium content. In addition, many potassium studies are conducted over short time-scales (< 2 years) and do not quantify the long-term effects of various potassium fertilization strategies.

Because of the lack of quality data, turfgrass managers have hedged their bets and often apply large doses of potassium to turfgrass (>6 lbs per thousand square feet) – particularly to putting greens. However, with more accurate information, we feel that turfgrass managers will be able to confidently reduce their potassium applications, thus saving time and money, while not reducing and possibly enhancing the quality of the turfgrass they manage. The objective of this research is to evaluate putting green quality, growth, and disease incidence over a wide range of soil test and tissue potassium levels.

MATERIALS AND METHODS

This project was initiated in 2011 at the O.J. Noer Turfgrass Research Facility in Madison, WI on a USGA putting green with ‘A4’ creeping bentgrass. The experiment is a randomized complete block design with four replications. The treatments include five different levels of biweekly liquid potassium sulfate at rates ranging from zero to 0.6 lbs/M every two weeks (~ 0 – 8 lbs K2O/M annually depending on the exact start and stop dates of the applications). Paired soil and plant tissue samples are collected monthly along with measurements of clipping yield. The soil samples are taken to a depth of 7 cm, and the plant tissue is collected by a walking greens mower, dried at 60°C, cleaned of debris (sand) and then dry weight is recorded. The dried turfgrass tissue is then analyzed for mineral nutrient content (N, P, K, S, Ca, Mg, Fe, Mn, Zn, Cu, and B) using a C/N/S analyzer and sulfuric acid digestion followed by inductively coupled plasma atomic emission spectroscopy. The soil samples are air dried, then analyzed for available nutrients using the Mehlich-3 method. Turfgrass color is evaluated biweekly using a reflectance meter that measures wavelengths corresponding to chlorophyll reflectance (CM-1000, spectrum technologies). Visual turfgrass quality is also evaluated biweekly using the standard NTEP rating scale of 1-9, where 1 represents completely brown or dead turf, 6 represents the minimally acceptable turf quality, and 9 represents the greatest possible quality. Finally, because we are interested in how potassium may affect common diseases, we apply fungicides only rarely –

usually in cases where we are concerned about losing the entire stand. In fact, only one fungicide has been applied during the past four years – a dollar spot control application was made last summer after a prolonged outbreak. Disease incidence is quantified by counting infection centers and by the grid intersection method, where an 81 point grid is placed on the plot and the presence/absence of the disease is recorded directly under each intersection.

RESULTS

We did not observe any statistically significant differences in color or quality among the plots during the 2016 season. No treatments had greater clipping yield than the non-fertilized control (Table 1).

Soil samples are taken monthly and the Mehlich-3 soil test results for potassium are show in Tables 2. The monthly soil samples show clear trends in differences in soil K values, and the differences closely follow the fertility treatments. Turfgrass tissue samples are collected and analyzed for nutrients monthly (one the same date as the soil sampling). Tissue concentrations of K are reported in Tables 3. These data show that the potassium fertilizer treatments strongly influenced the potassium in the leaf. The K ranges from below 1.0% in the no K treatment in June to over 2.0% in the high K treatment in July, demonstrating that our treatment applications have been successful in creating conditions suitable for testing the impact of K on turfgrass responses.

Potassium treatments affected pink snow mold severity (Table 4). The three treatments receiving potassium fertilizer had greater amounts of snow mold damage. This effect has been consistent for the last several years of the study.

Table 1. Average turfgrass color, quality and daily clipping mass for the 2016 season. Color is measured using the Spectrum CM-1000 on a scale from 1-999 (greenest) and quality is rated using the NTEP scale of 1-9 (best). Results followed by different letters within each column are statistically different (alpha=0.05).

Treatment	Color	Quality	Clipping Yield
	1-999	1-9	g m^{-2}
0.2 lb Ca/M (gypsum)	298.2 A	5.41 A	7.33 AB
Control (no application)	296.8 A	5.64 A	7.54 A
0.1 lb K2O/M (K2SO4)	298.3 A	5.45 A	6.69 B
0.2 lb K2O/M (K2SO4)	297.8 A	5.73 A	6.89 AB
0.6 lb K2O/M (K2SO4)	293.2 A	5.59 A	7.31 AB

Table 2. Mehlich-3 soil test potassium levels during the 2016 season. Results followed by different letters within each column are statistically different (alpha=0.05).

Treatment	3 May	3 June	6 July	2 Aug.	15 Sept.	4 Oct.
	------------------------------- K mg kg^{-1} -------------------------------					
0.2 lb Ca/M (gypsum)	19.6 AB	19.2 AB	12.9 C	27.3 C	28.3 C	25.0 C
Control (no application)	16.5 B	16.1 B	14.7 C	23.2 C	27.5 C	22.2 C
0.1 lb K2O/M (K2SO4)	25.2 AB	24.0 AB	26.9 B	37.9 B	35.5 BC	31.0 B
0.2 lb K2O/M (K2SO4)	27.8 A	26.8 A	31.9 B	47.1 AB	37.3 AB	34.5 B
0.6 lb K2O/M (K2SO4)	28.9 A	28.9 A	43.3 A	51.6 A	43.8 A	48.4 A

Table 3. Potassium concentration in turf tissue during the 2016 season. Results followed by different letters within each column are statistically different (alpha=0.05).

Treatment	8 May	5 June	1 July	4 Aug.	1 Sept.	8. Oct.
	------------------------------- % K in Tissue -------------------------------					
0.2 lb Ca/M (gypsum)	0.62 B	0.96 C	1.37 D	1.14 C	1.55 C	1.16 C
Control (no application)	0.50 B	0.96 C	1.39 D	1.05 C	1.54 C	1.18 C
0.1 lb K2O/M (K2SO4)	0.63 B	1.30 B	1.64 C	1.34 B	1.76 B	1.45 B
0.2 lb K2O/M (K2SO4)	0.95 A	1.37 B	1.86 B	1.54 A	1.93 A	1.51 A
0.6 lb K2O/M (K2SO4)	1.16 A	1.52 A	2.06 A	1.65 A	1.90 A	1.65 A

Table 4. Pink snow mold (PSM) disease severity was quantified by counting infection centers and/or visually estimating the percentage of plot area occupied by infection in April 2016 and February 2017. Results followed by different letters within each column are statistically different (alpha=0.05).

