

# **2007 Wisconsin Turfgrass Research Reports**

## **Volume XXV**

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## **2007 Research Donors and Sponsors**

We are sincerely grateful for the tremendous industry support for the UW Turfgrass Program provided by our sponsors. Without your help, our turfgrass research and educational program would be unable to function anywhere near its current and targeted level. In 2007, donors supplied mowers, topdressers, chemicals and fertilizers, irrigation parts, and more. Several golf courses supplied land and assistance for projects in Wisconsin and Minnesota. Jake Schneider became the first graduate student to complete his degree with support from the Terry and Kathleen Kurth Wisconsin Distinguished Graduate Fellowship. His project on the relative abilities of turf lawns and rain gardens to reduce urban runoff pollution and enhance groundwater recharge received national attention. The Kurth Fellowship is one of four such fellowships in the turf program at the University of Wisconsin-Madison, more than any other land grant university.

While we strive for perfection and attempt to list all of our supporters, oversights may someday occur. If you have any comments or suggestions for the Wisconsin Turf Research Report, please contact John Stier at 608-262-1624 or [jstier@wisc.edu](mailto:jstier@wisc.edu). References to any product mentioned in these reports is for factual purposes only and is not intended to promote or otherwise influence the sale of any product or service.

While we attempt to publish all studies of relevance, results of some studies were still not completed at press time and so these studies will be added at a later date.

## 2007 Research Donors and Sponsors

Abbey Springs GC	Monroe CC
AgraQuest	Monsanto
Andersons	Nagawaukee Golf Course
Aquatrols	National Mowers
Arysta Life Sciences	Nexgen Seed Co.
Badgerland Irrigation	Nitragin Inc.
Barenbrug Seed Co.	Northern Great Lakes GC Super. Assoc.
Bayer	Novozymes Biologicals Inc.
BASF	National Turfgrass Evaluation Program (NTEP)
Beacon Ballfields	Ocean Organics
Blackhawk C C	PBI Gordon
Blackwolf Run	Pearl Valley Organix
Bridges Golf Course	Pendelton Turf Supply
The Bruce Co.	Pennington Seed Inc.
Bull's Eye C C	Plant Health Care, Inc.
CALS/ARS	Quali-Pro
Cascade International Seed Co.	Reinders Turf and Irrigation
Cedar Creek C C	Seed Research of Oregon
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Dow Agrosiences	Summit Seed
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Eagle River G C	TJ Emmerich and Associates
Floratine Products Group	The Scotts Co.
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Green Image Golf	Turfco
Greenwood Hills CC	Turfgrass Producers International
Honeywell Inc.	Turf Products
Horst Distributing	Turf-Seed
Hynite Corporation	United States Golf Association
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ISK Bioscience	U.S. Dept. of Agriculture-CSREES
Jacklin Seed	Valent Chemicals
Keyman Lawn Care	Verdicon
Lake Breeze GC	Watertronics
L. L. Olds Seed Co.	Watts Regulator
Lebanon Seaboard Corp.	WDATCP
LESCO	West Madison ARS
Long Island Farm	Wisconsin Golf Course Superintendents Association
Madison Metro Sewage District	Wisconsin Green Industry Federation
Merrill Hills C C	Wisconsin Sod Producers Association
Microflo	Wisconsin Sports Turf Mgrs. Assoc.
Midwest Bio-Ag	Wisconsin Turf Equipment
Milorganite Division, MMSD	Wisconsin Turfgrass Association
Milwaukee C C	Yahara Hills Golf Course
Monona Golf Course	

## Introduction to the Turf Program at the University of Wisconsin

Thanks in part to tremendous support by you, the turf industry, the turf program at the University of Wisconsin has expanded its commitment to turf research, extension, and instruction tremendously in the past several years. In 2007, the University of Wisconsin's turf research and extension program received international recognition by hosting the combined Turfgrass Producers International and Midwest Sod Council Field Days along with our own WTA Field Day. Over 1100 persons attended from the Americas, Europe, and Asia. The program continues to grow strong and faculty members who have retired or moved have been replaced. Dr. Doug Soldat, hired in December 2006, made his presence known in 2007 by leading training efforts on-line and in person throughout the state to assist industry compliance with NR151 rules regarding turf fertilization. He also increased the 1 credit turf nutrition course to a 3 credit, turf nutrition and water course, in order to provide tomorrow's turf managers with more knowledge to deal with forthcoming water issues. Given the tough budget times at the university where less than 50% of faculty losses are being replaced, we've been fortunate to retain 100% of the turf positions. As with Dr. Soldat's position, the Wisconsin Turfgrass Association offered in 2007 to provide the first year's salary and benefits for an incoming turf pathologist. The Department of Plant Pathology held interviews in September and hired Jim Kerns from North Carolina State University who will begin his duties in Wisconsin on July 1, 2008.

Please take a moment to read about the faculty, staff, and graduate students and their exciting and diverse research and extension programs. The university exists ultimately to serve the public good, and so though it may not be evident at first glance, all of the projects have the final goal of enhancing our understanding of turf management to help you become more successful and aid in sound decision-making at both the managerial and legislative levels.

## Our Faculty

**Dr. Mike Casler** (USDA and Adjunct Professor-Agronomy) 70% research, 30% instruction

Mike's program emphasis is in breeding better grasses for forage and turf. His turf projects include development of bentgrasses (creeping, colonial, and velvet) that are adapted to Wisconsin conditions (especially snow mold and *Poa annua* resistance). He also assists faculty and graduate students with statistical analysis.

**Dr. Doug Soldat** (Soil Sciences) 75% extension, 15% research, 10% instruction

Doug's program focuses on the nutritional and water use aspects of turf management. Numerous fertilizer trials are conducted each year. In addition, research is being developed to investigate the temperature effects of nitrogen uptake. A rain-out shelter has been purchased and will be installed in 2008 to provide a means for conducting drought and effluent irrigation studies.

**Dr. John Stier** (Horticulture) 70% extension, 30% instruction

John's research interests lie in sustainable golf and lawn turf management, athletic field management, cold and shade stress physiology, and turf's impact on the environment. Ancillary research projects include sod production, herbicide efficacy, establishment practices and cultivar evaluations. He also coordinates the UW portion of Wisconsin's School IPM program.

**Dr. Chris Williamson** (Entomology) 70% Extension, 30% Research

Chris's research interests are primarily in the area of integrated pest management (IPM) with emphasis on alternative, non-pesticide management strategies including cultural control and applied plant resistance. Ancillary research projects include insecticide efficacy and cultivar evaluations. His extension efforts include turfgrass and ornamental insect pest management, invasive insect species education, and integrated turfgrass management (ITM).

## **Our Staff**

**Paul Koch** (Plant Pathology)

Paul is the diagnostician of the Turf Diagnostic Lab (TDL) and diagnoses commercial turf samples for golf courses, lawn care companies, schools, parks, and sod producers. In addition, he is completing his M.S. degree by investigating the dynamics of fungicide resistance as a function of the type and frequency of various fungicide programs on Wisconsin golf courses. Paul also conducts the day-to-day fungicide trials and interacts with cooperators.

**Eric Koeritz** (Horticulture)

Eric has worked as a research assistant with John Stier since he began his B.S. degree program over six years ago. Eric is in charge of the daily activities for all of the Horticulture field research projects at the O.J. Noer facility as well as several off-site trials, particularly herbicide investigations.

**Tom Schwab** (ARS-O.J. Noer manager)

As manager of the O.J. Noer facility Tom's responsibilities include procuring equipment and product donations from many turf companies, most of which is donated. His other responsibilities include building and grounds maintenance, including fixing irrigation. He also assists faculty and students with their projects when necessary.

**Audra Anderson** (ARS-WTA)

Audra splits her duties between the Agricultural Research Stations as the on-site office administrator and as secretary for the Wisconsin Turfgrass Association. If you've ever phoned, faxed, or visited the Noer, chances are Audra was the first one to greet you and provide assistance.

# Graduate Students

## **Mark Garrison** (M.S. student-Horticulture)

Mark is a native of Michigan and began his M.S. degree in autumn 2006 after graduating from the turf program at Michigan State University. His thesis topic is Invasiveness of Turfgrasses in Prairie Environments. He has already established plots on golf courses in Wausau, WI and Monroe, WI and will be collecting data from these sites as well as natural areas around sod farms. He is funded by a federal Hatch grant which is part of a multi-state effort to determine the invasiveness potential of turfgrasses.

## **Seung Cheon (Steve) Hong** (Ph.D. – Entomology)

Steve Hong completed his M.S. in 2003 and recently his Ph.D. degree in January 2008 in Dr. R. Chris Williamson's lab. Steve's M.S. research focused on exploiting the behavior of the black cutworm to develop alternative, non-pesticide management strategies of this important insect pest. His Ph.D. research identified the resistance mechanism(s) of Kentucky bluegrass resistance to black cutworm.

## **Eric Koeritz** (M.S. student-Horticulture)

Eric's M.S. thesis topic is Development of an Environmentally Sustainable Golf Course. His two major projects have been 1) fine fescue and colonial bentgrass fairways and 2) velvet bentgrass management for putting greens. He will graduate in 2008 and plans to pursue his Ph.D. in turf/plant breeding. He divides his time in graduate studies with his position as a research assistant in the Horticulture department for John Stier.

## **Paul Koch** (M.S. student-Plant Pathology)

Paul finished his M.S. degree in spring 2007 on explaining the background of fungicide use and development of fungicide resistance in *Sclerotinia homeocarpa*, the causal agent of dollar spot disease. After splitting his time between graduate program efforts and duties at the Turf Diagnostic Lab, Paul is happy to be able to focus his efforts on turf diagnostics and fungicide trials.

## **Patrick (P.J.) Liesch** (M.S.-Entomology)

P.J. graduated from the University of Wisconsin-Parkside with a B.S. from the Biological Sciences Department in May 2007, and joined the lab of Dr. R. Chris Williamson in Madison shortly thereafter. His main research project involves the control of May/June Beetle grubs using chemical and biological controls. In addition, he also works with silicate biostimulants as possible feeding deterrents of surface feeding insect pests (i.e., black cutworm and sod webworm) of creeping bentgrass.

## **Dan Lloyd** (M.S. student-Soil Science)

Dan began his graduate program in September 2007 under the mentorship of Doug Soldat. His thesis topic is low temperature nitrogen uptake of several turfgrass species. Information from his study will be used to improve nitrogen fertilization recommendations for better turf and environmental health.



**Jake Schneider** (M.S. student-Horticulture)

Jake is supported by the Terry and Kathleen Kurth Wisconsin Distinguished Fellowship. His primary M.S. topic is Rain Garden Efficacy for Controlling Stormwater Runoff which compares rain gardens to lawn turf to control runoff from rooftops and improve groundwater replenishment. A second project has been focused on shade tolerance of velvet and creeping bentgrasses. Jake will finish his degree in December 2007 and plans to work as a golf course superintendent.

**Ana Tapasieva** (M.S. student-Soil Science)

Ana hails from Russia and is working towards a master of science degree in soil science. Her thesis topic is utilization of composted sewage sludge as a soil amendment for horticultural crops, including turfgrass. Research includes both Kentucky bluegrass lawn and creeping bentgrass fairway evaluations.

# **Cultivar Evaluations**

## 2003 NTEP Bentgrass Putting Green Test

John Stier and Eric J Koeritz  
Department of Horticulture

### INTRODUCTION

Twenty-six cultivars of bentgrass representing creeping (*Agrostis stolonifera*) and velvet (*Agrostis canina*) species are being evaluated for putting green quality.

### MATERIALS AND METHODS

Plots were seeded September 23, 2003 into a native soil push-up green (silt loam). The plot was fertilized with Spring Valley 15-24-8 at a rate of 1# P<sub>2</sub>O<sub>5</sub> at the time of establishment. The plot was covered with a greens cover to promote germination and to discourage seed movement. The cover was removed approximately two weeks following seeding. The plot size is 4 x 6 ft (24 ft<sup>2</sup>). The experimental design was a randomized complete block with three replications.

The putting green was grown in during the spring of 2004. Mowing was initiated at 11/16" and gradually worked down to 5/32" using a regular topdressing program. The green is now topdressed monthly and it receives ½ lb N/1000 ft<sup>2</sup> per growing month. No core aerations have been conducted. Irrigation is supplied 3 times weekly to replenish 100% ET.

In October 2003 an application of Subdue Maxx (mefenoxam) was made to control an infection of pythium root rot on the velvet bentgrasses. In June 2004, an application of Lontrel was made at .25 oz/M to control broadleaf weeds. Velocity was applied at 30 g ai/Acre in October 2004 to control *Poa annua*. No pesticides were applied in 2006 or 2007.

Turfgrass quality will be rated monthly during the growing season. Spring green-up, genetic color and density ratings are taken annually.

### RESULTS AND DISCUSSION

*Poa annua* infestation was markedly reduced from previous years, no more than 1-2%. Several varieties of both creeping and velvet bentgrass have provided high quality turf despite the lack of fungicide applications. Some of these velvet bentgrasses have greatly improved their turf quality since the first two years of the test. Full results will be published early in 2008 at [www.ntep.org](http://www.ntep.org). Results from previous years are already available.

Table 1. Entries in 2003 National Turfgrass Evaluation Program putting green test.

<b>Entry</b>	<b>Name</b>	<b>Species</b>	<b>Sponsor</b>
1	LS-44	Creeping	Links Seed, LLC
2	Penn A-1	Creeping	Standard Entry
3	Benchmark DSR	Creeping	Turf Merchants, Inc.
4	Penncross	Creeping	Standard Entry
5	CY-2	Creeping	Snow Brand Seed Co.
6	Alpha	Creeping	Simplot/Jacklin Seed
7	T-1	Creeping	Simplot/Jacklin Seed
8	SR 7200	Velvet	Standard Entry
9	13-M	Creeping	Pennington Seed
10	Declaration	Creeping	Lebanon Turf Products
11	Independence	Creeping	Lebanon Turf Products
12	Legendary	Velvet	Lebanon Turf Products
13	235050	Creeping	LESCO, Inc.
14	Bengal	Creeping	Barenbrug USA
15	9200	Creeping	ProSeeds Marketing
16	IS-AC 1	velvet	DLF International Seeds
17	IS-AP 9	Creeping	DLF International Seeds
18	EFD	Velvet	ProSeeds Marketing
19	Vesper	Velvet	Standard Entry
20	A03-EDI	Creeping	The Scotts Company
21	DSB	Creeping	R. H. Hurley, LLC
22	Greenwich	Velvet	Turf-Seed, Inc.
23	23R	Creeping	Mountain View Seeds, Ltd.
24	SRX 1GPD	Creeping	Seed Research of Oregon
25	SRX 1GD	Creeping	Seed Research of Oregon
26	Pennlinks II	Creeping	Tee-2-Green Corp.

## 2003 Bentgrass Fairway NTEP Test

John Stier and Eric Koeritz  
Departments of Horticulture

### OBJECTIVE

The purpose of the test is to compare experimental and commercially available lines of bentgrasses for fairway use in Wisconsin (Table 1).

### MATERIALS AND METHODS

Plots were seeded 9 September 2003 on a Troxel silt loam soil following application of a starter fertilizer. Futerra® erosion control blankets were used to cover the plots to prevent potential washouts and provide a favorable environment for germination. Plots were topdressed once in spring 2004 using an 80:20 sand:peat mixture to assist grow-in. Plots are mowed 3 times weekly at 0.375 inch, and fertilized twice yearly with a total of 1.5 – 2 lb N per thousand square feet.

Data collected include:

- Establishment rate (% ground cover 4-6 weeks after seeding)
- Percent living ground cover at the end of each spring, summer, and autumn season
- Quality ratings (monthly)

Simulated golf cart traffic was applied 3 times weekly beginning spring 2005 and ending in September 2007. A golf cart traffic simulator developed by the UW Biological Systems Engineering department was used. The traffic simulator equals the weight of a conventional golf cart with 2 golfers and golf bags.

### RESULTS

Most cultivars did not provide high quality turf though several creeping bentgrass varieties provided acceptable quality turf. The colonial bentgrass varieties tended to perform poorly and most suffered from moderate to severe *Poa annua* invasion. Full data will be published early in 2008 at [www.ntep.org](http://www.ntep.org); data from previous years are already posted.