	11 April 2016		2 February 2017	
Treatment	PSM Infection Visually	PSM Infection Grid	PSM Infection Visually	PSM Infection Grid
	% area	% intercepts	% area	% intercepts
0.2 lb Ca/M (gypsum)	3.5 B	5.6 B	10.0 B	18.2 B
Control (no application)	4.8 B	2.2 B	7.5 B	19.0 B
0.1 lb K2O/M (K2SO4)	22.5 A	27.2 A	57.5 A	54.6 A
0.2 lb K2O/M (K2SO4)	22.5 A	18.8 A	52.5 A	49.7 A
0.6 lb K2O/M (K2SO4)	20.0 A	25.3 A	70.0 A	59.9 A

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, 2017 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

The infection center data shows a movement toward two distinct levels of control: high (a) and low (c). Nortica 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/bc). 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. Chlorophyll content does not show a consistent trend at the time of publication. The non-treated, Emerald, and Nortica treated plots are consistently at a high chlorophyll level but the other treated plots have fluctuated. This measurement will need more data to make any meaningful conclusions. The turfgrass quality data is very similar to the dollar spot infection centers data. Plots treated with Emerald have the highest turf quality with Civitas Pre-Mixed treated plots also performing well. All other treatments have a low turfgrass quality.

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 2017.

	Treatment	Application Rate	App Interval	App Dates[b]	Dollar Spot Infection Centers[a]		
					June 6	June 20	July 4
1	Non-treated control	N/A	N/A	N/A	1.5 b	107.75 b	119.5 ab
2	Emerald	0.18 oz/1000 ft^2	28 Day	CG	0.25 b	8 c	0 c
3	Nortica	(1st) 12.9 oz/1000 ft^2 (rest) 6.4 oz/1000 ft^2	28 Day	C	9 a	199 a	170 a
4	Timorex gold	0.314 fl oz/1000 ft^2	14 Day	G	1.75 ab	142.75 ab	111 ab
5	Double Nickel LC	4 fl oz/1000 ft^2	14 Day	CEGI	3 ab	77 bc	63.75 bc
6	Rhapsody	10 fl oz/1000 ft^2	14 Day	CEGI	5.25 ab	122.5 ab	125.25 ab
7	Civitas Pre-M1xed	8 fl oz/1000 ft^2	14 Day	CEGI	1.5 b	73 bc	47.25 bc
8	Actinovate AG Revolution	0.275 oz/1000 ft^2 6 fl oz/1000 ft^2	14 Day	CEGI CG	3.5 ab	136.5 ab	101 ab
9	Zio	1.837 oz/1000 ft^2	14 Day	CEGI	2.25 ab	125.75 ab	127.25 ab
10	Serenade OPTI	0.459 oz/1000 ft^2	14 Day	CEGI	2.75 ab	71 bc	112 ab

[a]Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application dates: C=5/23, E=6/6, G=6/20, I=7/4

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 2017.

	Treatment	Application Rate	App Interval	App Dates[b]	Dollar Spot Infection Centers[a]		
					June 6	June 20	July 4
1	Non-treated control	N/A	N/A	N/A	233.5 a	266.5 a	351.25 a
2	Emerald	0.18 oz/1000 ft^2	28 Day	CG	227.5 a	261.25 a	348.5 a
3	Nortica	(1st) 12.9 oz/1000 ft^2 (rest) 6.4 oz/1000 ft^2	28 Day	C	224 a	258.25 a	352 a
4	Timorex gold	0.314 fl oz/1000 ft^2	14 Day	G	216.75 a	244.5 ab	335.75 ab
5	Double Nickel LC	4 fl oz/1000 ft^2	14 Day	CEGI	228.75 a	247.75 ab	270 b
6	Rhapsody	10 fl oz/1000 ft^2	14 Day	CEGI	223 a	207.75 b	347.75 a
7	Civitas Pre-M1xed	8 fl oz/1000 ft^2	14 Day	CEGI	221.5 a	247.75 ab	346.25 a
8	Actinovate AG Revolution	0.275 oz/1000 ft^2 6 fl oz/1000 ft^2	14 Day	CEGI CG	214 a	245.25 ab	344.25 a
9	Zio	1.837 oz/1000 ft^2	14 Day	CEGI	221.5 a	253.5 ab	341.5 ab
10	Serenade OPTI	0.459 oz/1000 ft^2	14 Day	CEGI	216.75 a	252.5 ab	337.5 ab

[a]Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application dates: C=5/23, E=6/6, G=6/20, I=7/4

Table 3. Mean turfgrass quality per treatment on creeping bentgrass maintained at putting green height at the OJ Noer Turfgrass Research Facility in Madison, WI during 2017.

	Treatment	Application Rate	App Interval	App Dates[b]	Dollar Spot Infection Centers[a]		
					June 6	June 20	July 4
1	Non-treated control	N/A	N/A	N/A	7 ab	4.75 bc	4 bc
2	Emerald	0.18 oz/1000 ft^2	28 Day	CG	6.75 ab	6.5 a	7.75 a
3	Nortica	(1st) 12.9 oz/1000 ft^2 (rest) 6.4 oz/1000 ft^2	28 Day	C	6.75 ab	3.75 bc	3.25 c
4	Timorex gold	0.314 fl oz/1000 ft^2	14 Day	G	7 ab	3.5 c	4 bc
5	Double Nickel LC	4 fl oz/1000 ft^2	14 Day	CEGI	6 b	5 b	4.75 bc
6	Rhapsody	10 fl oz/1000 ft^2	14 Day	CEGI	6.75 ab	4.25 bc	4 bc
7	Civitas Pre-M1xed	8 fl oz/1000 ft^2	14 Day	CEGI	7.5 a	4.25 bc	5.75 ab
8	Actinovate AG Revolution	0.275 oz/1000 ft^2 6 fl oz/1000 ft^2	14 Day	CEGI CG	6.75 ab	4 bc	4.5 bc
9	Zio	1.837 oz/1000 ft^2	14 Day	CEGI	7 ab	4.25 bc	3.75 bc
10	Serenade OPTI	0.459 oz/1000 ft^2	14 Day	CEGI	6.25 b	4.5 bc	4.5 bc

[a]Means followed by the same letter do not significantly differ (P=.05, Fisher's LSD).
[b]Application dates: C=5/23, E=6/6, G=6/20, I=7/4

Common Ground Initiative

Kurt Hockemeyer, Matt Kapushinski, 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 3 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 moderate so far this season with non-treated controls averaging 41.5 dollar spot foci per plot on the June 26 rating date. All fungicide programs have significantly reduced dollar spot severity compared to the nontreated controls. All fungicide programs have been of acceptable turf quality as well.

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 2017.

		Treatment	Rate	Application Date	Dollar spot severity[a]	
					Jun 13	Jun 26
1		Non-treated control			3.8a	41.5a
2	25 % of State average	Xzemplar	0.26 fl oz/1000 ft2	May 17	1.0a	0.8a
		Banner Maxx	2 fl oz/1000 ft2	Jun 14		
		Velista	0.5 oz/1000 ft2	Jun 28		
		Secure	0.5 fl oz/1000 ft2	Jul 12		
		Secure	0.5 fl oz/1000 ft2	Jul 26		
		Xzemplar	0.26 fl oz/1000 ft2	Aug 9		
		Emerald	0.18 oz/1000 ft2	Sep 6		
		Banner Maxx	2 fl oz/1000 ft2	Oct 4		
		Secure	0.5 fl oz/1000 ft2	Nov 16		
		Torque	0.6 fl oz/1000 ft2	Nov 16		
3	50 % of State average	Xzemplar	0.26 fl oz/1000 ft2	May 17	1.8a	0.8a
		Secure	0.5 fl oz/1000 ft2	Jun 7		
		Secure	0.5 fl oz/1000 ft2	Jun 28		
		Secure	0.5 fl oz/1000 ft2	Jul 12		
		Secure	0.5 fl oz/1000 ft2	Jul 26		
		Banner Maxx	1 fl oz/1000 ft2	Aug 9		
		Xzemplar	0.26 fl oz/1000 ft2	Aug 23		
		Daconil Ultrex	3.6 oz/1000 ft2	Aug 23		
		Banner Maxx	2 fl oz/1000 ft2	Sep 20		
		Daconil Ultrex	5 oz/1000 ft2	Sep 20		
		Daconil Ultrex	5 oz/1000 ft2	Nov 14		
		Torque	0.6 fl oz/1000 ft2	Nov 14		
4	75 % of State average	Secure	0.5 fl oz/1000 ft2	May 24	1.3a	1.8a
		Xzemplar	0.26 fl oz/1000 ft2	Jun 14		
		Banner Maxx	1 fl oz/1000 ft2	Jul 5		
		Heritage TL	1 fl oz/1000 ft2	Jul 5		
		Xzemplar	0.26 fl oz/1000 ft2	Jul 26		
		Daconil Action	3 fl oz/1000 ft2	Aug 16		
		Concert II	3 fl oz/1000 ft2	Aug 30		
		26 GT	2 fl oz/1000 ft2	Sep 23		
		Banner Maxx	2 fl oz/1000 ft2	Oct 14		
		Instrata	9 fl oz/1000 ft2	Nov 10		
5	100 % of State average	Banner Maxx	2 fl oz/1000 ft2	May 17	0.0a	2.3a
		Banner Maxx	1 fl oz/1000 ft2	May 31		
		26 GT	4 fl oz/1000 ft2	Jun 14		
		Renown	3.53 fl oz/1000 ft2	Jul 5		
		Daconil Weatherstik	3.6 fl oz/1000 ft2	Jul 19		
		Torque	0.6 fl oz/1000 ft2	Aug 2		
		26 GT	4 fl oz/1000 ft2	Aug 16		
		Heritage TL	1 fl oz/1000 ft2	Aug 16		
		Torque	0.6 fl oz/1000 ft2	Aug 30		
		Emerald	0.15 oz/1000 ft2	Sep 20		
		Instrata	7 fl oz/1000 ft2	Nov 20		

[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 2017.