**Table 1. Entries in the 2003 National Bentgrass Test for Fairways.**

<b>Name</b>	<b>Species</b>	<b>Name</b>	<b>Species</b>
<b>LS-44</b>	<b>Creeping</b>	<b>9200</b>	<b>Creeping</b>
<b>L-93</b>	<b>Creeping</b>	<b>IS-AT 7</b>	<b>Colonial</b>
<b>Bardot</b>	<b>Creeping</b>	<b>IS-AP 14</b>	<b>Creeping</b>
<b>Penncross</b>	<b>Creeping</b>	<b>23R</b>	<b>Creeping</b>
<b>EWTR</b>	<b>Colonial</b>	<b>Sr 7150</b>	<b>Colonial</b>
<b>Alpha</b>	<b>Creeping</b>	<b>SRX 1GPD</b>	<b>Creeping</b>
<b>T-1</b>	<b>Creeping</b>	<b>SR 1119</b>	<b>Creeping</b>
<b>cPrinceville</b>	<b>Creeping</b>	<b>SRX 1PDH</b>	<b>Creeping</b>
<b>13-M</b>	<b>Creeping</b>	<b>Pennlinks II</b>	<b>Creeping</b>
<b>Declaration</b>	<b>Creeping</b>	<b>Penneagle II</b>	<b>Creeping</b>
<b>Independence</b>	<b>Creeping</b>	<b>PST-OEB</b>	<b>Creeping</b>
<b>Tiger II</b>	<b>Colonial</b>	<b>PST-9NBC</b>	<b>Colonial</b>
<b>235050</b>	<b>Creeping</b>	<b>PST-9VN</b>	<b>Colonial</b>
<b>Bengal</b>	<b>Creeping</b>	<b>Seaside</b>	<b>Creeping</b>

## **2003 Fine Fescue NTEP Fairway**

John Stier and Eric J Koeritz  
Department of Horticulture

### **OBJECTIVE**

Evaluate commercial and experimental varieties of fine fescue species for fairway use.

### **MATERIALS AND METHODS**

Fifty-three varieties of fine fescue representing strong creeping red, chewings, hard, and sheep fescue were seeded on silt loam on September 17, 2003. Plots were fertilized with 1 lb P<sub>2</sub>O<sub>5</sub> at the time of seeding and covered with Futerra erosion blankets. The trial is conducted under the following management:

Mowing height: 1 1/16", 3 times weekly

Nitrogen rate: 1 lb N/1000ft<sup>2</sup> in May and September

Irrigation: 75% ET 1X/week

Pesticide use: Mec-Amine-D 3-way June 2004 for broadleaves, Vantage .5 oz/M 8/25/04 for annual grasses, Velocity 30 g ai/acre for Poa annua, 10/15/04 Lontrel .5oz/M 10/25/04 for broadleaves

Plot Size: 5 x 5 ft (25ft<sup>2</sup>)

Experimental design: Randomized complete block, 3 replications

Traffic treatments were applied to the trial using a golf cart traffic simulator beginning in spring of 2005. Treatments were applied 3 X per week, twice each time, for a total of 6 golf cart passes per week, from early May to mid-September each year.

### **RESULTS AND DISCUSSION**

Unlike in the previous (1998) trial when only one variety consistently provided acceptable quality under traffic, a number of varieties have provided acceptable quality under traffic in this test. Most tend to be Chewings fescues though some of the creeping reds are performing fairly well. Full data are published at [www.ntep.org](http://www.ntep.org) and are free for viewing.

Table 1. Entries in the 2003 Fine Fescue Test.

<b>Name</b>	<b>Species</b>	<b>Name</b>	<b>Species</b>
Razor	Strong creeping	Quatro	Sheep
Predator	Hard	IS-FRR 30	Strong creeping
7 Seas	Chewings	IS-FL 28	Hard
Seabreeze	Slender creeping	TL1	Strong creeping
Shademaster	Strong creeping	Pick CRF 1-03	Strong creeping
TL 53	Strong creeping	BMXC-S02	Strong creeping
Celestial	Strong creeping	Boreal	Strong creeping
SPM	Hard	SR 3000	Hard
Oracle	Strong creeping	Dawson E	Slender creeping
A01630Rel	Hard	Scaldis	Hard
ACF 174	Chewings	BUR 4601	Chewings
ASC 245	Strong creeping	SRX 51G	Chewings
5001	Strong creeping	SRX 3K	Hard
Audobon	Strong creeping	SRX 55R	Slender creeping
Jamestown 5	Chewings	Ambassador	Chewings
C-SMX	Strong creeping	Oxford	Hard
Jasper II	Strong creeping	Pathfinder	Strong creeping
Pick HF #2	Hard	DP 77-9885	Chewings
ACF 188	Chewings	DP 77-9886	Chewings
C03-RCE	Strong creeping	DP 77-9578	Strong creeping
C03-4676	Strong creeping	DP 77-9360	Strong creeping
Berkshire	Hard	DP 77-9579	Strong creeping
IS-FRR 23	Strong creeping	PST-4TZ	Chewings
IS-FRR 29	Strong creeping	PST-8000	Strong creeping
DLF-RCM	Strong creeping	Musica	Strong creeping
Longfellow II	Chewings	Cascade	chewings
IS-FRC 17	Chewings		



## **2004 NTEP Perennial Ryegrass Test**

John Stier, Kevin Schneider, and Eric Koeritz  
Department of Horticulture

### **INTRODUCTION**

The purpose of this trial is to evaluate commercial and experimental cultivars of perennial ryegrass.

### **MATERIALS AND METHODS**

This study is conducted at the O.J. Noer Turfgrass Facility in Verona, WI and is maintained as an athletic field at 1.5-inch mowing height. Plots were seeded 14 September, 2004 as a randomized complete block with 25 ft<sup>2</sup> individual plots. The study receives 0.5 lb N/growing month. Irrigation is applied to prevent dormancy. No pesticides were applied in 2006 or 2007.

Turf quality is rated monthly. Spring green-up, color, and density data are collected seasonally. Disease and weed ratings are taken when pests are present.

### **RESULTS**

Some winterkill occurred throughout the plot during 2004-05 although ice was not present for extended periods. Much of the damage appeared to be varietally-related. Overall quality markedly improved for most of these plots during 2006 but many plots suffered invasion by weeds in 2007. Data will be collected on this study until the summer of 2010. Additional information for Wisconsin and other state evaluations is available at [www.ntep.org](http://www.ntep.org).

Table 1. Perennial ryegrass entry numbers, varieties, and sponsors for 2004 NTEP test.

Entry	Sponsor	Entry	Sponsor
1 LPR02203	Deutsche Saatveredulung	61 PST-2AG4	Pure-Seed Testing, Inc.
2 Panther	Standard Entry	62 PST-2GSM	Pure-Seed Testing, Inc.
3 Manhattan II	Standard Entry	63 PST-2LAN	Pure-Seed Testing, Inc.
4 Pizaazz	Turf Merchants, Inc.	64 04-BEN	Oregro Seed, Inc.
5 Affinity	Turf Merchants, Inc.	65 05-BRE	Oregro Seed, Inc.
6 Paragon	Turf Merchants, Inc.	66 Sunshine 2	Pickseed West
7 Protege	Turf Merchants, Inc.	67 Pick F4	Pickseed West
8 LTP-611-GLR	Lebanon Seaboard Corp.	68 Pick 02-R	Pickseed West
9 ES45	Bailey Seeds	69 PRG HS-01-09	Pickseed West
10 TR47	Bailey Seeds	70 PM 101	Pickseed West
11 CNV	Columbia Seeds	71 APR 1663	Mountain View Seeds
12 GPR	Grasslands Oregon	72 AAZ-B104	Z Seeds
13 KN42	Kanako Seeds, Inc.	73 RG3P	Mountain View Seeds
14 VB99	Landmark Seed Company	74 DCM	LESCO, Inc.
15 VB77	Landmark Seed Company	75 AF	LESCO, Inc.
16 L44	LESCO, Inc.	76 PS-2	LESCO, Inc.
17 TRS	McCarthy Research Farm	77 Palmer III	Standard Entry
18 BPR	McCarthy Research Farm	78 RAD-PR8	Radix Research, Inc.
19 AJM	McCarthy Research Farm	79 Brightstar SLT	Turf-Seed, Inc.
20 LPGA	McCarthy Research Farm	80 Citation Fore	Turf-Seed, Inc.
21 EXS54	McCarthy Research Farm	81 Silver Dollar	Turf-Seed, Inc.
22 RTS	McCarthy Research Farm	82 PST-2LGL	Turf-Seed, Inc.
23 PWDR	Pennington Seed Company	83 Quicksilver	Turf-Seed, Inc.
24 SP4	Smith Seed Company	84 Premier II	Barenbrug USA
25 SNR	Smith Seed Company	85 Pinnacle II	Barenbrug USA
26 APR 1660	Ampac Seed Company	86 Barlennium	Barenbrug USA
27 Pick 01-2	Ampac Seed Company	87 BAR Lp 4317	Barenbrug USA
28 JR-119	Jacklin Seed/Simplot	88 BAR Lp 4420	Barenbrug USA
29 JR-324	Jacklin Seed/Simplot	89 BAR Lp 4920	Barenbrug USA
30 JR-348	Jacklin Seed/Simplot	90 SRX 4682	Seed Research of Oregon
31 JR-408	Jacklin Seed/Simplot	91 SRX 4692	Seed Research of Oregon
32 DPI	Pennington Seed Company	92 SRX 4SP	Seed Research of Oregon
33 MMW	Pennington Seed Company	93 SRX 4UP3	Seed Research of Oregon
34 ARR 1664	Pennington Seed Company	94 PM 102	Pickseed West
35 Mach I	Standard Entry	95 Headstart 2	Turf-One
36 Pick RB-1	Pickseed West	96 MS2	Pickseed West
37 LCK	Rutgers University	97 Repell GLS	ProSeeds Marketing
38 IS-PR 271	DLF International Seed Inc.	98 Panther GLS	ProSeeds Marketing
39 IS-PR 273	Columbia Seeds	99 GL-2	ProSeeds Marketing
40 IS-PR 270	LESCO, Inc.	100 RNS	ProSeeds Marketing
41 IS-PR 274	DLF International Seeds	101 Palmer IV	ProSeeds Marketing
42 IS-PR 276	DLF International Seeds	102 APR 1797	ProSeeds Marketing
43 IS-PR 312	DLF International Seeds	103 AC2	Pickseed West
44 IS-PR 269	Columbia Seeds	104 PM 103	Pickseed West
45 IS-PR 268	DLF International Seeds	105 E-99	Ultra-Turf
46 IS-PR 236	Mountain View Seeds	106 D04-LP05	The Scotts Company
47 IS-PR 233	Grasslands Oregon	107 D04-UP	The Scotts Company
48 IS-PR 235	Grasslands Oregon	108 D04-11T	The Scotts Company
49 Buena Vista	Burlingham Seeds, LLC	109 D04-1667	The Scotts Company
50 Fusion	Burlingham Seeds, LLC	110 Inspire	The Scotts Company
51 LTP-PG-GLR	Lebanon Seaboard Corp.	111 Pentium	The Scotts Company
52 LTP-101-GLR	Lebanon Seaboard Corp.	112 APR 1648	Ultra-Turf
53 JR-163	Jacklin Seed/Simplot	113 APR 1670	Lewis Seed Co.
54 JR-114	Jacklin Seed/Simplot	114 Premier	Standard Entry
55 JR-255	Jacklin Seed/Simplot	115 Pinnacle	Standard Entry
56 Overdrive	Burlingham Seeds, LLC	116 Linn	Standard Entry
57 PST-217	Pure-Seed Testing, Inc.	117 DP 17-9499	DLF-Trifolium A/S
58 PST-2AM	Pure-Seed Testing, Inc.	118 DP 17-9502	DLF-Trifolium A/S
59 PST-2BLK	Pure-Seed Testing, Inc.	119 DP 17-9505	DLF-Trifolium A/S
60 PST-2MNG	Pure-Seed Testing, Inc.	120 DP 17-9788	DLF-Trifolium A/S

## **2005 NTEP Kentucky Bluegrass Test**

John Stier, Kevin Schneider, David Anderson and Eric Koeritz  
Department of Horticulture

### **INTRODUCTION**

The purpose of the trial is to evaluate commercial and experimental cultivars of Kentucky bluegrass under golf course fairway conditions.

### **MATERIAL AND METHODS**

Plots were seeded in September 2005 on a silt loam soil. Starter fertilizer (1 lb P<sub>2</sub>O<sub>5</sub>/1000ft<sup>2</sup>) was applied at time of establishment. Futerra covers were used to prevent wash out or cross contamination. Plots are irrigated to prevent visual drought stress. The study receives 3-4 lbs N/M/year. Mowing height is 0.5 inches. Beginning in May 2007, ½ of each plot received simulated golf cart traffic using a traffic simulator developed by the Biological Systems Engineering Department at UW-Madison. Traffic was applied three times weekly until mid-September.

Turf quality is rated on a monthly basis. Spring green up, color, and density are collected seasonally. Disease ratings are taken when diseases are present. An application of Confront was made 22 May 2006 to control broadleaf weeds.

### **RESULTS**

Most varieties achieved acceptable or nearly acceptable quality for fairway turf prior to the start of traffic in May. By the end of the growing season many varieties were partially infested with *Poa annua*. Data for 2006 will be posted by mid-2007 at [www.ntep.org](http://www.ntep.org) for free viewing.

Table 1. 2005 Kentucky bluegrass NTEP cultivar entries.

Entry #	Cultivar	Sponsor	Entry #	Cultivar	Sponsor
#1	SW AG 514	Burlingham Seeds, LLC	#56	A00-1254	Mountain View Seed, Ltd.
#2	Shamrock	Standard Entry	#57	Bluestone	Mountain View Seed, Ltd.
#3	A97-890	Blue Mountain Seed, Inc.	#58	A98-999	Mountain View Seed, Ltd.
#4	Midnight	Standard Entry	#59	A95-410	Seeds, Inc.
#5	A98-689	Columbia River Seed	#60	RAD-343	Seeds, Inc.
#6	NA-3261	Columbia River Seed	#61	RAD-762	Seeds, Inc.
#7	Kenblue	Standard Entry	#62	Washington	Seeds, Inc.
#8	NA-3249	Columbia River Seed	#63	RAD-0AN64	Seeds, Inc.
#9	NA-3271	Columbia River Seed	#64	A99-3119	DLF International Seeds
#10	Bd 98-2108	The Scotts Company	#65	A99-2559	DLF International Seeds
#11	Bd 95-1930	The Scotts Company	#66	Harmonie	DLF International Seeds
#12	Bd 98-1358	The Scotts Company	#67	A97-1287	DLF International Seeds
#13	Bd 03-84	The Scotts Company	#68	Rhythm	DLF International Seeds
#14	Bd 99-2103	The Scotts Company	#69	Dynamo	Burlingham Seeds, LLC
#15	Bd 03-159	The Scotts Company	#70	Avid	Burlingham Seeds, LLC
#16	MSP 3722	University of Minnesota	#71	A01-299	Burlingham Seeds, LLC
#17	MSP 3723	University of Minnesota	#72	Reveille	Standard Entry
#18	MSP 3724	University of Minnesota	#73	Belissimo	Turf Merchants, Inc.
#19	Blueberry	Turf Merchants, Inc.	#74	Skye	Grassland Oregon
#20	Bewitched	Turf Merchants, Inc.	#75	RAD-504	Columbia River Seed
#21	Julia	Standard Entry	#76	SPTR 2LM95	Seed Research/Pickseed
#22	CPP 817	DLF International Seeds	#77	STR 2553	Seed Research of Oregon
#23	CPP 822	Cebeco Seeds	#78	STR 2703	Seed Research of Oregon
#24	CPP 821	Cebeco	#79	STR 23180	Seed Research of Oregon
#25	DP 76-9066	DLF Trifolium A/S	#80	SPTR 2959	Seed Research/Pickseed
#26	DP 76-9081	DLF Trifolium A/S	#81	STR 2485	Seed Research of Oregon
#27	DLF 76-9075	DLF International Seeds	#82	1QG-38	Columbia River Seed
#28	CP 76-9068	DLF Trifolium A/S	#83	PST-109-752	Pure-Seed Testing, Inc.
#29	A98-948	Pennington Seed, Inc.	#84	PST-101-390	Pure-Seed Testing, Inc.
#30	Argos	TurfOne	#85	PST-101-73	Pure-Seed Testing, Inc.
#31	PSG 366	Pickseed West, Inc.	#86	PST-Y2K-169	Seed Research of Oregon
#32	J-1326	Jacklin Seed by Simplot	#87	Prosperity	Turf-Seed, Inc.
#33	J-1334	Jacklin Seed by Simplot	#88	PST-1A1-899	Pure-Seed Testing, Inc.
#34	J-1466	Jacklin Seed by Simplot	#89	NA-3248	Columbia River Seed
#35	J-2024	Jacklin Seed by Simplot	#90	NA-3259	Columbia River Seed
#36	J-2399	Jacklin Seed by Simplot	#91	H98-701	Grassland Oregon
#37	J-2404	Jacklin Seed by Simplot	#92	LTP 2949	Lebanon Seaboard Corp.
#38	J-2502	Jacklin Seed by Simplot	#93	PSG 711	Pickseed West, Inc.
#39	J-2791	Jacklin Seed by Simplot	#94	America	Standard Entry
#40	J-2870	Jacklin Seed by Simplot	#95	Barrister	Barenbrug USA
#41	J-3429	Jacklin Seed by Simplot	#96	Bariris	Barenbrug USA
#42	Everglade	Jacklin Seed by Simplot	#97	Baron	Standard Entry
#43	Everest	Jacklin Seed by Simplot	#98	BAR VV 9634	Barenbrug USA
#44	Rugby II	Jacklin Seed by Simplot	#99	BAR VV 9630	Barenbrug USA
#45	Nu Destiny	Standard Entry	#100	BAR VV 0665	Barenbrug USA
#46	Award	Jacklin Seed by Simplot	#101	BAR VV 8536	Barenbrug USA
#47	NuGlade	Jacklin Seed by Simplot	#102	BAR VV 0709	Barenbrug USA
#48	Impact	Jacklin Seed by Simplot	#103	BAR VK 0710	Barenbrug USA
#49	Beyond	Jacklin Seed by Simplot	#104	LTP-73	Lebanon Seaboard Corp.
#50	A00-1400	Pennington Seed, Inc.	#105	LTP-149	Lebanon Seaboard Corp.
#51	Excursion	LESCO, Inc.	#106	H94-305	ProSeeds Marketing, Inc.
#52	NA-3257	LESCO, Inc.	#107	Mystere	ProSeeds Marketing, Inc.
#53	Glenmont	LESCO, Inc.	#108	AKB449	ProSeeds Marketing, Inc.
#54	A00-247	LESCO, Inc.	#109	Diva	ProSeeds Marketing, Inc.
#55	A01-349	Mountain View Seed, Ltd.	#110	POPR 04594	Euro Grass Breeding