		Treatment	Rate	Application Date/Interval	Turf Quality[a]	
					Jun 13	Jun 26
1		Non-treated control			7.0a	5.8a
2	25 % of State average	Xzemplar	0.26 fl oz/1000 ft2	May 17	7.0a	7.0a
		Banner Maxx	2 fl oz/1000 ft2	Jun 14		
		Velista	0.5 oz/1000 ft2	Jun 28		
		Secure	0.5 fl oz/1000 ft2	Jul 12		
		Secure	0.5 fl oz/1000 ft2	Jul 26		
		Xzemplar	0.26 fl oz/1000 ft2	Aug 9		
		Emerald	0.18 oz/1000 ft2	Sep 6		
		Banner Maxx	2 fl oz/1000 ft2	Oct 4		
		Secure	0.5 fl oz/1000 ft2	Nov 16		
		Torque	0.6 fl oz/1000 ft2	Nov 16		
3	50 % of State average	Xzemplar	0.26 fl oz/1000 ft2	May 17	7.0a	7.0a
		Secure	0.5 fl oz/1000 ft2	Jun 7		
		Secure	0.5 fl oz/1000 ft2	Jun 28		
		Secure	0.5 fl oz/1000 ft2	Jul 12		
		Secure	0.5 fl oz/1000 ft2	Jul 26		
		Banner Maxx	1 fl oz/1000 ft2	Aug 9		
		Xzemplar	0.26 fl oz/1000 ft2	Aug 23		
		Daconil Ultrex	3.6 oz/1000 ft2	Aug 23		
		Banner Maxx	2 fl oz/1000 ft2	Sep 20		
		Daconil Ultrex	5 oz/1000 ft2	Sep 20		
		Daconil Ultrex	5 oz/1000 ft2	Nov 14		
		Torque	0.6 fl oz/1000 ft2	Nov 14		
4	75 % of State average	Secure	0.5 fl oz/1000 ft2	May 24	7.0a	7.0a
		Xzemplar	0.26 fl oz/1000 ft2	Jun 14		
		Banner Maxx	1 fl oz/1000 ft2	Jul 5		
		Heritage TL	1 fl oz/1000 ft2	Jul 5		
		Xzemplar	0.26 fl oz/1000 ft2	Jul 26		
		Daconil Action	3 fl oz/1000 ft2	Aug 16		
		Concert II	3 fl oz/1000 ft2	Aug 30		
		26 GT	2 fl oz/1000 ft2	Sep 23		
		Banner Maxx	2 fl oz/1000 ft2	Oct 14		
		Instrata	9 fl oz/1000 ft2	Nov 10		
5	100 % of State average	Banner Maxx	2 fl oz/1000 ft2	May 17	7.0a	7.0a
		Banner Maxx	1 fl oz/1000 ft2	May 31		
		26 GT	4 fl oz/1000 ft2	Jun 14		
		Renown	3.53 fl oz/1000 ft2	Jul 5		
		Daconil Weatherstik	3.6 fl oz/1000 ft2	Jul 19		
		Torque	0.6 fl oz/1000 ft2	Aug 2		
		26 GT	4 fl oz/1000 ft2	Aug 16		
		Heritage TL	1 fl oz/1000 ft2	Aug 16		
		Torque	0.6 fl oz/1000 ft2	Aug 30		
		Emerald	0.15 oz/1000 ft2	Sep 20		
		Instrata	7 fl oz/1000 ft2	Nov 20		

[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).

Dollar Spot Control Using Alternative Methods

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

OBJECTIVE

To monitor the impacts of various fertilizer and other alternative suppression methods on dollar spot control.

MATERIALS AND METHODS

The study was conducted at the O. J. Noer Turfgrass Research and Education Facility in Madison, WI on a stand of creeping bentgrass (*Agrostis stolonifera* ‘Penncross’) 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 p.s.i. using a CO_2 pressurized boom sprayer equipped with two 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. All treatments were initiated on June 1st and products were reapplied at a 14-day interval or as determined by the Smith-Kerns model. Disease severity (number of dollar spot foci per plot) and turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) were assessed. Turf quality and disease severity were subjected to an analysis of variance and means were separated using Fisher’s LSD ($P = 0.05$). Results of the 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 66 dollar spot infection centers per plot on the most recent rating date. The only treatment to significantly reduce dollar spot severity was the fungicide treatment. The only treatments to significantly increase turf quality compared to the non-treated controls was the urea treatments and the fungicide treatment.

Table 1. Mean number of dollar spot foci per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI during 2017.

	Treatment	Application Interval	Rate	Application Code[a]	Dollar Spot Severity[b]	
					Jun 13	Jun 26
1	Non-treated control				5.9a	66.3a
2	Urea	14 day	0.6 lbs N/1000 ft2	DFHJ	3.7a	29.3ab
3	Urea	20% risk	0.6 lbs N/1000 ft2	DFHJ	3.2a	16.7ab
4	Iron Sulfate	14 day	3 oz/1000 ft2	DFHJ	4.9a	59.6a
5	Iron Sulfate	20% risk	3 oz/1000 ft2	DFHJ	2.7a	42.5ab
6	Potassium Carbonate	14 day	1.1 oz/1000 ft2	DFHJ	7.1a	44.6ab
7	Potassium Carbonate	20% risk	1.1 oz/1000 ft2	DFHJ	2.7a	9.6ab
8	Sulfur Duraphite 12	14 day	0.25 lbs S/1000 ft2 3.14 fl oz/1000 ft2	DFHJ	3.9a	21.8ab
9	Sulfur Duraphite 12	20% risk	0.25 lbs S/1000 ft2 3.14 fl oz/1000 ft2	DFHJ	7.9a	43.4ab
10	Manganese Sulfate	14 day	3 oz/1000 ft2	DFHJ	9.3a	45.2ab
11	Manganese Sulfate	20% risk	3 oz/1000 ft2	DFHJ	3.8a	47.2ab
12	Xzemplar Banner Maxx Secure Xzemplar Secure 26 GT Secure Banner Maxx		0.26 fl oz/1000 ft2 1.5 fl oz/1000 ft2 0.5 fl oz/1000 ft2 0.26 fl oz/1000 ft2 0.5 fl oz/1000 ft2 3 fl oz/1000 ft2 0.5 fl oz/1000 ft2 1.5 fl oz/1000 ft2	D H J	0.4a	0.4b

[a]Application code D=June 1st, F=June 15th, H=June 27th, J=July 11th
[b]Dollar spot severity 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 turfgrass quality at the OJ Noer Turfgrass Research and Education Facility in Madison, WI during 2017.