## **2006 Tall Fescue NTEP Test**

John Stier and Eric Koeritz  
Department of Horticulture

### **OBJECTIVE**

Evaluate new and existing tall fescue varieties for low maintenance turf use.

### **MATERIALS AND METHODS**

Plots were seeded and established in September 2006. The soil type was a silt loam with pH of approximately 7.8. Data to be collected over the next few years will include quality, winterkill, disease susceptibility, color and leaf texture.

### **RESULTS**

A prolonged period of subfreezing temperatures in October 2006 squelched development of the young swards, resulting in incomplete coverage before the end of the growing season. The amount of turf cover was rated 4 weeks after seeding and ranged from approximately 25-85%.

All turf survived winter well and throughout the summer. Major differences in turf quality, disease, color or leaf texture were observed with a few varieties, though most had similarly acceptable turf quality. Data will be posted on the [www.ntep.org](http://www.ntep.org) website early in 2008 for public viewing.

# **Environmental Research**

# **Invasiveness of Cool-Season Turfgrasses into Natural Areas**

Mark A. Garrison and John Stier  
Department of Horticulture

## **INTRODUCTION**

Executive Order 13122 was enacted on February 3, 1999. The order is intended to prevent the introduction of, provide for the control of, and to minimize the economic, ecological, and human health impacts that invasive species cause (E.O. 13122). The turf industry has become a stakeholder of such legislation due to the species of economically important turfgrasses which have been added to Wisconsin Dep. of Natural Resources (WDNR) and National invasive species lists (USDA-NCRS, 2002; WDNR, 2003). These lists include; Kentucky bluegrass, creeping bentgrass, and Tall Fescue.

There is a dearth of scientific data on the invasiveness of turfgrasses. Listings often are developed based on casual observation of a species occurrence at a site. The Nature Conservancy, for example, lists numerous sites where Kentucky bluegrass and bentgrasses (*Agrostis* spp.) exist as proof of their invasiveness. It is unclear whether the occurrence of turfgrasses at these sites is due to an ancient planting or self-establishment and elimination of and/or cause economic and/or environmental harm. For example, the Plant Conservation Alliance (PCA, 2003) lists red fescue (*Festuca rubra*) as an invasive species while the USDA lists it as native (USDA-NRCS, 2002). Determining the invasive potential of turfgrasses is important to protecting sensitive natural areas and determining if transgenic turfgrasses should be approved for commercial use.

## **OBJECTIVES**

The results of this research will help regulatory agencies to make decisions regarding policies on turfgrasses, including transgenic turfgrasses. The objectives of this study are to clarify and document the invasiveness of commercially produced turf species/varieties in natural prairie environments. The null hypothesis is that no turfgrass species observed is invasive. The prediction is that some turfgrasses will have the ability to become established in the native areas. Anecdotal evidence suggests that certain species may indeed be invasive depending on the environmental setting and management. The study will be in three parts. These parts are to include; 1) collecting grass samples and identifying through molecular markers technology, 2) Burying and exhuming turfgrass seeds, stolons, and rhizomes to study their ability of to survive in the seed bank, 3) Measuring the survivability and spread of live turfgrass plants in a native setting.

## **MATERIALS AND METHODS**

Part 1 of this investigation will observe and collect grass samples from areas bordering present and former golf courses and sod farms. The goal is to record the frequencies and identify the samples as elite or common varieties in order to determine if undesired

distribution has occurred. Data collection for this part of the study started in the fall of 2007.

Part 2 will measure the spread of turfgrass plants in a native prairie setting. This study will take place at two locations; Monroe Country Club (Monroe, WI) and Greenwood Hills Country Club (Wausau, WI). These locations selected have been reestablished to native prairie a minimum of 9 years prior to the establishment of the research plots. Each location will consist of 5 replications in a randomized complete block design on 8' centers. Each replication consists of individual monotype plugs of 11 separate turfgrass species/varieties. Turf plugs were germinated and initially grown under greenhouse conditions at the University of Wisconsin-Madison West Madison Agricultural Research Station. Plugs transferred to the field a planted in small holes of a proper depth and a slightly larger diameter. After planting small metal cages and irrigation flags were placed over the plants and next to the plants to mark their location and help to protect them from predators during their initial establishment. The cages were removed in the spring and replaced again the following fall for the winter. Measurements are collected on a monthly basis, unless snow cover is present.

Part 3 will determine the longevity of Kentucky bluegrass and creeping bentgrass seeds will maintain dormancy in the seed bank. For comparison, two Kentucky bluegrass seed varieties and one creeping bentgrass variety will be used along with several native seed species. The native seed species include Canada bluegrass, Virginia wild rye, local ecotype switchgrass, Rough bluegrass, local ecotype big bluestem, and tall fescue. This study is being conducted at two locations; Monroe Country Club (Monroe, WI) and Greenwood Hills Country Club (Wausau, WI). Each location consists of 5 replications in a randomized complete block design. Each replication will observe seven time periods; 0, 6, 12, 24, 36, and 60 month(s). Each seed sample contains 100 seeds combined with sterilized soil and contained in a bag like structure made from 440 count silk screeners mesh material. Seeds were hand counted and mixed at a seed/soil ratio of 25:1 (by volume). Bags were buried at a depth of approximately 2" (5 cm) in holes cut by a 4" diameter putting green cup cutter. To prevent light from reaching the seeds, initiating germination, a round plastic electrical box cover was placed above the bags in the soil profile and the existing ground cover (plug previously removed) was replaced. A soil water and temperature monitoring station was placed at both the Monroe CC and Greenwood Hills CC sites to monitor soil conditions. The data will be retrieved monthly. Germination tests will then be used to determine seed viability. These tests will follow the ASOA seed vigor testing handbook procedures and a tetrazolium staining process will be used on non germinated seed to determine if dormancy exists.

## RESULTS

Following a year of data collection, the results are still inconclusive. Data from three time periods for the seed longevity study are analyzed. The results show a dramatic decrease in viability. The spread of live turf study has shown that leaf and crown herbivory and seed predation are significant factors a turfgrass plant must overcome to become establish in a non-maintained area.



## DISCUSSION

Each project is designed to produce at least one manuscript. Appropriate audiences for the invasiveness research include the USDA and Wisconsin DNR. Results will be submitted to the peer-reviewed Journal of Environmental Quality, Ecology, Oecologia or other journal and presented at the National Extension Natural Resources conference in 2008 and/or other appropriate venues. Results will be presented to state and national regulatory groups and the turf and seed industries through trade show conferences and publications in trade journals Golf Course Management, Grounds Management, Grounds Maintenance, and The Grass Roots.

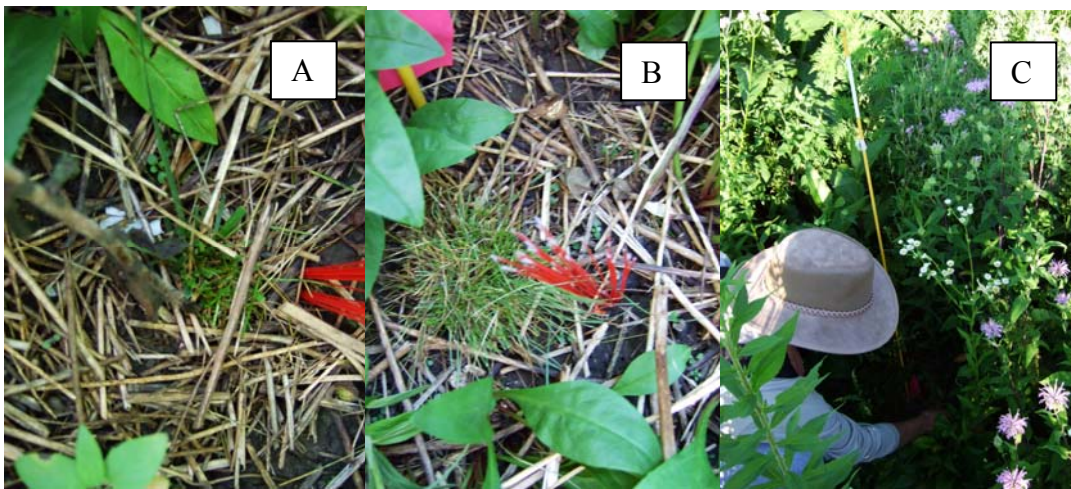


Fig. 1. Kentucky bluegrass foliage eaten by herbivores, probably rabbits (A); after 10 months fine fescue is still dwarfed by prairie plants (B); difficulty of locating turf plants in restored prairie. All photos collected 5 July 2007, Monroe, WI.

# Rain Gardens for Urban Water Quality Improvement

Jacob L. Schneider<sup>1</sup>, John C. Stier<sup>1</sup>, and Doug Soldat<sup>2</sup>

<sup>1</sup>Department of Horticulture and <sup>2</sup>Department of Soil Science

## INTRODUCTION

Rain gardens are bermed areas that are designed to trap water coming from rooftop downspouts and allow this water to filter through the soil. They potentially offer one solution in the battle against urban water-quality issues. Rain gardens may decrease contaminant-laden surface runoff while increasing the quantity and quality of aquifer recharge. The objective of this study was to determine which factors have the greatest effect on the ability of rain gardens to reduce runoff and to increase potential groundwater recharge. The factors in this study were (i) presence of berms; (ii) emergent prairie or turfgrass; (iii) interaction between berm presence and emergent prairie or turfgrass. It was hypothesized that berms would be the components of emergent rain gardens that would increase potential groundwater recharge by reducing runoff, not the vegetation type.

## MATERIALS AND METHODS

This study was a randomized, complete block design with four treatments replicated four times. The four treatments were 1) bermed Kentucky bluegrass (KBG), 2) unbermed KBG, 3) bermed prairie plants, and 4) unbermed prairie plants. The KBG sod and prairie plant plugs were installed in October 2005. All berms were approximately 6" high and surrounded the appropriate treatments on four sides. Treatment plot sizes were 8' x 8.75'. Each treatment was associated with an 8' x 25' rooftop that was sloped at 10% and an 8' x 10' KBG area. Downspouts traversed the KBG area and connected the treatment areas to their respective rooftops. With the exception of the flat-bottomed bermed areas, the entire plot area had a 5% slope from rooftop to weir. Each treatment had a PVC weir system to collect runoff water and a buried lysimeter to collect leached water. Treatments were separated by a 2' buffer strip and by in-ground root barriers.

All KBG areas were fertilized with three pounds of nitrogen per 1000 ft<sup>2</sup>, using three one-pound applications. No irrigation or any other supplemental input was provided to the KBG. The plots were mown at 3" approximately one time per week with clippings returned.

The data collected for each treatment area were: runoff volume per runoff event, leachate volume as needed, monthly visual percent ground cover, monthly chlorophyll readings, yearly soil infiltration rates, and yearly estimated biomass. Runoff sub-samples were analyzed for nitrate-N, ammonium-N, dissolved-P, total-P, and total suspended solids (TSS). Leachate sub-samples were analyzed for nitrate-N, ammonium-N, and dissolved-P. Sensors in each treatment area also collected soil moisture readings and soil temperature readings. An on-site weather station collected data on air temperature, relative humidity, and rainfall.

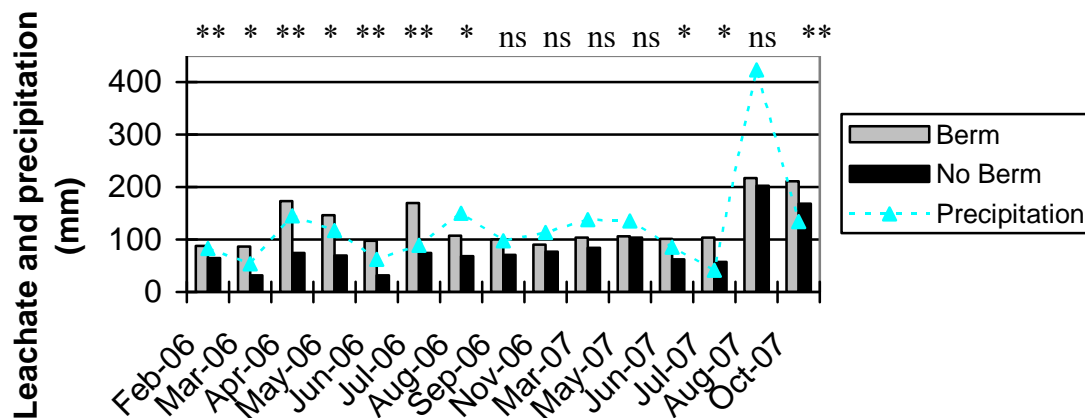
## RESULTS AND DISCUSSION

Table 1 illustrates the treatment means of the runoff volumes per year. There were no statistical differences in annual runoff volume between either of the bermed treatments. Both had very little associated runoff. Regarding the unbermed treatments, the prairie plant treatments had significantly high runoff volumes than did the KBG treatments. Because of the emergent nature of the unbermed prairie plant treatments, these plots had 20 times greater TSS loading and four times greater total-P loading in year 1 than any of the other three treatments. However, in year 2, the TSS and total-P loading in the unbermed prairie plant treatments was of the same magnitude as the other treatments.

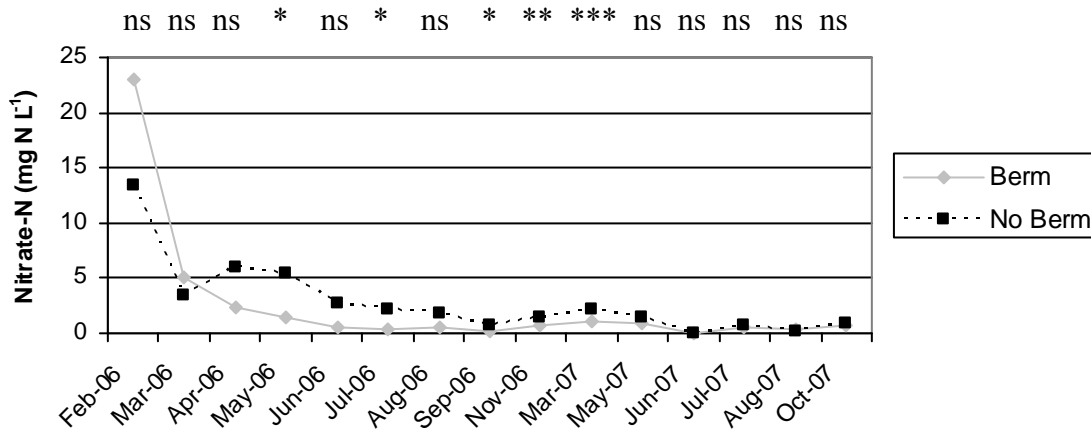
**Table 1.** Interaction of vegetation type and berm presence on runoff depth (mm) on areas receiving runoff water from simulated rooftops in 2005-2006 and 2006-2007, Verona, WI.