	Treatment	Application Interval	Rate	Application Code[a]	Turf Quality[b]	
					Jun 13	Jun 26
1	Non-treated control				6.5a	5.0c
2	Urea	14 day	0.6 lbs N/1000 ft2	DFHJ	7.5a	7.0ab
3	Urea	20% risk	0.6 lbs N/1000 ft2	DFHJ	7.8a	7.2a
4	Iron Sulfate	14 day	3 oz/1000 ft2	DFHJ	6.8a	5.2c
5	Iron Sulfate	20% risk	3 oz/1000 ft2	DFHJ	6.8a	5.0c
6	Potassium Carbonate	14 day	1.1 oz/1000 ft2	DFHJ	6.8a	5.2c
7	Potassium Carbonate	20% risk	1.1 oz/1000 ft2	DFHJ	7.0a	6.5abc
8	Sulfur Duraphite 12	14 day	0.25 lbs S/1000 ft2 3.14 fl oz/1000 ft2	DFHJ	6.5a	6.1abc
9	Sulfur Duraphite 12	20% risk	0.25 lbs S/1000 ft2 3.14 fl oz/1000 ft2	DFHJ	6.3a	5.5bc
10	Manganese Sulfate	14 day	3 oz/1000 ft2	DFHJ	6.5a	5.2c
11	Manganese Sulfate	20% risk	3 oz/1000 ft2	DFHJ	6.8a	5.7abc
12	Xzemplar Banner Maxx Secure Xzemplar Secure 26 GT Secure Banner Maxx		0.26 fl oz/1000 ft2 1.5 fl oz/1000 ft2 0.5 fl oz/1000 ft2 0.26 fl oz/1000 ft2 0.5 fl oz/1000 ft2 3 fl oz/1000 ft2 0.5 fl oz/1000 ft2 1.5 fl oz/1000 ft2	D H J	7.0a	7.0ab

[a]Application code D=June 1st, F=June 15th, H=June 27th, J=July 11th
[b]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).

Effects of Dew Removal on Dollar Spot Control

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

OBJECTIVE

To determine if dew removal has any effect on efficacy of various fungicides for the control of dollar spot.

MATERIALS AND METHODS

The study was conducted at the O. J. Noer Turfgrass Research and Education Facility in Madison, WI on a stand of creeping bentgrass (*Agrostis stolonifera* 'Penncross') 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 p.s.i. using a CO_2 pressurized boom sprayer equipped with two 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. All treatments were initiated on June 1st and fungicides were reapplied at either a 14 or 21-day interval. Half of the fungicide treatments were applied early in the morning when the dew was thick, and the other half were applied at the same time but only after the dew had been removed with a dew whip. Disease severity (number of dollar spot foci per plot) and turfgrass quality (1-9, 9 being excellent, 6 acceptable, and 1 bare soil) were assessed. Turf quality and disease severity were subjected to an analysis of variance and means were separated using Fisher's LSD ($P = 0.05$). Results of the 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 nontreated controls averaging 80.8 (dew) and 46.3 (no dew) dollar spot infection centers per plot. Removing the dew significantly reduced dollar spot severity in the nontreated control plots only on the last rating date. Dew removal has not had any statistical effect on disease in the fungicide treated plots. The turf quality ratings were not statistically different for nontreated controls regardless of dew removal. No fungicide treatments were statistically different on the last rating date

Table 1. Mean number of dollar spot foci per treatment at the OJ Noer Turfgrass Research and Education Facility in Madison, WI during 2016.

	Treatment	Dew/No Dew	Rate	Application Interval	Dollar Spot Severity[a]	
					Jun 13	Jun 26
1	Non-treated control	Dew			13.5a	80.8a
2	Daconil Weatherstik	Dew	5.5 fl oz/1000 ft2	14 day	2.5b	6.8c
3	26 GT	Dew	3 fl oz/1000 ft2	14 day	4.0ab	20.5c
4	Emerald	Dew	0.13 oz/1000 ft2	21 day	1.5b	9.0c
5	Non-treated control	No Dew			11.8ab	46.3b
6	Daconil Weatherstik	No Dew	5.5 fl oz/1000 ft2	14 day	0.5b	3.8c
7	26 GT	No Dew	3 fl oz/1000 ft2	14 day	2.3b	1.5c
8	Emerald	No Dew	0.13 oz/1000 ft2	21 day	4.3ab	2.3c

[a]Dollar spot severity 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 turfgrass quality at the OJ Noer Turfgrass Research and Education Facility in Madison, WI during 2016.

	Treatment	Dew/No Dew	Rate	Application Interval	Turf Quality[a]	
					Jun 13	Jun 26
1	Non-treated control	Dew			4.3c	4.5b
2	Daconil Weatherstik	Dew	5.5 fl oz/1000 ft2	14 day	6.8ab	6.8a
3	26 GT	Dew	3 fl oz/1000 ft2	14 day	6.0b	6.3a
4	Emerald	Dew	0.13 oz/1000 ft2	21 day	6.8ab	6.5a
5	Non-treated control	No Dew			5.0c	4.8b
6	Daconil Weatherstik	No Dew	5.5 fl oz/1000 ft2	14 day	7.5a	6.8a
7	26 GT	No Dew	3 fl oz/1000 ft2	14 day	7.3ab	6.8a
8	Emerald	No Dew	0.13 oz/1000 ft2	21 day	6.8ab	6.8a

[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

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

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. Three 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, the second based the application timing on the Smith-Kerns dollar spot prediction model using conventional fungicides, and the third based application timing on the Smith-Kerns dollar spot model and used low rates of conventional fungicides tank-mixed with Civitas Pre-M1xed. 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 varied greatly between the three study locations. Only the Noer location has had dollar spot pressure up to this point with non-treated controls averaging 197.5 and 145.3 dollar spot foci per plot on each rating date. All three fungicide programs have significantly reduced dollar spot symptoms despite high disease pressure. All three fungicide programs were also above the acceptable threshold 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 2017.