	Runoff Depth (mm)	
	Nov 2005 - Oct 2006	Nov 2006 - Oct 2007
Turf w/berm	8.87	10.33
Turf w/o berm	20.38	8.97
Prairie plants w/berm	8.22	9.02
Prairie plants w/o berm	42.79	17.94
LSD (0.05)	12.31	4.04

Precipitation from Nov. 2005-Oct. 2006 and from Nov. 2006-Oct. 2007 was 859 and 1011 mm, respectively.



**Figure 1.** Effect of berm presence and precipitation (mm) on leachate depth (mm) combined, for turfgrass and emergent prairie treatments. \*, \*\*, \*\*\* indicate significance at 0.05, 0.01, and 0.001, respectively.



**Figure 2.** Effect of berm presence on nitrate-nitrogen concentration in leachate. \*, \*\*, \*\*\* indicate significance at 0.05, 0.01, and 0.001, respectively.

Figure 1 illustrates the treatment means of leachate volume as affected by berm presence and precipitation. Berm presence significantly increased leachate volume and decreased nitrate-N concentration (Fig. 2) throughout the study. With the exception of the first collection date, the nitrate-N concentrations were generally below the USEPA drinking water standard of 10 mg L<sup>-1</sup>, regardless of treatment.

## CONCLUSIONS

Rain gardens that receive runoff from rooftops that were vegetated with either turfgrass or prairie plants did an equally effective job at reducing runoff volume and improving runoff quality, when compared to the unbermed prairie plant treatment. Turfgrass without a berm, which simulated a home lawn, was as effective in controlling runoff as both bermed treatments. The emergent prairie treatments without berms allowed significantly more nutrient-laden runoff to occur. For surface water improvement, rooftop runoff should be directed onto a lawn or into rain gardens vegetated by either turfgrass or prairie plants; if prairie plants are used, berms will be necessary to reduce runoff volume and associated pollutants, at least during the first two years.

The results also indicate that a rain garden vegetated by either prairie plants or KBG that is placed on a silt loam soil does an effective job of promoting a potential groundwater recharge on a quantity and quality basis when berms are present and often when berms are not present. Berms were only necessary if precipitation rates and amounts exceed infiltration rates, in which case the bermed areas acted as temporary catch basins. Except for the first collection date under a disturbed soil, nitrate-N concentrations in all treatments were below the USEPA drinking water standards.

# Carbon Sequestration by Grasses: Soil Carbon Two Years After Sowing Turf, Pasture, and Prairie Plants

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## INTRODUCTION

Soil C accumulation is the net balance between soil C inputs via plant production and soil C respired by microbes (Post and Kwon 2000, Brye and Kucharik 2003). Soils are known to differ in their C sequestration ability depending on the plant community (Conant *et al.* 2001, Follett *et al.* 2001) and its management (Conant and Paustian 2002, Halvorson *et al.* 2002, Conant *et al.* 2003). The relative ability of turf grasses, forage grasses, native prairie grasses, and commercially-popular “prairie” mixtures to sequester atmospheric C have received scant attention. This information is needed because all are potential candidates for vegetated buffer strips and other uses in urban and rural settings.

## METHODS

In Fall 2004, five species mixes were sown (1 g seed·m<sup>-2</sup>) into bare soil (5×5 Latin square experimental design; Fig. 1) at the O.J. Noer Turfgrass Facility (Verona, WI) in a field that had been under corn-soybean rotation for over 20 years. The 5 plant communities were 1) C4 prairie grasses, 2) a retail prairie mix (forb dominant), 3) reed canarygrass, 4) Kentucky bluegrass, and 5) fine fescue. In 2005, we mowed and weeded plots to facilitate establishment of the treatment vegetation. In Spring 2006, each 4-m<sup>2</sup> vegetation treatment plot was divided into three strips (0.66 m wide × 2 m long) and randomly assigned to mow, mow+fertilize, and control treatments.

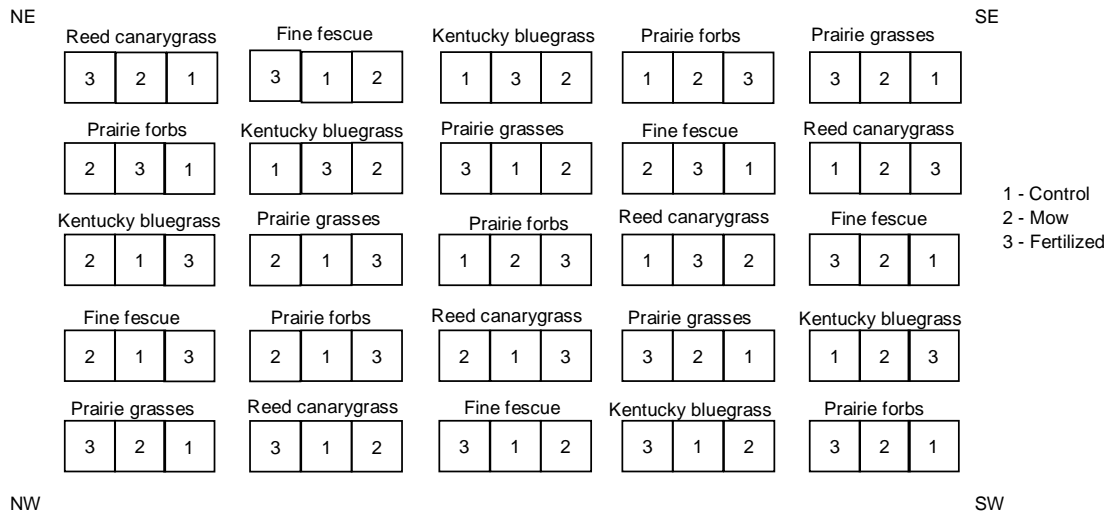


Figure 1. Latin square experimental design. Whole plots are plant community treatments and subplots are management treatments.

We collected soils (n=5 per treatment) and analyzed them for total C before sowing the treatment species in summer 2004 and again in fall 2006. In spring 2007, we estimated soil bulk density, root biomass, and the abundance of 4 plant functional groups: C3 grasses, C4 grasses, prairie forbs, and weeds.

## RESULTS

The absolute cover of 4 plant functional groups in June 2007 indicates that the treatments were effectively established (Fig. 2). More bare ground was found in the Kentucky bluegrass treatment, but C3 grasses comprised over 60% of the vegetation in these plots. Weeds were most apparent in the Prairie grasses treatment, but early season sampling probably biases against the C4 grasses that grow more in the hot summer months of July and August.

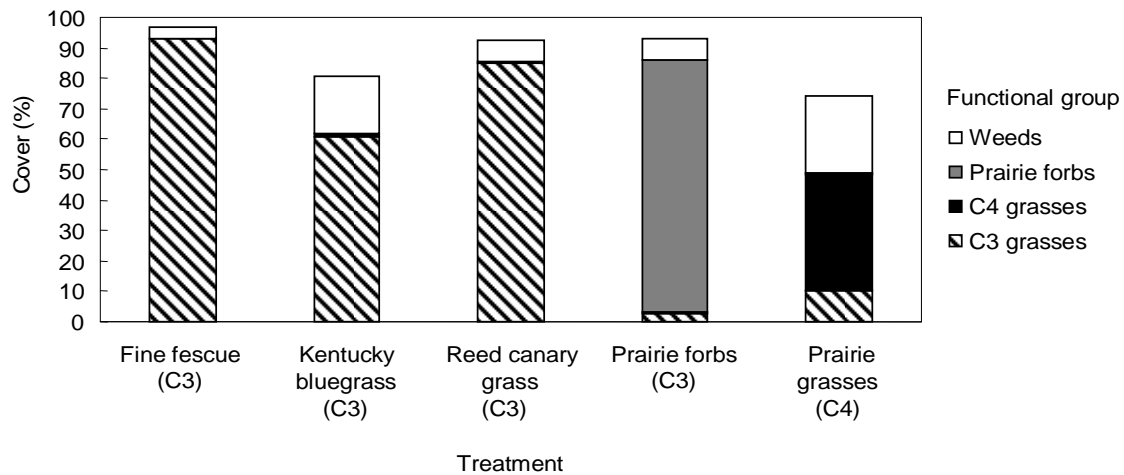


Figure 2. Average cover of four functional groups in the 5 plant community treatments.

Phenological differences may also explain the lower root biomass found in the Prairie grasses treatment in June 2007 (Table 1), although visual observation suggested that plant density was much lower in the Prairie forb and Prairie grass treatments. Little variability in soil bulk density was observed in spring 2007 (Table 1). Across all plots, total soil C was about 4600 g C m<sup>-2</sup> in summer 2004, with apparent differences amongst the treatments (Table 1). By fall 2006, soil C values were negative in all treatment except Reed canarygrass, which was not different from zero (Fig. 3).

Table 1. Belowground C to 15 cm depth (mean [SE], n=5) under 5 experimental vegetation treatments.

Treatment	Spring 2007 root biomass (g C/m <sup>2</sup> )*	Spring 2007 soil bulk density (g C/cm <sup>3</sup> )	Summer 2004 soil C (g C/m <sup>2</sup> )**	Fall 2006 soil C (g C/m <sup>2</sup> )**
Fine fescue	53 [4]	1.49 [0.05]	4508 [120]	4323 [152]
Kentucky bluegrass	41 [6]	1.55 [0.02]	4840 [38]	4616 [70]
Reed canarygrass	28 [3]	1.55 [0.02]	4686 [72]	4680 [150]
Prairie forbs	16 [5]	1.52 [0.05]	4632 [214]	4467 [197]
Prairie grass	9 [2]	1.55 [0.03]	4691 [151]	4501 [133]

\*assumes 50% of root biomass is C

\*\*roots excluded from soil C estimates

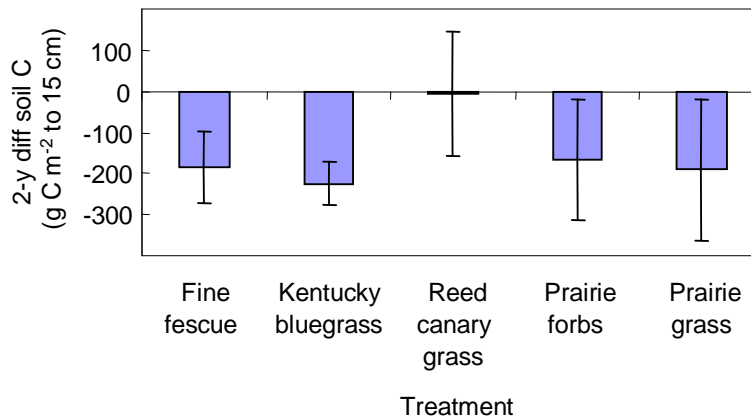


Figure 3. The difference in soil C to 15 cm depth (mean  $\pm$  SE,  $n=5$ ) between summer 2004 and fall 2006.

## DISCUSSION

Our results indicate that the process of grassland renovation, where a sod is killed with herbicide, lightly disked, and sown to a new grassland community, is likely to result in a short-term loss of soil C. Loss of soil C means that mineralization of soil organic matter is occurring at a rate that is higher than net primary productivity. The only plots that did not lose soil C on average were those sown to the highly productive Reed canarygrass, which is considered a noxious invader by wetland managers, but promoted for upland pasture by many agronomists.

It is well known that soil disturbance results in a loss of soil C because C that was otherwise protected from microbial mineralization is exposed to  $O_2$  and quickly converted to  $CO_2$  (Wagai *et al.* 1998, Rees *et al.* 2005). However, after two growing seasons we expected the productivity of the newly established plant communities to result in C accumulation. We were less surprised by the soil C loss under the prairie plantings, because these communities are notoriously slow to establish, typically taking 3 or 4 years until they dominate (Camill *et al.* 2004). But, the Fine fescue and Kentucky bluegrass treatments were well-established in the first growing season and by all accounts very productive.

In established perennial grasslands, some have estimated that soil C accumulates, but these studies usually employ models that require assumptions about root-shoot ratios in calculating C inputs via NPP and the relative contribution of root and microbial respiration for estimates of C outputs from the ecosystem (Rees *et al.* 2005, Derner *et al.* 2006). Recent work in cool-season pastures of New Zealand, where the authors used our approach of measuring total soil C at two points in time, showed that over a 15 to 20-y period soils were losing C at a rate of  $106 \text{ g C m}^{-2} \text{ y}^{-1}$  (Schipper *et al.* 2007). These estimates were similar to those found by Bellamy *et al.* (Bellamy *et al.* 2005), who surveyed over 2000 sites in the UK and Mack *et al.* (Mack *et al.* 2004) working in Arctic tundra.

Perennial grasslands are often espoused as C sinks (Sperow *et al.* 2003, Soussana *et al.* 2004), but it is clear that the balance between C loss and C gain is sensitive to species composition, disturbance, and nutrient inputs. The relative importance of these management influences in turf, pasture, and prairie requires further study against a backdrop of interannual weather variability and directional climate change.

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# **Turf Management**

# Velvet Bentgrass Nitrogen Type and Rate Evaluation

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## INTRODUCTION

Interest in velvet bentgrass (*Agrostis canina*) has increased in recent years due to its excellent quality, playability and stress tolerance characteristics. Velvet bentgrass has a lower fertility requirement and requires less water than creeping bentgrass to maintain quality turf (Brillman and Meyer, 2000) (DaCosta and Huang, 2006). Much of the research done on velvet bentgrass to date was on older cultivars and in the Northeast United States. Many of the new recommendations for nitrogen rates on velvet putting greens are inconsistent with older research. An extension publication from the University of Rhode Island claimed that liquid fertilizers work better than granular and that more acidifying fertilizers are better than ureas and nitrates which can temporarily raise soil pH around turfgrass roots and lead to micronutrient imbalance (Boesch, 2005). These claims about liquid fertilizers and fertilizer type seemed to be based mostly on anecdotal evidence. According to Dr. Phil Barak (UW-Madison Soil Science Dept. 2007), all nitrogen fixation, even from *Rhizobium*, decreases soil pH to varying degrees over time.

Recently new and improved velvet bentgrass cultivars have been developed but proper management strategies are not known or have not been documented based on scientific research. Furthermore, velvet bentgrass has not been planted extensively or studied in great detail, especially in the upper Midwest under trafficked conditions.

## OBJECTIVES

- 1) To determine if ureas and nitrates are suitable for use on velvet bentgrass putting greens and to compare them to more acidifying ammoniacal fertilizers.
- 2) To determine how the nitrogen application rate affects agronomic and playability of velvet bentgrass using each nitrogen form.

## MATERIALS AND METHODS

The study was seeded on both a sand and native silt loam green on 7 August 2006 using 1.1 lbs of seed per 1000 square feet. The seed was pre-treated with metalaxyl to control root pythium diseases. Starter fertilizer was applied at a rate of 1 lb P<sub>2</sub>O<sub>5</sub> per 1000 square feet. Plots were grown in during autumn of 2006 and spring of 2007. Initial fertilizer treatment applications were made in June of 2007 and continued through October 2007. In the spring of 2008 initial applications will begin the week of April 23 and will be made every two weeks through October for a total of 14 applications. The four nitrogen types used in this study along with their calcium carbonate equivalent (CCE) are listed in Table 1.

**Table 1.** Nitrogen types and their residual basicity.

<b>Nitrogen type</b>	<b>Calcium Carbonate Equivalent(CCE)/100 lb fertilizer (lb)</b>
Urea	84
Ca(NO <sub>3</sub> ) <sub>2</sub>	20 B <sup>†</sup>
NH <sub>4</sub> NO <sub>3</sub>	59
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	110

<sup>†</sup> B indicates a residual basicity. All other values refer to acidifying effects.

#### Nitrogen Rates

1, 3, and 5 lbs N/M/yr

Application rates are be .36, .21, and .07 lbs N/M/every 2 weeks.

#### Pesticides

Apply contact fungicides curatively after disease pressure develops to prevent significant stand loss.

#### Data Collection

Quality – rate weekly

Clipping yield – weekly

Root biomass – Late July, October

Clipping nutrient analysis – spring, summer, fall

Shoot density – (count shoots in 3 plugs) May, August, October

Disease incidence

Chlorophyll Content – weekly

Organic Matter – October

Ball roll – weekly

Soil pH – Aug 1, October 1

#### Other Plot Maintenance

Mow daily at .156”

Topdress monthly

Aerate in Fall

Irrigation Sand: 4x/week at 75%ET

Irrigation Soil: 4x/week at 60%ET

## RESULTS FROM SAND BASED GREEN

Preliminary data from the 2007 growing season is shown in Table 2 and 3 below. On sand, urea and ammonium nitrate provided the best turf quality for a significant portion of the growing season (Table 2). In addition the higher nitrogen rates provided better turf quality on sand. Treating velvet bentgrass grown on sand with urea and ammonium nitrate resulted in the turf having more chlorophyll (Table 3). Plots treated with calcium nitrate and ammonium sulfate tended to have less chlorophyll as well as reduced quality. Treating velvet bentgrass grown on sand with higher nitrogen rates resulted in the turf having more chlorophyll.

**Table 2.** Effect of nitrogen type and rate on velvet bentgrass putting green turf quality (sand based rootzone), Verona, WI, 2007.

Source	Quality								
Nitrogen Type	6 July	12 July	19 July	23 July	15 Aug	27 Aug	17 Sept	26 Sept	12 Oct
1 Urea	5.2	5.3	5.2	5.7	5.0	5.7	4.9	5.3	4.8
2 Calcium Nitrate	5.2	5.1	5.1	5.6	4.5	5.2	4.5	4.7	4.5
3 Ammonium Nitrate	5.3	5.4	5.2	5.7	4.8	5.6	5.0	5.3	5.0
4 Ammonium Sulfate	5.3	5.4	5.1	5.6	4.7	5.3	4.7	4.8	4.8
LSD (0.05)	ns	ns	ns	ns	ns	ns	0.20	0.36	0.25
Nitrogen rate									
1 (lbs N/M/yr)	5.0	4.9	4.6	5.1	4.3	4.7	4.1	4.0	3.9
3 (lbs N/M/yr)	5.3	5.3	5.3	5.7	4.9	5.7	5.0	5.3	5.0
5 (lbs N/M/yr)	5.4	5.7	5.5	6.2	5.0	5.9	5.3	5.7	5.4
LSD (0.05)	0.28	0.32	0.28	0.21	0.21	0.28	0.18	0.21	0.19

Quality rating scale: 1-9, 1=dead turf, 9=best quality, 6=acceptable

**Table 3.** Effect of nitrogen type and nitrogen rate on chlorophyll content of velvet bentgrass putting green turf (sand based rootzone), Verona, WI, 2007.

Source	Index of Relative Chlorophyll Content (0-999)								
Nitrogen Type	6 July	20 July	24 July	31 July	8 Aug	27 Aug	17 Sept	26 Sept	12 Oct
1 Urea	185	210	214	230	234	268	198	208	198
2 Calcium Nitrate	186	202	206	216	202	235	174	189	179
3 Ammonium Nitrate	185	192	203	215	218	259	196	206	200
4 Ammonium Sulfate	185	203	200	213	206	247	182	198	190
LSD (0.05)	ns	12.0	ns	ns	19.7	17.4	11.8	11.7	7.02
Nitrogen rate									
1 (lbs N/M/yr)	170	188	181	190	194	227	165	165	157
3 (lbs N/M/yr)	186	203	209	223	221	261	193	208	199
5 (lbs N/M/yr)	198	213	227	243	230	269	205	228	218
LSD (0.05)	6.7	15.1	6.6	9.2	7.5	8.1	5.2	9.7	4.7

Index of relative chlorophyll content rating scale: 0-999, 0=no chlorophyll, 999=most chlorophyll

## RESULTS FROM SOIL-BASED GREEN

Nitrogen type had no effect on turf quality on the soil based green (Table 4). Turf quality was only affected by nitrogen rate. The results indicate that growing velvet bentgrass on soil requires less nitrogen to provide acceptable turf quality than when velvet bentgrass is grown on sand (Table 5).

Nitrogen rate was the only variable to affect chlorophyll content on the soil based putting green (Table 6). Chlorophyll contents resulting from the low nitrogen rate treatments on the soil based green were much higher than the chlorophyll contents resulting from the low nitrogen rate treatments on the sand based green.

**Table 4.** Analysis of variance for turfgrass quality on velvet bentgrass fertilizer trial (soil based rootzone), Verona, WI, 2007.

Source	6 July	12 July	19 July	23 July	15 Aug	27 Aug	17 Sept	26 Sept	12 Oct
Replication (R)	ns	ns	ns	ns	ns	ns	ns	ns	ns
Nitrogen type (N)	ns	ns	ns	ns	ns	ns	ns	ns	ns
Nitrogen rate (R)	**	**	**	**	ns	**	**	**	**
Type x Rate (NxR)	ns	ns	ns	ns	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 5.** Effect of nitrogen rate on velvet bentgrass putting green turf quality (soil based rootzone), Verona, WI, 2007.

Source	Quality								
Nitrogen rate	6 July	12 July	19 July	23 July	15 Aug	27 Aug	17 Sept	26 Sept	12 Oct
1 (lbs N/M/yr)	6.5	6.3	5.3	6.0	5.3	5.6	4.9	4.5	4.3
3 (lbs N/M/yr)	6.6	6.6	5.8	6.6	5.7	6.1	5.4	5.3	5.3
5 (lbs N/M/yr)	6.9	7.2	6.0	6.9	5.9	6.5	6.0	6.0	5.9
LSD (0.05)	0.20	0.24	0.39	0.38	ns	0.49	0.41	0.41	0.27

Quality rating scale: 1-9, 1=dead turf, 9=best quality, 6=acceptable

**Table 6.** Analysis of variance for chlorophyll content measurements on velvet bentgrass fertilizer trial (soil based rootzone), Verona, WI, 2007.

Source	6 July	20 July	24 July	31 July	8 Aug	27 Aug	17 Sept	26 Sept	12 Oct
Replication (R)	ns	ns	ns	ns	ns	ns	ns	ns	ns
Nitrogen type (N)	ns	ns	ns	ns	ns	ns	ns	ns	ns
Nitrogen rate (R)	**	**	**	**	ns	**	**	**	**
Type x Rate (NxR)	ns	ns	**	ns	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 7.** Effect of nitrogen rate on chlorophyll content of velvet bentgrass putting green turf (soil based rootzone), Verona, WI, 2007.

<b>Source</b>	<b>Index of Relative Chlorophyll Content (0-999)</b>								
<b>Nitrogen rate</b>	<b>6 July</b>	<b>20 July</b>	<b>24 July</b>	<b>31 July</b>	<b>8 Aug</b>	<b>27 Aug</b>	<b>17 Sept</b>	<b>26 Sept</b>	<b>12 Oct</b>
1 (lbs N/M/yr)	266	298	299	343	299	278	230	273	244
3 (lbs N/M/yr)	272	310	310	370	303	390	242	305	269
5 (lbs N/M/yr)	290	328	318	380	306	305	261	338	283
LSD (0.05)	11.2	9.1	9.6	17.8	ns	13.6	11.1	15.2	9.4

Index of relative chlorophyll content rating scale: 0-999, 0=no chlorophyll, 999=most chlorophyll

# **Organic Putting Green Management with HumaCal**

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## **OBJECTIVE**

One objective is to observe the effects of an organic calcium fertilizer (HumaCal) on agronomic and playability characteristics of putting green turf when used as a supplement a conventional fertility program. A second objective is to determine if fungicide rates can be reduced when HumaCal is used as a supplement to a conventional fertility program.

## **MATERIALS AND METHODS**

This study is conducted on a USGA-specified sand-based putting green seeded with Penncross creeping bentgrass. The turf is mowed 5 days per week at .156" with clippings removed. Irrigation is supplied to replenish 100% of estimated evapotranspiration. Nitrogen is supplied using urea at a rate of 3 lb N/1000 square feet per year. Phosphorous and potassium are supplied when needed as determined by soil test using liquid tetra potassium pyrophosphate (See Table 1).

Treatments are arranged in a randomized complete block with four replications. The experiment was designed as a 4 x 2 factorial with a total of eight treatments. Factor 1 (fungicide rate) consists of four fungicide rates: Full rate,  $\frac{3}{4}$  rate,  $\frac{1}{2}$  rate, and no fungicide. Factor two (+/- organic calcium fertilizer) consists of plots with or without HumaCal. Fungicides are applied when disease pressure reaches a threshold of 10% of the plot area for each treatment (See Table 1). HumaCal was applied at various rates five times throughout the growing season as part of a pre-determined program (See Table 1).

Turf quality was rated visually on a scale from 1-9 where 1=worst turf quality, 9=optimal turf quality, and 6=minimum level of acceptable turf quality. Turf color was rated visually on a scale from 1 to 9 where 1=totally brown, 9=dark green, and 6=minimum level of acceptable turf color. Disease incidence was rated whenever it occurred and was rated visually as percent area affected. Ball roll distance was evaluated periodically as a measure of turf playability. A modified stimpmeter was used to make ball roll measurements. Photochemical efficiency of the turf was evaluated by determining chlorophyll fluorescence using a modulated chlorophyll fluorometer.

**Table 1.** Treatment record for organic calcium fertilizer study.

Date	Application	Rate
24 April	HumaCal	6 lbs/M*
21 May	Urea	.5 lbs N/M
28 May	HumaCal	12 lbs/M
19 June	Urea	.5 lbs/M
29 June	HumaCal	12 lbs/M
16 July	Urea	.5 lbs/M
21 July	Emerald (boscolid)	High rate = 0.18 oz/M
31 August	TKPP	1 lb P <sub>2</sub> O <sub>5</sub> /M
8 August	HumaCal	12 lbs/M
15 August	Urea	.5 lbs/M
4 September	26 GT (iprodione)	High rate = 4 oz/M
14 September	Urea	.5 lbs/M
15 October	Urea	.5 lbs/M
31 October	TKPP	2 lbs P <sub>2</sub> O <sub>5</sub> /M
11 November	HumaCal	20 lbs/M

\*M is an abbreviation for 1000ft<sup>2</sup>

## RESULTS

Dollar spot caused by *Sclerotinia homeocarpa* and brown patch caused by *Rhizoctonia solani* were the only diseases which affected this study. Visual dollar spot ratings taken on 9 and 16 July did not detect any treatment differences due to program or HumaCal application. Disease pressure had not exceeded the 10% threshold by these dates so fungicide had not been applied however there had been three applications of HumaCal made by the 9 July rating date. By the 8 August rating date disease pressure had increased enough to warrant fungicide application so we began to notice treatment differences due to fungicide program. All programs treated with some fungicide had significantly less dollar spot pressure than the program that received no fungicide (Table 3). The ½ and ¾ fungicide rate programs were statistically similar to the full fungicide rate. Percent brown patch incidence was also rated on 8 August. The full and ¾ fungicide rate programs were providing good control of brown patch. The ½ fungicide rate and no fungicide programs were not as effective at controlling brown patch. Another outbreak of dollar spot was observed and a rating was taken on 27 August. The full fungicide rate was providing the best control of dollar spot but all programs that received some fungicide were statistically similar. The ½ fungicide rate program was statistically the same as the no fungicide program. A final dollar spot rating was taken on 12 October. Again all programs that received some fungicide were statistically similar and were providing significantly better control of dollar spot than the no fungicide program. There were no differences in disease incidence due to the application of HumaCal at any rating date (Table 2).

Quality remained at acceptable levels or above for all treatments until 27 August when we began to see differences due to disease pressure (Table 3). On 27 August all



programs that received some fungicide were statistically similar although the  $\frac{1}{2}$  fungicide rate program had similar quality to the no fungicide program (Table 4). There were no differences due to application of HumaCal at this or any rating date. There were also differences in quality due to program on 12 October. All programs treated with some fungicide had acceptable turf quality. The program that received no fungicide had below acceptable turf quality.

Photochemical efficiency was rated on 28 August and 12 October and data is reported as Fv/Fm ratios in Table 6. There were no differences due to program or application of HumaCal on the two rating dates. Fv/Fm ratios were higher in October indicating that the turf was less stressed during the optimal growing conditions of fall.

Turf color was rated visually seven times throughout the growing season. There were no differences due to program or application of HumaCal at any rating date (Table 7). Turf color was acceptable for all treatments throughout the growing season (data not shown).

Ball roll distance was measured using a modified stimpmeter to determine effects of various treatments on playability of putting green turf. Interactions between program and HumaCal application were observed on 13 August and 28 August (Table 8). On 13 August the programs that received full fungicide had greater ball roll when treated with HumaCal but the plots that received no fungicide resulted in greater ball roll when not treated with HumaCal (Table 9). Programs that received  $\frac{3}{4}$  or  $\frac{1}{2}$  rates of fungicide were not affected by HumaCal application on this rating date. On 28 August the only program that was affected by application of HumaCal was the  $\frac{1}{2}$  rate fungicide program which had greater ball roll when HumaCal was not applied. Greater ball roll is generally desirable to golfers and golf course superintendents.

## CONCLUSION

One of the objectives of this study was to observe the effects of HumaCal on agronomic characteristics and playability of putting green turf. The application of HumaCal in addition to a conventional fertility program did not affect the agronomic characteristics of creeping bentgrass putting green turf in the first year of this study. The application of HumaCal had a slight effect on ball roll in August but the effect was not consistent. Another year of data collection would be valuable especially considering the fact that it may take time to build up calcium and humic substances in the sand root-zone using the HumaCal program. It is possible that HumaCal did not have an effect on turf quality or playability in the first year because there was already adequate calcium in the sand root-zone mix. Soil tests indicated that the sand root-zone making up the study area had around 561 ppm calcium which is considered sufficient by University of Wisconsin soil test guidelines.

In the first year of this study there was no statistically significant evidence to show that applying HumaCal can reduce the need for fungicide. Data however did indicate that it is possible to maintain acceptable levels of disease control, quality, and color while only

using  $\frac{3}{4}$  or  $\frac{1}{2}$  fungicide rates. Using no fungicide often resulted in below acceptable levels of quality and disease control.

Although the application of HumaCal had little effect on putting green turfgrass performance in 2007 it may have more of an effect as additional applications are made over the course of multiple growing seasons. Results may also be different if the product is used on a putting green with insufficient calcium or where calcium is not present in irrigation water.

**Table 2.** Analysis of variance for dollar spot and brown patch incidence. Verona, WI, 2007.

Source	9 July	16 July	8 Aug	8 Aug <sup>†</sup>	27 Aug	12 Oct
Program (Pgm)	ns	ns	**	*	*	**
HumaCal (Hum)	ns	ns	ns	ns	ns	ns
Pgm*Hum	ns	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

<sup>†</sup> Indicates brown patch rating.

**Table 3.** Effect of fungicide program on disease incidence. Disease incidence rating scale: 0-100%, 0=no disease, 100=totally dead. Verona, WI, 2007.

Source	% Incidence					
Program	9 July	16 July	8 Aug	8 Aug <sup>†</sup>	27 Aug	12 Oct
Full Fungicide rate	3.0	1.8	0.1	0.5	0.8	4.3
$\frac{3}{4}$ Fungicide rate	3.0	2.0	0.4	1.8	3.4	6.9
$\frac{1}{2}$ Fungicide rate	3.8	1.8	1.6	5.6	5.9	9.4
No Fungicide	3.5	1.8	5.9	5.3	10.6	25.6
LSD (0.05)	ns	ns	2.9	3.7	6.1	8.9
<b>HumaCal</b>						
+ Humacal	3.5	2.1	1.9	3.8	5.0	11.3
- HumaCal	3.1	1.7	2.1	2.8	5.3	11.8
LSD (0.05)	ns	ns	ns	ns	ns	ns

<sup>†</sup> Indicates brown patch rating.