		Treatment	Rate	Application Date/Interval	Dollar spot severity[a]	
					Jun 20	Jul 7
1		Non-treated control			197.5a	145.3a
2	Standard Program	Emerald	0.18 oz/1000 ft2	May 23	19.0b	39.3b
		Banner Maxx	2 fl oz/1000 ft2	Jun 20		
		Interface	4 fl oz/1000 ft2	Jul 11		
		Velista	0.5 oz/1000 ft2	Jul 25		
		Secure	0.5 fl oz/1000 ft2	Jul 25		
		Xzemplar	0.26 fl oz/1000 ft2	Aug 8		
		Pinpoint	0.31 fl oz/1000 ft2	Sep 5		
		26 GT	4 fl oz/1000 ft2	Oct 3		
		Banner Maxx	2 fl oz/1000 ft2	Oct 15		
3	Smith-Kerns model: Standard	Emerald (C)	0.18 oz/1000 ft2	28 day	21.3b	38.5b
		Banner Maxx (G)	2 fl oz/1000 ft2	21 day		
		Interface (J)	4 fl oz/1000 ft2	14 day		
		Velista (L)	0.5 oz/1000 ft2	14 day		
		Secure (L)	0.5 fl oz/1000 ft2			
		Xzemplar (N)	0.26 fl oz/1000 ft2	28 day		
		Pinpoint (R)	0.31 fl oz/1000 ft2	28 day		
		26 GT (V)	4 fl oz/1000 ft2	14 day		
		Banner Maxx (X)	2 fl oz/1000 ft2	14 day		
4	Smith-Kerns model: Low Rate Convent.+Civitas	Emerald (C)	0.13 oz/1000 ft2	28 day	10.3b	41.3b
		Civitas Pre-M1xed (C)	8.5 fl oz/1000 ft2			
		Banner MAXX (G)	1 fl oz/1000 ft2	21 day		
		Civitas Pre-M1xed (G)	8.5 fl oz/1000 ft2			
		Interface (J)	2 fl oz/1000 ft2	14 day		
		Civitas Pre-M1xed (J)	8.5 fl oz/1000 ft2			
		Velista (L)	0.5 oz/1000 ft2	14 day		
		Secure (L)	0.5 fl oz/1000 ft2			
		Civitas Pre-M1xed (L)	8.5 fl oz/1000 ft2			
		Xzemplar (N)	0.13 fl oz/1000 ft2	28 day		
		Civitas Pre-M1xed (N)	8.5 fl oz/1000 ft2			
		Pinpoint (R)	0.16 fl oz/1000 ft2	28 day		
		Civitas Pre-M1xed (R)	8.5 fl oz/1000 ft2			
		26 GT (V)	2 fl oz/1000 ft2	14 day		
		Civitas Pre-M1xed (V)	8.5 fl oz/1000 ft2			
		Banner MAXX (X)	1 fl oz/1000 ft2	14 day		
		Civitas Pre-M1xed (X)	8.5 fl oz/1000 ft2			

[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 2017.

		Treatment	Rate	Application Date/Interval	Turf Quality[a] Jun 20	Turf Quality[a] Jul 7
1		Non-treated control			4.0b	4.0b
2	Standard Program	Emerald (C)	0.18 oz/1000 ft2	May 23	7.0a	6.8a
		Banner Maxx (G)	2 fl oz/1000 ft2	Jun 20		
		Interface (J)	4 fl oz/1000 ft2	Jul 11		
		Velista (L)	0.5 oz/1000 ft2	Jul 25		
		Secure (L)	0.5 fl oz/1000 ft2	Jul 25		
		Xzemplar (N)	0.26 fl oz/1000 ft2	Aug 8		
		Pinpoint (R)	0.31 fl oz/1000 ft2	Sep 5		
		26 GT (V)	4 fl oz/1000 ft2	Oct 3		
		Banner Maxx (X)	2 fl oz/1000 ft2	Oct 15		
3	Smith-Kerns model: Standard	Emerald (C)	0.18 oz/1000 ft2	28 day	7.3a	6.8a
		Banner Maxx (G)	2 fl oz/1000 ft2	21 day		
		Interface (J)	4 fl oz/1000 ft2	14 day		
		Velista (L)	0.5 oz/1000 ft2	14 day		
		Secure (L)	0.5 fl oz/1000 ft2			
		Xzemplar (N)	0.26 fl oz/1000 ft2	28 day		
		Pinpoint (R)	0.31 fl oz/1000 ft2	28 day		
		26 GT (V)	4 fl oz/1000 ft2	14 day		
		Banner Maxx (X)	2 fl oz/1000 ft2	14 day		
4	Smith-Kerns model: Low Rate Convent.+Civitas	Emerald (C)	0.13 oz/1000 ft2	28 day	7.5a	6.8a
		Civitas Pre-M1xed (C)	8.5 fl oz/1000 ft2			
		Banner MAXX (G)	1 fl oz/1000 ft2	21 day		
		Civitas Pre-M1xed (G)	8.5 fl oz/1000 ft2			
		Interface (J)	2 fl oz/1000 ft2	14 day		
		Civitas Pre-M1xed (J)	8.5 fl oz/1000 ft2			
		Velista (L)	0.5 oz/1000 ft2	14 day		
		Secure (L)	0.5 fl oz/1000 ft2			
		Civitas Pre-M1xed (L)	8.5 fl oz/1000 ft2			
		Xzemplar (N)	0.13 fl oz/1000 ft2	28 day		
		Civitas Pre-M1xed (N)	8.5 fl oz/1000 ft2			
		Pinpoint (R)	0.16 fl oz/1000 ft2	28 day		
		Civitas Pre-M1xed (R)	8.5 fl oz/1000 ft2			
		26 GT (V)	2 fl oz/1000 ft2	14 day		
		Civitas Pre-M1xed (V)	8.5 fl oz/1000 ft2			
		Banner MAXX (X)	1 fl oz/1000 ft2	14 day		
		Civitas Pre-M1xed (X)	8.5 fl oz/1000 ft2			

[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).

Impact of Nitrogen Rate and Source on Dollar Spot

R.V. Townsend, E. J. Nangle, D.J. Soldat, D.L. Smith, D.F. Dinelli, P.L. Koch
Department of Plant Pathology
University of Wisconsin – Madison

INTRODUCTION

To determine the impact of nitrogen rate and nitrogen source on dollar spot (*Sclerotinia homoeocarpa*) development on a golf course putting green.