**Table 4.** Analysis of variance for effect of program and HumaCal on putting green turf quality. Verona, WI, 2007.

Source	27 May	8 June	19 June	3 July	16 July	27 Aug	12 Oct
Program (Pgm)	ns	ns	ns	ns	ns	*	**
HumaCal (Hum)	ns	ns	ns	ns	ns	ns	ns
Pgm*Hum	ns	ns	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 5.** Effect of fungicide program putting green turf quality. Quality rating scale: 1-9, 1=dead turf, 9=best quality, 6=acceptable. Verona, WI, 2007.

Source	Quality						
Program	27 May	8 June	19 June	3 July	16 July	27 Aug	12 Oct
Full Fungicide rate	5.9	6.9	6.1	7.0	6.3	6.0	6.6
¾ Fungicide rate	5.9	6.9	6.0	7.1	6.4	5.7	6.6
½ Fungicide rate	6.0	6.9	6.0	7.0	6.4	5.4	5.9
No Fungicide	5.8	6.8	5.8	7.0	6.3	5.0	4.9
LSD (0.05)	ns	ns	ns	ns	ns	0.61	0.97
<b>HumaCal</b>							
+ Humacal	5.9	6.9	6.0	7.1	6.4	5.5	6.0
- HumaCal	5.9	6.9	6.0	7.0	6.3	5.5	6.0
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns

**Table 6.** Analysis of Variance for effect of fungicide program and HumaCal on photochemical efficiency measured by chlorophyll fluorescence (Fv/Fm), Verona, WI, 2007.

Source	28 Aug	12 Oct
Program (Pgm)	ns	ns
HumaCal (Hum)	ns	ns
Pgm*Hum	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 7.** Effect of fungicide program and HumaCal on photochemical efficiency measured by chlorophyll fluorescence (Fv/Fm). Verona, WI, 2007.

Source	Chlorophyll Fluorescence (Fv/Fm) <sup>†</sup>	
Program	28 Aug	12 Oct
Full Fungicide rate	.782	.802
¾ Fungicide rate	.782	.809
½ Fungicide rate	.777	.808
No Fungicide	.792	.808
LSD (0.05)	ns	ns
<b>HumaCal</b>		
+ Humacal	.778	.808
- HumaCal	.788	.805
LSD (0.05)	ns	ns

<sup>†</sup>Larger Fv/Fm values indicate the plant is less stressed.

**Table 8.** Analysis of variance for effect of program and HumaCal on putting green turf color. Verona, WI, 2007.

Source	27 May	8 June	19 June	3 July	16 July	27 Aug	12 Oct
Program (Pgm)	ns	ns	ns	ns	ns	ns	ns
HumaCal (Hum)	ns	ns	ns	ns	ns	ns	ns
Pgm*Hum	ns	ns	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 9.** Analysis of variance for effect of program and HumaCal on ball roll using a modified stimp meter. Verona, WI, 2007.

Source	29 May	18 June	17 July	13 Aug	28 Aug
Program (Pgm)	ns	ns	ns	ns	*
HumaCal (Hum)	ns	ns	ns	ns	ns
Pgm*Hum	ns	ns	ns	*	**

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 10.** Interaction between program and HumaCal and their effect on ball roll. Verona, WI, 2007.

Program	+/- HumaCal	Ball Roll (inches)	
		13 Aug	28 Aug
Full fungicide rate	+	58.3	47.5
¾ Fungicide rate	+	58.5	48.6
½ Fungicide rate	+	57.6	47.6
No fungicide	+	59.3	49.0
Full fungicide rate	-	56.6	46.5
¾ Fungicide rate	-	58.5	47.4
½ Fungicide rate	-	58.8	51.1
No fungicide	-	61.5	49.4
LSD within Pgm (0.05)		1.6	2.4
LSD among Pgms (0.05)		3.5	2.2

Quality rating scale: 1-9, 1=dead turf, 9=best quality, 6=acceptable

# Organic Putting Green Management 2007

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## OBJECTIVE

The objective of this study was to compare an organic based compounds to a conventional fertilizer regime at various input levels on putting green turf and evaluate their effects on agronomic and playability characteristics.

## MATERIALS AND METHODS

This study was conducted on a USGA-specified putting green with an 80:20 sand:peat root zone. Turf was mowed daily at .156" and clippings were removed. Turf was irrigated three times weekly at 100% of the estimated evapotranspiration rate. Irrigation would usually occur five times weekly but was supplied three times weekly to potentially enhance the effects of calcium-modulated stress tolerance. The turf was topdressed monthly with an 80:20 sand:peat mix.

### Data collected

- Turf quality ratings (1-9 on visual scale) monthly during the growing season.
- Turf color ratings (1-9 on visual scale) at 2 week intervals during the growing season.
- Disease ratings (% area infected) when disease occurs.
- Stimpmeter (green speed) readings taken 3 times during peak growing season.

### Treatments

All treatments were replicated 4 times and the experimental design was a randomized complete block. The experiment was designed as a loose 4x2 factorial treatment arrangement with a total of 8 treatments. The factorial arrangement allowed for separation of the effects of the input program (input level of fertilizer and fungicides) from the fertilizer type (regime) (HealthyGro + organic calcium fertilizer vs. conventional) and to determine any potential interactions. Factor 1 (main plots) consisted of 4 input programs: high, medium, moderate, and low input (3 lb N/1000 ft<sup>2</sup> + full fungicide rate, 2.25 lb N plus ¾ of the full fungicide rate, 1.5 lb N plus ½ of the full fungicide rate, and 1.5 lb N with no fungicides. Factor 2 (sub plots) consist of two fertilizer regimes: HealthyGro + organic calcium fertilizer vs. a conventional synthetic fertilizer with a 4:1:4 ratio. The conventional fertilizer was custom blended using 60% 21-3-12, 10% 0-0-50, and 30% 18-9-18 to give an analysis of 18-4.5-17.6 with mostly slow release and some fast release nitrogen. Individual plots measured 3x14 ft. Fertilizer was watered in following application.

As a modification to the protocol used in 2005, the following treatments were added to the study for the 2006 and 2007 growing season: 1) After dormancy, 50 lbs/M HealthyGrow 2-5-4 and 20 lbs/M HumaCal was applied on all organic based fertility plots and 1 lb N/M using conventional fertilizer on the conventional based fertility plots. At this time iprodione was applied to plots according to the input level originally specified to control snow mold. 2) In late March, 6.25 lbs/M of HealthyGrow 8-3-8 and 6 lbs/M of HumaCal was applied to the organic Bio Ag fertilizer regime plots. No conventional fertilizer was applied at this time.

The idea behind the modifications to the protocol was to compare an organic based regime specified by Midwestern Bio Ag to what is typically done on a golf course using conventional fertilizer. As a result of these modifications, the fertilizer types used as sub-plots are now referred to as ‘fertilizer regime’.

**Table 1.** Treatment schedule for Midwestern Bio Ag Fertilizer Evaluation, Verona, WI, 2007.

Date	Application	Fungicide Rates
18 Nov 2006	Made dormant fertilizer applications	
28 March 2007	Made organic fertilizer regime applications	
29 May 2007	Made fertilizer treatments to all plots	
20 June 2007	Emerald (boscolid) fungicide treatment	0.18, 0.14, and 0.09 oz/M
30 June 2007	Made fertilizer treatments to all plots	
18 July 2007	Chipco 26 GT (iprodione) fungicide treatment	4, 3, and 2 oz/M <sup>†</sup>
1 August 2007	Emerald (boscolid) fungicide treatment	0.18, 0.14, and 0.09 oz/M
8 August 2007	Made fertilizer treatments to all plots	
12 Nov 2007	Made dormant fertilizer applications	

<sup>†</sup> M is the symbol for 1000ft<sup>2</sup>.

## RESULTS

Results of turf color ratings are shown in Table 2. The 26 March rating shows differences in terms of early spring green-up between treatments. For all practical purposes there were no major differences in color between input programs in March. The plots treated with the organic fertilizer regime resulted in significantly faster green-up than the conventional fertilizer regime and remained darker green through May. Beginning on 8 June differences in turf color due to input program were observed. In general input programs that received more nitrogen had better turf color. Interestingly, all input programs provided acceptable turf color until 27 August. In August, input program 4, which was the low fertilizer rate without fungicide, received lower color ratings than input program 3 which was the low fertilizer rate with fungicide. This trend continued to the 27 August rating date where the input program that received no fungicide had unacceptable turf color.

Plots treated with the organic fertilizer regime had better color early in the season but by July plots treated with the conventional fertilizer regime had better turf color (Table 2). Turf color was above acceptable levels for both fertilizer regimes following spring green-up.

The effect of input program on turfgrass quality is shown in Table 3. All input programs provided similar turf quality in May and early June. On 19 June input program 1 was providing the best turf quality. All other programs received lower quality ratings but were still acceptable. On 8 and 20 July input programs 1 and 2 were providing the best turf quality. Turf quality for input program 3 was not quite as good as programs 1 and 2. Program 4 was providing the worst turf quality. On 3 August input programs 1, 2, and 3 were all statistically similar and received quality ratings above 7. Program 4 received slightly worse quality ratings. Quality for all programs was acceptable throughout the entire growing season.

Fertilizer regime only affected turf quality on 28 May when the organic fertilizer regime received slightly higher quality ratings (Table 3).

Input program and fertilizer regime had an effect on leaf texture. Data from a rating taken on 28 May is presented in Table 4. All input programs resulted acceptable leaf texture but the program that received no fungicide had significantly coarser leaf texture than the other input programs. In addition, observations show that the organic fertilizer regime resulted in finer leaf texture on 28 May and casual observations indicate that this was the case for most of the growing season.

Lack of adequate rainfall coupled with the irrigation regime resulted in drought stress. Data showing the effect of input program on visual drought stress is presented in Table 5. On 28 May Programs 1 and 2 were exhibiting the most severe drought stress symptoms. Program 4 was exhibiting the least amount of drought stress symptoms. Differences between input programs were not statistically significant on 19 June but similar trends were seen with program 4 showing almost no drought stress symptoms.

In June and July ball roll distances were greater on plots treated with the conventional fertilizer regime (Table 6). These results were consistent with results obtained in previous years. Input program did not affect ball roll in 2007.

## CONCLUSION

This study compared various input levels and within each input level compared two different fertilizer regimes. In early spring the organic fertilizer regime resulted in improved quality and spring green-up. The improved qualities are likely due to the fast release nitrogen source in the HealthyGro fertilizer and the addition of nitrogen to only the organic fertilizer regime plots in April. Few differences due to input program were observed early in the growing season due largely to the dormant application of a constant rate of fertilizer across all input levels. Later in the growing season differences due to

input program in terms of turf color and quality were observed due to the application of various rates of fertilizer. It is important to note that even reduced input programs were providing acceptable levels of quality and color. A reduction of quality and color in program 4 which receives no fungicide is a residual effect from the previous growing season when disease pressure killed a significant percentage of the turf. There was little or no disease pressure for much of 2007 so reduced quality and color ratings for program 4 reflect a thin turf stand with coarse leaf texture that is still recovering from damage that occurred the previous season.

The leaf texture ratings in Table 4 show coarser leaf texture in plots not treated with fungicide. This is due to a thin turf stand caused by disease pressure in 2006. Thin turf stands tend to have plants with wider and more horizontal leaf blades as the turf spreads to fill in the bare areas. Finer leaf texture observed with the organic fertilizer regime is likely due to higher total nitrogen rates received by the organic fertilizer regime plots. It is possible that other factors such as application of HumaCal or nitrogen source are contributing to the fine leaf texture but the design of this experiment does not allow us to make such conclusions.

Differences in visual drought stress symptoms due to input program were observed. Input programs that received higher levels of inputs were showing more severe symptoms of drought stress. One factor that may have contributed to this is the application of more nitrogen causing increased growth rates and therefore causing greater water consumption. Plots receiving the lowest nitrogen rates had slower growth rates. In addition plots receiving input program 4 had fewer plants, plants with coarser leaf texture, and plants with a more horizontal leaf orientation. The presence of fewer plants means that there are less plants competing for available water. Ebdon and Petrovic (1998) noted that mowed turfgrass cultivars that use less water have a 17 percent more horizontal leaf orientation. They observed that mowed KBG plants, which have a more horizontal leaf orientation, require less energy for re-growth of leaves, possibly resulting in greater drought tolerance.

Results from the stimpmeter readings are consistent with results from previous years. There was a slight reduction in ball roll distance with the organic fertilizer regime. This is likely due to more lush growth as a result of the fast release nitrogen source as well as a higher overall nitrogen rate in the organic fertilizer regime plots. It is a common practice to reduce nitrogen rates to increase stimpmeter readings on golf courses.

Overall, the organic fertility regime is equivalent to the conventional fertility regime at all input levels. Benefits from the organic fertility regime include faster spring green-up, better early spring turf quality, and finer leaf texture.



**Table 2.** Effect of program and fertilizer regime on putting green turf color, Verona, WI 2007.

Factor	26 Mar	28 May	8 June	19 June	8 July	20 July	3 Aug	27 Aug
<b>Program</b>								
1. 3 lb N + fungicide	4.1 b	6.0	6.9 a	7.4 a	7.4	6.9 a	7.8 a	7.2 a
2. 2.25 lb N + $\frac{3}{4}$ fungicide	4.0 b	5.9	6.4 b	6.9 b	7.2	6.8 a	7.6 a	6.6 b
3. 1.5 lb N + $\frac{1}{2}$ fungicide	4.0 b	5.8	6.3 b	6.6 bc	7.0	6.4 b	7.3 a	5.8 c
4. 1.5 lb N + no fungicide	4.4 a	5.8	6.6 ab	6.3 c	7.1	6.3 b	6.4 b	5.2 d
LSD (0.05)	0.27	ns	0.35	0.48	ns	0.34	0.45	0.34
<b>Fertilizer Regime</b>								
1. Conventional Fertilizer	3.3 b	5.6 b	6.4	6.8	7.4 a	6.8 a	7.5 a	6.18
2. Bio Ag Program	5.0 a	6.1 a	6.6	6.9	7.0 b	6.4 b	7.1 b	6.15
LSD (0.05)	0.15	0.30	ns	ns	0.27	0.19	0.23	ns

Color rating scale: 1-9, 1=totally brown, 9=dark green, 6=acceptable

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 3.** Effect of program and fertilizer regime on putting green turf quality. Verona, WI 2007.

Factor	<b>Turfgrass Quality</b>					
	28 May	8 June	19 June	8 July	20 July	3 Aug
<b>Program</b>						
1. 3 lb N + fungicide	6.1	6.4	7.0 a	7.8 a	6.9 a	7.4 a
2. 2.25 lb N + $\frac{3}{4}$ fungicide	6.0	6.1	6.3 b	7.6 a	6.7 ab	7.3 a
3. 1.5 lb N + $\frac{1}{2}$ fungicide	6.3	5.9	6.2 b	7.1 b	6.4 bc	7.1 a
4. 1.5 lb N + no fungicide	6.0	5.7	5.9 b	6.6 c	6.1 c	6.3 b
LSD (0.05)	ns	ns	0.71	0.41	0.31	0.61
<b>Fertilizer Regime</b>						
1. Conventional Fertilizer	5.8 b	6.0	6.3	7.2	6.5	7.0
2. Bio Ag Program	6.4 a	6.1	6.4	7.3	6.6	7.1
LSD (0.05)	0.30	ns	ns	ns	ns	ns

Quality rating scale: 1-9, 1=dead turf, 9=best quality, 6=acceptable

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 4.** Effect of program and fertilizer regime on leaf texture of putting green turf. Verona, WI 2007.

Factor	Leaf Texture
	28 May
Program	
1. 3 lb N + fungicide	7.5 a
2. 2.25 lb N + $\frac{3}{4}$ fungicide	7.3 a
3. 1.5 lb N + $\frac{1}{2}$ fungicide	7.3 a
4. 1.5 lb N + no fungicide	6.5 b
LSD (0.05)	0.33
Fertilizer Regime	
1. Conventional Fertilizer	6.8 b
2. Bio Ag Program	7.6 a
LSD (0.05)	0.24

Leaf texture rating scale: 1-9, 1=extremely coarse, 9=very fine, 6=acceptable

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 5.** Effect of program on visual drought stress symptoms. Verona, WI 2007.

Program	Drought Stress	
	28 May	19 June
1. 3 lb N + fungicide	2.1 a	1.8
2. 2.25 lb N + $\frac{3}{4}$ fungicide	2.4 a	2.4
3. 1.5 lb N + $\frac{1}{2}$ fungicide	1.8 ab	1.9
4. 1.5 lb N + no fungicide	1.4 b	1.1
LSD (0.05)	0.71	ns

Leaf texture rating scale: 1-9, 1=no drought stress, 9=brown and dead turf, 3=unacceptable.