MATERIALS AND METHODS

Field trials are being conducted at O.J. Noer Turfgrass Research Facility and at North Shore Country Club in Glenview, Illinois. These trials were initiated in June of 2015. Currently, there are two trials being conducted at each site analyzing nitrogen rate and nitrogen source on green height turf. The trials at North Shore Country Club are being conducted on a push-up based nursery that is mowed at 0.115 inch cutting height using a Toro Greensmaster 1000. Trials taking place at the O.J Noer facility are grown on a sand-based root zone maintained at a height of 0.125” using a Toro Greensmaster 3150. Individual plots measured 6 ft X 4 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 nozzles. All fungicides were agitated by hand and applied in the equivalent of 2.0 gallons of water per 1000 ft^2. Disease severity (number of dollar spot foci) and turfgrass quality (1-9, 9 being excellent, 6 being acceptable, and 1 bare soil) are visually assessed every 2 weeks. Clippings are collected from each plot and then analyzed each month for foliar pH and foliar nitrogen content.

RESULTS AND DISCUSSION

Nitrogen Rate

Dollar Spot Pressure is slowly starting to increase at both sites. Compared to the data from last year dollar spot pressure at the O.J Noer and North Shore Country Club has been fairly similar. The results from last year suggest that dollar spot can be controlled using nitrogen applications. However the results show this is not a dose dependent relationship and the only rate of nitrogen to successfully control the disease was the highest rate. The highest rate of nitrogen not only was more significantly different from the non-treated control but also provide the same level of control as our conventional fungicide program see figures 1 and 2 below.

Table 1. Area under disease progress curve (AUDPC) for all treatments in located at OJ Noer Turfgrass Research Facility in Madison WI during 2016.

	Treatment	Rate	Application Interval	AUDPC (Infection Centers)
1	Non-treated control			2765 A[a]
2	Urea	0.1 LB N/1000 FT2	14 Day	2352 A
3	Urea	0.2 LB N/1000 FT2	14 Day	2514.75 A
4	Urea	0.4 LB N/1000 FT2	14 Day	1596 A
5	Urea	0.6 LB N/1000 FT2	14 Day	428.75 B
6[b]	Xzemplar Banner MAXX II Secure Xzemplar Secure Iprodione Secure Banner MAXX II	0.26 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 0.26 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 3.0 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2	14 Day	234.5 B

[a]Area under the disease progress curve (AUDPC) assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=0.05).
[b]Treatment 6 received no applications of nitrogen since the trials inception in June of 2015.

Table 2. Area under disease progress curve (AUDPC) for all treatments in located at North Shore Country Club in Glenview IL during 2016.

	Treatment	Rate	Application Interval	AUDPC (Infection Centers)
1	Non-treated control			8410.5 A[a]
2	Urea	0.1 LB N/1000 FT2	14 Day	7952 A
3	Urea	0.2 LB N/1000 FT2	14 Day	7847 A
4	Urea	0.4 LB N/1000 FT2	14 Day	7441 A
5	Urea	0.6 LB N/1000 FT2	14 Day	2656.5 B
6 [b]	Xzemplar Banner MAXX II Secure Xzemplar Secure Iprodione Secure Banner MAXX II	0.26 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 0.26 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 3.0 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2	14 Day	633.5 B

[a]Area under the disease progress curve (AUDPC) assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=0.05).
[b]Treatment 6 received no applications of nitrogen since the trials inception in June of 2015

Nitrogen Source

Dollar spot pressure is starting to intensify on both sites. Looking at the data from the last two years we did not see any significant differences between nitrogen sources for reducing dollar spot severity. Looking at the tables below we see slight differences between some of the nitrogen sources but these differences are not significant. Early in the season we did see less dollar spot in the calcium nitrate treatments however over the course of the season no significant differences were found, see table 3 and 4 below.

Table 3. Area under disease progress curve (AUDPC) for all treatments in located at OJ Noer Turfgrass Research Facility in Madison WI during 2016.

	Treatment	Rate	Application Interval	AUDPC (Infection Centers)
1	Non-treated control			5496.75 A[a]
2	Calcium Nitrate	0.2 LB N/1000 FT2	14 Day	4705.75 A
3	Ammonium Sulfate	0.2 LB N/1000 FT2	14 Day	5141.5 A
4	Ammonium Nitrate	0.2 LB N/1000 FT2	14 Day	5164.25 A
5[b]	Xzemplar Banner MAXX II Secure Xzemplar Secure Iprodione Secure Banner MAXX II	0.26 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 0.26 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 3.0 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2	14 Day	693 B

[a]Area under the disease progress curve (AUDPC) assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=0.05).

[b]Treatment 5 received no applications of nitrogen since the trials inception in June of 2015.

Table 4. Area under disease progress curve (AUDPC) for all treatments in located at North Shore Country Club in Glenview IL during 2016.

	Treatment	Rate	Application Interval	AUDPC (Infection Centers)
1	Non-treated control			7525 A[a]
2	Calcium Nitrate	0.2 LB N/1000 FT2	14 Day	7056 A
3	Ammonium Sulfate	0.2 LB N/1000 FT2	14 Day	7119 A
4	Ammonium Nitrate	0.2 LB N/1000 FT2	14 Day	7840 A
5[b]	Xzemplar Banner MAXX II Secure Xzemplar Secure Iprodione Secure Banner MAXX II	0.26 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 0.26 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 3.0 FL OZ/1000 FT2 0.5 FL OZ/1000 FT2 1.5 FL OZ/1000 FT2	14 Day	427 B

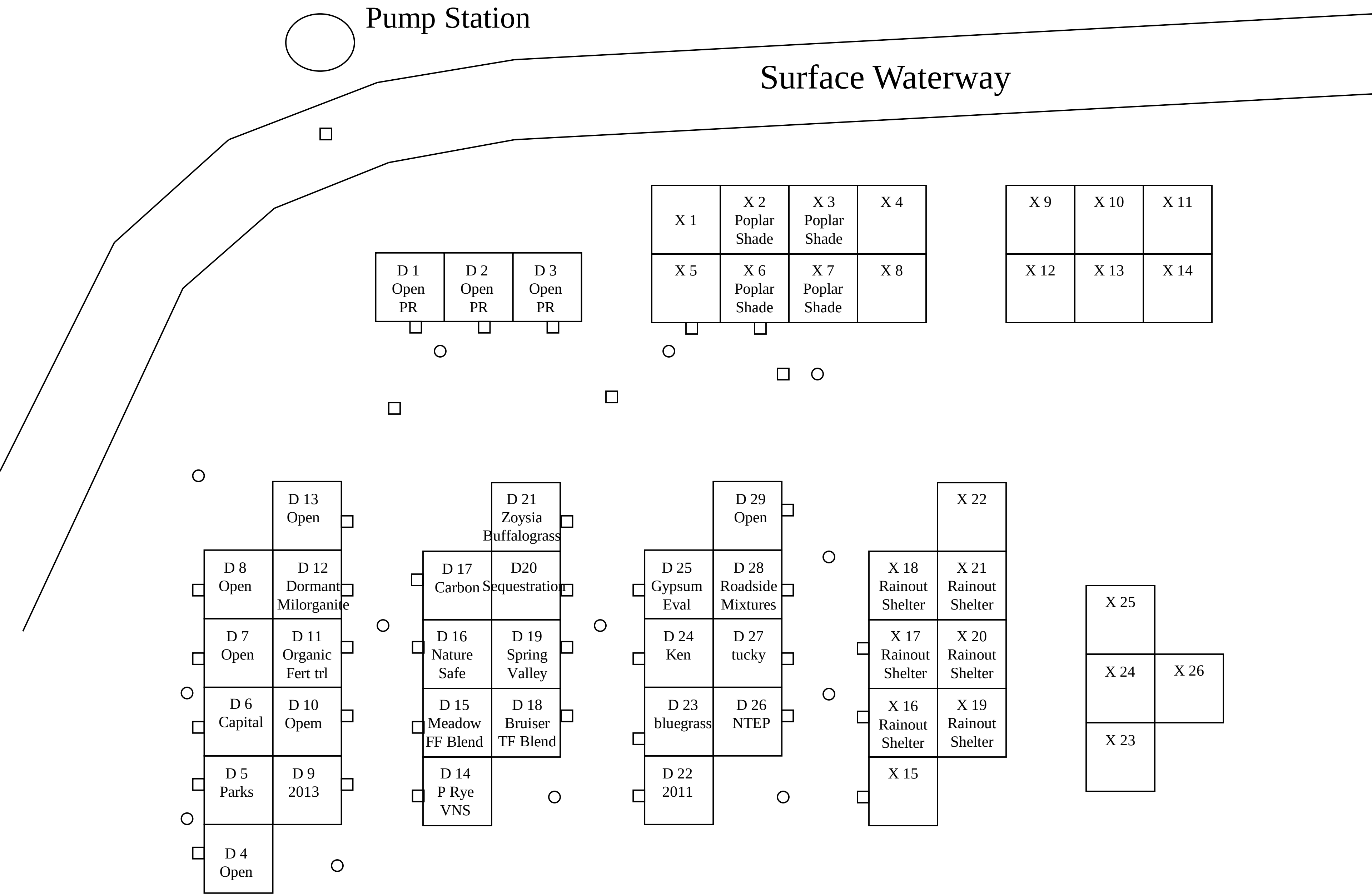
[a]Area under the disease progress curve (AUDPC) assessed as number of dollar spot infection centers per plot. Means followed by the same letter do not significantly differ (P=0.05).

[b]Treatment 5 received no applications of nitrogen since the trials inception in June of 2015.

2008 NTEP Bentgrass Fairway/Tee Test

7	19	21	15	3	9	10	2	17	12	11	1
14	23	18	16	8	20	6	5	4	13	22	X
1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	X
5	14	11	12	21	16	15	20	8	18	6	10
7	3	1	13	4	22	23	19	9	17	2	X

Entry No.	Name	Entry No.	Name
1	Penncross	13	A08-TDN2
2	Crystal Bluelinks	14	A08-FT12 (colonial)
3	Benchmark DSR	15	SRP-1WM
4	Declaration	16	007
5	LTP-FEC	17	PST-OJD
6	L-93	18	PST-R9D7 (colonial)
7	T-1	19	Princeville
8	Authority	20	HTM
9	CY-2	21	BCD (colonial)
10	MVS-Ap-101	22	Tiger II (colonial)
11	Memorial	23	Greentime (colonial)
12	A08-EDM (colonial)		


Pump Station
Surface Waterway
D 1 Open PR
D 2 Open PR
D 3 Open PR
X 1
X 2 Poplar Shade
X 3 Poplar Shade
X 4
X 5
X 6 Poplar Shade
X 7 Poplar Shade
X 8
X 9
X 10
X 11
X 12
X 13
X 14
D 13 Open
D 8 Open
D 12 Dormant Milorganite
D 7 Open
D 11 Organic Fert trl
D 6 Capital
D 10 Opem
D 5 Parks
D 9 2013
D 4 Open
D 21 Zoysia Buffalograss
D 17 Carbon
D20 Sequestration
D 16 Nature Safe
D 19 Spring Valley
D 15 Meadow FF Blend
D 18 Bruiser TF Blend
D 14 P Rye VNS
D 29 Open
D 25 Gypsum Eval
D 28 Roadside Mixtures
D 24 Ken
D 27 tucky
D 23 bluegrass
D 26 NTEP
D 22 2011
X 22
X 18 Rainout Shelter
X 21 Rainout Shelter
X 17 Rainout Shelter
X 20 Rainout Shelter
X 16 Rainout Shelter
X 19 Rainout Shelter
X 15
X 25
X 24
X 26
X 23

O.J. Noer Turfgrass Research and Education Facility

Large numbers roughly correspond to morning research tour locations