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 6.** Effect of fertilizer regime on ball roll using a full length stimpmeter. Verona, WI 2007.

Fertilizer Regime	Ball Roll (inches)		
	29 May	22 June	20 July
1. Conventional Fertilizer	95.7	106.7 a	113.5 a
2. Bio Ag Program	95.0	104.1 b	110.3 b
LSD (0.05)	ns	2.36	3.2

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

## REFERENCES

- Ebdon, J., and A. Petrovic. 1998. Morphological and Growth Characteristics of Low- and High-Water Use Kentucky Bluegrass Cultivars. Crop Sci. 38:143-152.

# Herbicide Trials

# Large Crabgrass Control with Granular Post-emergent Herbicides

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## INTRODUCTION

Large crabgrass (*Digitaria sanguinalis*) is a common annual weed that is found on athletic fields, lawns and golf courses. There are many granular pre-emergent herbicides for the control of crabgrass but it can be difficult to know when an infestation of crabgrass will occur since seed can remain viable in the soil for multiple years. A site that was void of crabgrass one year can suddenly be infested with crabgrass the next if there is thinning of the turf. Because crabgrass infestations are unsightly and common on both mature and newly established turf there is a need for granular post-emergent crabgrass herbicides which are as effective as sprayable post-emergent crabgrass herbicides.

## OBJECTIVES

The objective of this study is to evaluate the effectiveness of several products for post-emergent control of large crabgrass (*Digitaria sanguinalis*) when applied to wet turf.

## MATERIALS AND METHODS

The study was conducted at the Lake Wisconsin Country Club in Prairie du Sac, WI. The study area was a mixed stand of Kentucky bluegrass and perennial ryegrass mowed at fairway height 2-3 times per week. The study site was located the driving range of the golf course and was irrigated to prevent drought stress during the growing season. The experimental design was a randomized complete block with three replications. Herbicide treatments were main plots which measured 3 x 3 feet. A one foot border was located between each plot to allow for the passing of the wheels of a Scotts box in order to avoid disturbing previously treated plots.

Treatments were applied on 8 August 2007 at approximately 6:30 a.m. when there was heavy dew. In addition to dew there was extremely high humidity so the turf remained wet well into the morning. The granular treatments were applied using a 3 x 3 foot Scotts box. Liquid herbicide treatments were sprayed in 1 gallon of water per thousand square feet using a CO<sub>2</sub> powered backpack sprayer and XR TeeJet 8004 VS nozzles at 40 psi. A uniform, naturally occurring population of large crabgrass (*Digitaria sanguinalis*) infested the area. Control of large crabgrass was rated at 1, 2, and 4 weeks after treatment (WAT). Percent crabgrass control was determined by visually estimating living crabgrass present initially and at each rating date. Percent control was calculated using the following equation: % Control = ((% crabgrass initial - % crabgrass current)/ % crabgrass initial)\*100. Turfgrass phytotoxicity was rated visually on 21 August and 6 September using a rating scale 0 – 100% where 0=no phytotoxicity and 100=totally dead.

**Table 1.** Treatment list for Andersons post-emergent crabgrass herbicide study. Verona, WI 2007.

Trt #	Code	Carrier	A.I. %	Lbs A.I./Acre
1	AND7064	NUREA w/ XRP+Lcob	0.143% CF + 0.43% quinclorac	0.25 + 0.75
2	AND7065	NUREA w/XRP+Lcob (Hangtime)	0.143% CF + 0.43% quinclorac	0.25 + 0.75
3	AND7066	8-0-0 AS/NUTRA+PNUT75	0.143% CF + 0.43% quinclorac	0.25 + 0.75
4	AND7067	8-0-0 AS / NUTRA + PNUT75 (Hangtime)	0.143% CF + 0.43% quinclorac	0.25 + 0.75
5	AND7068	8-0-0 Urea/NUTRA+PNUT75	0.143% CF + 0.43% quinclorac	0.25 + 0.75
6	AND7069	8-0-0 Urea / NUTRA +PNUT75 (Hangtime)	0.143% CF + 0.43% quinclorac	0.25 + 0.75
7	AND7070	NUREA w/ XRP + Lcob	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
8	AND7071	NUREA w/ XRP + Lcob (Hangtime)	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
9	AND7072	8-0-0 AS/NUTRA+PNUT75	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
10	AND7073	8-0-0 AS / NUTRA + NUT75 (Hangtime)	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
11	AND7074	8-0-0 Urea / NUTRA + PNUT75	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
12	AND7075	8-0-0 Urea / NUTRA + PNUT75 (Hangtime)	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
13	AND7076	NUREA w/ XRP + Lcob	0.43% quinclorac + 0.287% dithiopyr	0.75 + 0.5
14	AND7077	NUREA w/ XRP + Lcob (Hangtime)	0.43% quinclorac + 0.287% dithiopyr	0.75 + 0.5
15	AND7078	8-0-0 AS / NUTRA + PNUT75	0.43% quinclorac + 0.287% dithiopyr	0.75 + 0.5
16	AND7079	8-0-0 AS / NUTRA + PNUT75 (Hangtime)	0.43% quinclorac + 0.287% dithiopyr	0.75 + 0.5
17	AND7080	8-0-0 Urea / NUTRA + PNUT75	0.43% quinclorac + 0.287% dithiopyr	0.75 + 0.5
18	AND7081	8-0-0 Urea / NUTRA + PNUT75 (Hangtime)	0.43% quinclorac + 0.287% dithiopyr	0.75 + 0.5
19	AND7095	9-0-18 Contec (Hangtime)	0.143% CF + 0.43% quinclorac + 0.287% dithiopyr	0.25 + 0.75 + 0.5
20	Drive 75DF	Sprayable quinclorac + 1 %v/v MSO	75% quinclorac	0.75
21	Acclaim Extra	--	0.57 lbs a.i./gal	0.129
22	Mesotrione 4SC	--	4 lbs a.i./gal	0.25
23	Untreated			

## RESULTS

Treatment types had significantly different effects on crabgrass control at 1, 2, and 4 weeks after treatment (Table 2). Percent crabgrass control data are shown in Table 3. On 14 August treatment 20, the sprayable quinclorac, was already exhibiting around 87 percent control of crabgrass. The best granular treatment was providing only 37 percent control. Most of the granular treatments were statistically similar in terms of crabgrass control at this rating date. However, it should be noted that treatments 10, 11, 14, 15 and 19 were not significantly different than the untreated control. At the 2 WAT rating on 21 August the treatment 20, sprayable quinclorac, was providing 96 percent control of crabgrass. The sprayable mesotrione treatment was providing 68 percent control of crabgrass. Most granular treatments were providing between 40 and 60 percent control and were statistically similar to one another. At 4 WAT the sprayable quinclorac treatment was providing 98 percent control of crabgrass (Figure 1). On this rating date many of the granular treatments were providing greater than 75 percent control and were statistically similar to the sprayable quinclorac treatment. Notable granular treatments that were providing greater than 90 percent control include treatments 9, 17, and 18. The next best treatments behind 17 and 18 were treatments 11 and 12 which used the same carrier as treatments 17 and 18. Treatments 1, 3, 5, 15, and 21 were providing less than 75 percent control of crabgrass and would likely not provide acceptable levels of control in a real world situation.

Some slight phytotoxicity was caused by a few of the treatments at the 2 WAT rating date but phytotoxicity was deemed acceptable and was not seen at the 4 WAT rating date.

## CONCLUSION

The results of this study indicate that several of the Andersons granular crabgrass herbicide formulations are extremely effective for post-emergent control of large crabgrass in Wisconsin. Sprayable quinclorac, commonly known as Drive 75DF, is frequently used for post-emergent control of crabgrass. Although the granular treatments were slower acting than the sprayable quinclorac treatment, many of the granular treatments provided levels of control similar to that of sprayable quinclorac at 4 WAT with minimal phytotoxicity. The results of this study indicate that formulations using 8-0-0 Urea / NUTRA + PNUT75 as a carrier may provide better control than other formulations. The effect of carrier may need to be analyzed in more detail to make further conclusions about carrier and herbicide combinations.

**Table 2.** Analysis of variance for effect of treatment on percent crabgrass control with granular post-emergent crabgrass herbicides, Verona, WI, 2007.

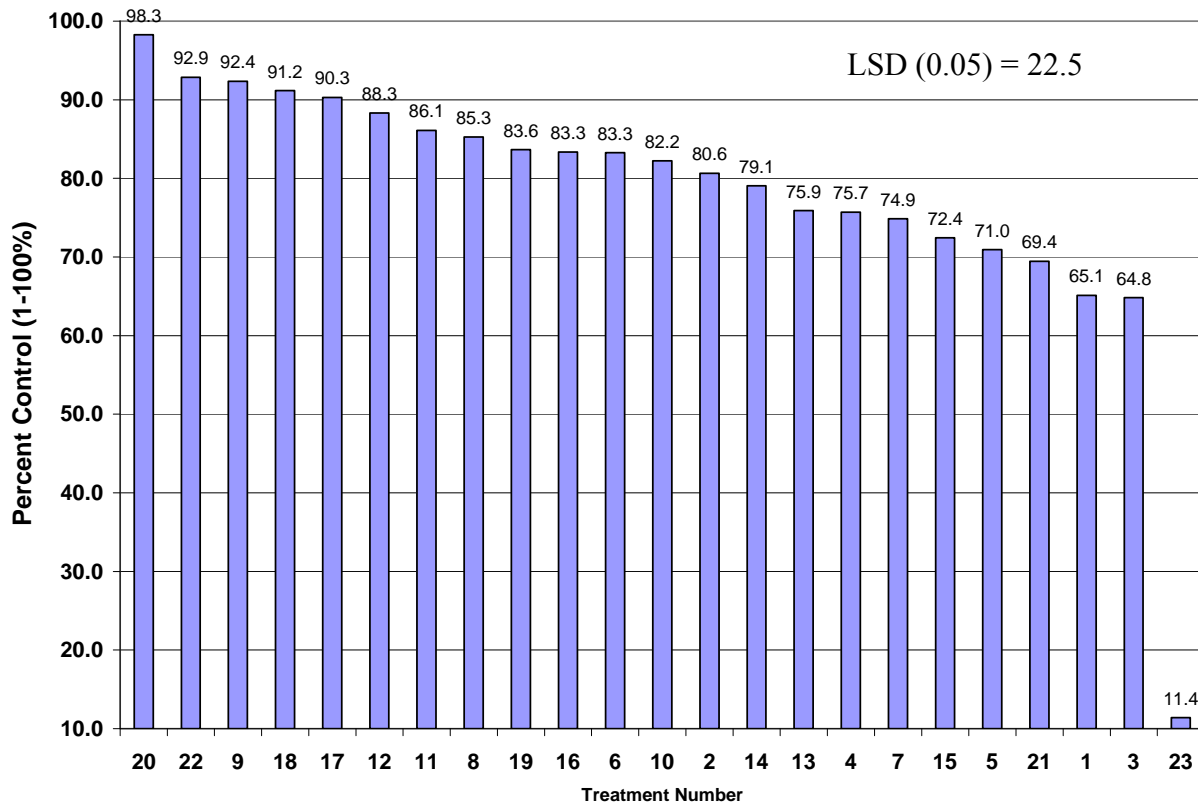
Source	14 Aug	21 Aug	6 Sept
Treatment	**	**	**

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 3.** Effect of treatment on percent crabgrass control with granular post-emergent crabgrass herbicides, Verona, WI, 2007.

Trt #	Code	% Crabgrass Control		
		14 Aug	21 Aug	6 Sept
1	AND7064	22.3 bc	46.5 cde	65.1 d
2	AND7065	36.9 b	54.4 bcd	80.6 abcd
3	AND7066	22.0 bc	47.8 cde	64.8 d
4	AND7067	24.3 bc	56.9 bcd	75.7 bcd
5	AND7068	24.8 bc	41.3 cde	71.0 bcd
6	AND7069	28.3 bc	54.2 bcde	83.3 abcd
7	AND7070	34.8 b	60.8 bc	74.9 bcd
8	AND7071	30.3 bc	53.3 bcde	85.3 abcd
9	AND7072	27.2 bc	49.9 bcde	92.4 ab
10	AND7073	20.8 bcd	55.6 bcd	82.2 abcd
11	AND7074	19.4 bcd	44.4 cde	86.1 abcd
12	AND7075	21.7 bc	42.2 cde	88.3 abc
13	AND7076	29.0 bc	43.4 cde	75.9 abcd
14	AND7077	20.3 bcd	50.4 bcde	79.1 abcd
15	AND7078	18.9 bcd	38.5 de	72.4 bcd
16	AND7079	26.7 bc	33.9 e	83.3 abcd
17	AND7080	33.6 bc	47.6 cde	90.3 abc
18	AND7081	31.7 bc	50.0 bcde	91.2 abc
19	AND7095	13.1 cd	38.5 de	83.6 abcd
20	Drive 75DF	86.6 a	95.6 a	98.3 a
21	Acclaim	22.2 bc	44.4 cde	69.4 cd
22	Mesotrione 4SC	26.5 bc	68.3 b	92.9 ab
23	Untreated Control	0.0 d	7.0 f	11.4 e
	LSD (0.05)	20.9	20.3	22.5

Means followed by the same letter are not significantly different at  $P \leq 0.05$



**Figure 1. Effect of treatment on percent crabgrass control with granular post-emergent crabgrass herbicide on 6 September 2007.**



**Table 4.** Effect of treatment on turfgrass phytotoxicity. Rated on a scale from 1-9 where 1=no phytotoxicity and 9=totally dead. Verona, WI, 2007.

Trt #	Code	Turfgrass Phytotoxicity	
		21 Aug	6 Sept
1	AND7064	0.0	0.0
2	AND7065	3.3	0.0
3	AND7066	1.7	0.0
4	AND7067	0.0	0.0
5	AND7068	1.7	0.0
6	AND7069	0.0	0.0
7	AND7070	0.0	0.0
8	AND7071	1.7	0.0
9	AND7072	0.7	0.0
10	AND7073	0.0	0.0
11	AND7074	1.7	0.0
12	AND7075	0.0	0.0
13	AND7076	3.3	0.0
14	AND7077	3.3	0.0
15	AND7078	0.0	0.0
16	AND7079	1.7	0.0
17	AND7080	1.7	0.0
18	AND7081	1.7	0.0
19	AND7095	0.0	0.0
20	Drive 75DF	3.3	0.0
21	Acclaim	0.0	0.0
22	Mesotrione 4SC	1.3	0.0
23	Untreated Control	0.0	0.0
	LSD (0.05)	ns	ns

Means followed by the same letter are not significantly different at  $P \leq 0.05$

## Dimension 2 EW for Crabgrass Control Demonstrations

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### OBJECTIVE

The objective of this study was to determine if pre-emergent application of Dimension 2EW provides crabgrass control that is comparable to Barricade.

### MATERIALS AND METHODS

The study was conducted at the O.J. Noer Turfgrass Research and Educational Facility in Verona, WI, on perennial ryegrass maintained as a low input athletic field. The plot was mowed 3 times per week at 1.5" and irrigated only to prevent severe drought stress. The soil type was a silt loam with pH approximately 7.5. The experimental design was a randomized complete block with three replications. Each experimental unit (individual plot) measured 5'x10' (50ft<sup>2</sup>). An on-site weather station and data logger (Campbell Scientific) were used to record weather data which are available upon request.

The site was maintained as a low input athletic field to simulate conditions that would encourage crabgrass growth. To further encourage the germination of crabgrass the plot was scalped to a height of 1" and verticut in two directions to thin the turf and disturb the soil on 17 April 2007. Following verticutting large crabgrass seed was applied at a rate of 0.8 lbs seed / 1000 ft<sup>2</sup>. The crabgrass seed was mixed with Milorganite to facilitate even distribution in a drop spreader. Milorganite was applied at a rate equivalent to 0.5 lbs N / 1000 ft<sup>2</sup>. No additional fertilizer was applied to the site.

Liquid herbicide treatments were applied using a CO<sub>2</sub>-powered backpack sprayer with XR TeeJet 8004 VS nozzles at 40 psi with 2.5 gal H<sub>2</sub>O/1000 ft<sup>2</sup> as carrier (Table 1). All treatments were applied 19 April and irrigated with ½ inch of water using an in-ground automated irrigation system.

Crabgrass control was rated monthly beginning in May and ending in August. The amount of crabgrass in each plot was estimated visually and percent control was calculated by dividing the percent of crabgrass plants in treated plots by the percent in the control plot for that replication, multiplying the dividend by 100, and subtracting the product by 100.

**Table 1.** Treatment list for Dimension 2EW crabgrass control demonstrations.

Trt. #	Product	Form.	Rate (lb a.i./A)
1	Dimension Ultra	2 EW	0.25
3	Dimension Ultra	2 EW	0.38
3	Dimension Ultra	2 EW	0.5
4	Barricade	65 WG	0.5
5	Barricade	65 WG	0.75
6	Untreated Control		

### RESULTS

Crabgrass control was rated monthly between May and August and the results are presented in Table 2. Although intense crabgrass pressure was not observed until mid-July, some crabgrass was visible in control plots on 18 May and 14 June. All plots that were treated were exhibiting 100% crabgrass control at these rating dates. At the 10 July rating date there was an average of 18 percent crabgrass in the control plots. Treatment 3, the high rate of Dimension, was providing the best control. Take note that on this rating date all rates of Dimension and the high rate of Barricade were providing levels of control that were statistically similar to the high rate of Dimension. The low rate of Barricade was not performing as well as the high rate of Dimension. By 22 August crabgrass pressure increased dramatically. The high rate of Dimension and the high rate of Barricade were providing the best crabgrass control. The medium rate of Dimension and the low rate of Barricade did not perform as well as the high rates of the two herbicides on this rating date.

No phytotoxicity was observed with any of the treatments in this study.

## CONCLUSION

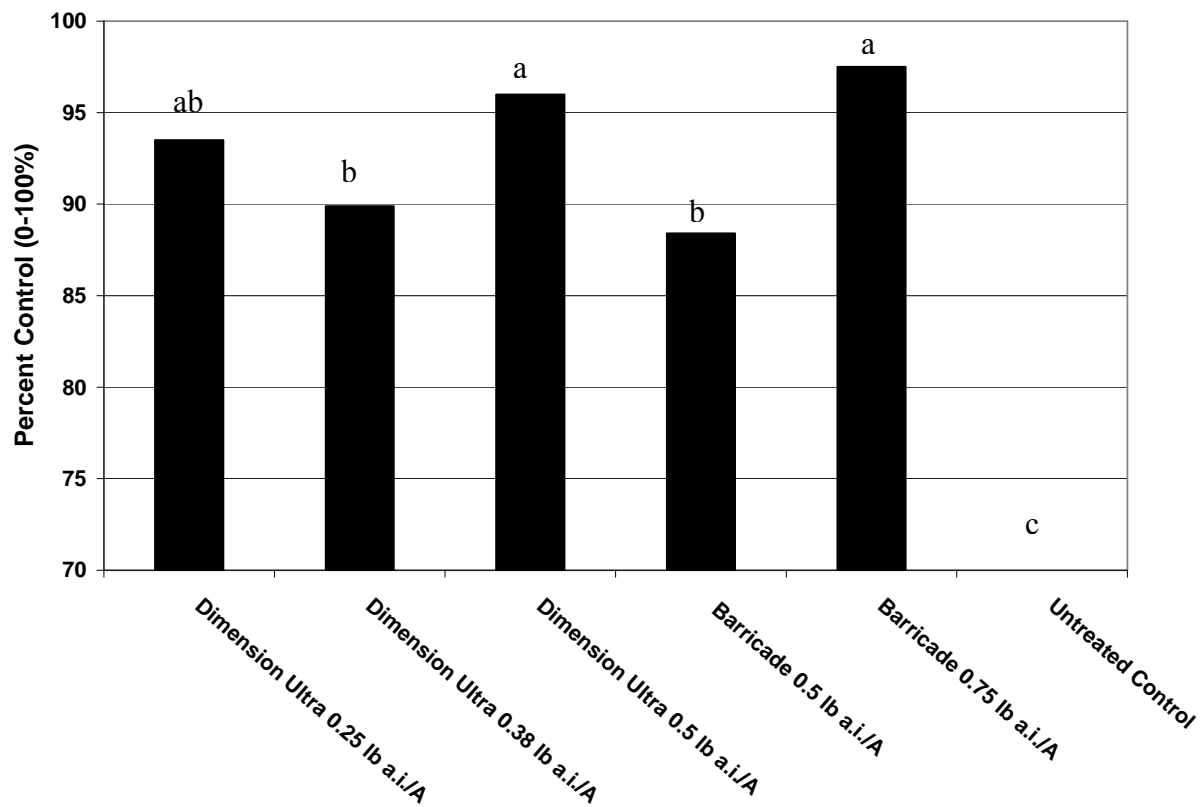
Dimension 2EW appears comparable to Barricade in terms of crabgrass control. The low rate of Dimension was statistically similar to the high rate of Barricade in this study. The low percent control observed with the medium rate of Dimension in August is due to a slightly higher percentage of crabgrass in the plot treated with treatment 2 in one of the replications. The high percentage of crabgrass could have resulted from abiotic stress to the turf which allowed for more favorable conditions for the crabgrass. Despite the slightly lower percent control rating the level of control was acceptable and this event should just be considered part of experimental error.

**Table 2.** Crabgrass control (%) in perennial ryegrass turf. Products were applied 19 April 2007, Verona, WI.

Trt #	Product	Rate (lb a.i./A)	18 May	14 June	10 July	22 Aug
1	Dimension Ultra	0.25	100.0 a	100.0 a	90.3 ab	93.5 ab
2	Dimension Ultra	0.38	100.0 a	100.0 a	93.7 a	89.9 b
3	Dimension Ultra	0.5	100.0 a	100.0 a	97.0 a	96.0 a
4	Barricade	0.5	100.0 a	100.0 a	82.7 b	88.4 b
5	Barricade	0.75	100.0 a	100.0 a	92.0 ab	97.5 a
6	Untreated Control		0.0 b	0.0 b	0.0 c	0.0 c

† Percent area covered in crabgrass per 40 ft<sup>2</sup> control plots averaged 1% in May, 2% in June, 18% in July, and 52% in August.

‡ Values followed by the same letter were not significantly different at  $P \leq 0.05$ .



**Figure 1.** Effect of treatment on percent crabgrass control on 22 Aug 2007. Verona, WI. ‡ Bars with the same letter were not significantly different at  $P \leq 0.05$ .

# Dismiss™ Nutsedge Control and Performance on Cool Season Turf

Eric Koeritz and John Stier  
Department of Horticulture

## OBJECTIVE

The objective of this study is to determine post-emergence control of sedges and to confirm turfgrass tolerance.

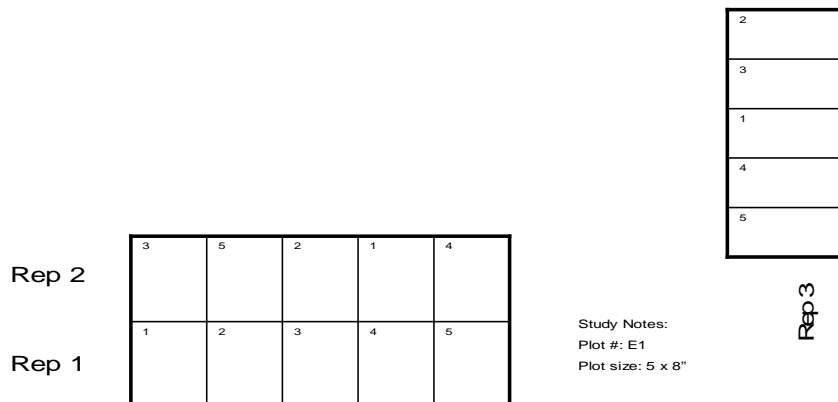
## MATERIALS AND METHODS

The Dismiss nutsedge control study is located at the O.J. Noer Turfgrass Facility on plot # E1. The study is being conducted on a stand Kentucky bluegrass mowed one time per week at 2.5". There are five treatments arranged in a randomized complete block design with three replications. Treatments were made on 5 July 2007. All treatments were sprayed using a CO<sub>2</sub> powered backpack sprayer at 40 PSI, using XR TeeJet 8004 VS nozzles, in water equivalent to 1 gallon per 1000 square feet. Percent nutsedge control and turf phytotoxicity will be evaluated at 3, 7, 21, 28, and 60 days after the initial application.

**Table 1.** Dismiss Nutsedge Control treatments, Verona, WI 2007.

Trt. #	Trt. Name	Rate (lb a.i./acre)
1	Dismiss 4F	0.125
2	Dismiss 4F	0.188
3	Dismiss 4F	0.250
4	Sedgehammer	1 oz prod/acre
5	Untreated Control	

## Dismiss Nutsedge Control – Performance on Cool Season Turf



## Glyphosate + Residual Efficacy Screen

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### OBJECTIVE

The objective of this study was to evaluate glyphosate + residual (MON 79158) formulation versus competitive standards.

### MATERIALS AND METHODS

The glyphosate + residual study was located at the O.J. Noer Turfgrass Facility on plot # A17. The study was conducted on a mixed stand of Kentucky bluegrass, creeping bentgrass, and annual bluegrass representing both annual and perennial type weeds (see percentage of each type in Table 2, 3, and 4). A known annual bluegrass seed infestation in the soil served as the weed seed population for determining pre-emergent activity of the tested chemicals. There were seven treatments arranged in a randomized complete block design with three replications. Each experimental unit measured 5x8 feet. Treatments were made on 17 July 2007. All treatments were sprayed using a CO<sub>2</sub> powered backpack sprayer at 40 PSI, using XR TeeJet 8004 VS nozzles, in water equivalent to 2 gallons per 1000 square feet. Percent control of all species present was evaluated at 7, 15, 30, and 60 days after the initial application. Percent control was determined by visually rating percent cover of the species of interest and calculating percent control using the following equation: %Control=((initial % cover – current % cover)/initial % cover)\*100.

**Table 1.** Glyphosate + residual treatments for study #2007-01-A9-14.

Trt. #	Trt. Name	Rate	Alt. Rate
1	MON 76207	1.2 lb AE/acre	2.28 QT/acre
2	MON 79158	1.2 lb AE/acre	3.02 QT/acre
3	MON 79158	2.4 lb AE/acre	6.04 QT/acre
4	MON 76207	1.2 lb AE/acre	2.28 QT/acre
	SURFLAN AS	2.0 QT/acre	2.0 QT/acre
5	ProDeuce	4 QT/acre	4 QT/acre
6	ProDeuce	8 QT/acre	8 QT/acre
7	Untreated Control	--	--

### RESULTS

Results showing the effects of herbicide treatment on control of *Poa annua* are shown in Table 2. The average initial percentage of *Poa annua* present is listed in the 'Initial' column of Table 2. Excellent post emergent control of *Poa annua* was observed for all treatments. By 10 days after treatment, 27 July, all treatments were providing around 100% control. Plots were monitored for the next few months and through 15 August no *Poa annua* was observed in treated plots.

Between 15 August and 22 September *Poa annua* began to germinate from seed and fill in areas that were previously bare. The '% P. annua' column of Table 2 shows the percentage of the treated plot area that was covered in *Poa annua* on 22 September. Treatments 1 and 3 allowed the most re-growth of *Poa annua* showing 35 and 33% coverage respectively. Treatment 4, which was MON 76207+Surflan AS resulted in 14% *Poa annua* re-growth compared to 35% *Poa annua* re-growth when MON 76207 was used alone. Treatment 2 and 5, MON 79158 and low rate ProDeuce, allowed 20% *Poa annua* re-growth. The high rate of ProDeuce provided the best pre-emergent control (8.3% re-growth). Note that MON 76207+Surflan AS was statistically similar to the high rate of ProDeuce.

Control of Kentucky bluegrass was slower than for other species and the results are shown in Table 3. Again, the average initial percentage of Kentucky bluegrass in each treated area is shown in the column labeled 'Initial'. At 10 days after treatment, 27 July, treatments 1, 4, 5 and 6 were providing around 90% control or greater. Treatments 2 and 3, MON 79158, were providing the least control of Kentucky bluegrass on this date with the low and high rates providing 22 and 63% control respectively. Control of Kentucky bluegrass improved overall between 27 July and 4 August. On 4 August treatments 1, 4, 5, and 6 were providing essentially 100% control. Control by treatments 2 and 3 improved to 50 and 90% respectively on this date. Between 4 August and 22 September control levels improved to 100% for all herbicide treatments except for treatment 2. Control provided by treatment 2 was only 16.4% which was not different from the untreated control.

The effect of glyphosate + residual treatments on creeping bentgrass control is shown in Table 4. The average initial percentages of creeping bentgrass in treated plot areas are shown in the column labeled 'Initial'. By 10 days after initial treatment, 27 July, all herbicide treatments were providing 100% control of creeping bentgrass. All herbicide treatments continued to provide 100% control through 22 September.

## CONCLUSION

All herbicide treatments provided 100% post emergent control of *Poa annua* and Creeping bentgrass. In addition all treatments except for the low rate of MON 79158 provided 100% control of Kentucky bluegrass. Control of *Poa annua* and creeping bentgrass occurred very rapidly while it took up to 2 months to see 100% control of Kentucky bluegrass with some treatments.

The objective of the study was to evaluate glyphosate + residual (MON 79158) compared to competitive standards. MON 79158 at the high rate provided good post emergent control of all species in this study. The low rate of MON 79158 provided excellent post-emergent control of *Poa annua* and creeping bentgrass but had nearly no effect on Kentucky bluegrass. MON 79158 at low rates could potentially be used to remove *Poa annua* and creeping bentgrass from Kentucky bluegrass but more testing would need to be done to verify results of this study.

In terms of pre-emergent activity, there was no observed re-growth of Kentucky bluegrass or creeping bentgrass in any of the treatments. Re-growth of *Poa annua* was observed for all treatments however some provided more pre-emergent control than others. The high rate of

ProDeuce and MON 76207+Surflan AS provided the best pre-emergent control. For an unknown reason the low rate of MON 79158 provided better pre-emergent control of *Poa annua* than the high rate.

The high rate of MON 79158 performed as well as competitive standards in all areas except for pre-emergent control of *Poa annua*. The low rate of MON 79158 performed as well as the low rate of competitive standards in all areas except for Kentucky bluegrass control. Additional studies could be done to assess the effect of different rates and environmental conditions.



**Table 2.** Effect of glyphosate + residual treatment on post-emergent (% *P. annua* control) and pre-emergent control (% *P. annua*) of annual bluegrass. Verona, WI 2007.

Trt.#	Trt. Name	Rate (units/Acre)	Initial	% <i>P. annua</i> Control			% <i>P. annua</i>
			17 July	27 July	4 Aug	15 Aug	22 Sep
1	MON 76207	1.2 lb AE	28.7	100.0 a	100.0 a	100.0 a	35.0 a
2	MON 79158	1.2 lb AE	25.3	98.3 a	100.0 a	100.0 a	20.0 b
3	MON 79158	2.4 lb AE	18.3	100.0 a	100.0 a	100.0 a	33.3 a
4	MON 76207+SURFLAN AS	1.2 lb AE + 2.0 QT	28.7	100.0 a	100.0 a	100.0 a	14.0 bc
5	ProDeuce	4 QT	21.0	100.0 a	100.0 a	100.0 a	20.0 b
6	ProDeuce	8 QT	33.0	100.0 a	100.0 a	100.0 a	8.3 c
7	Untreated Control	--	25.3	0.0 b	0.0 b	-33.3 b	33.0 a

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 3.** Effect of glyphosate + residual treatment on post and pre-emergent control of Kentucky bluegrass. Verona, WI 2007.

Trt.#	Trt. Name	Rate (units/Acre)	Initial	% Kentucky Bluegrass Control			
			17 July	27 July	4 Aug	15 Aug	22 Sep
1	MON 76207	1.2 lb AE	35.3	89.3 a	99.2 b	98.6 a	100.0 a
2	MON 79158	1.2 lb AE	38.7	21.7 c	50.0 d	11.3 c	16.4 b
3	MON 79158	2.4 lb AE	36.7	63.3 b	90.0 c	77.1 b	100.0 a
4	MON 76207+SURFLAN AS	1.2 lb AE + 2.0 QT	35.3	88.3 a	99.3 b	98.2 a	100.0 a
5	ProDeuce	4 QT	41.0	90.3 a	99.3 b	97.8 a	100.0 a
6	ProDeuce	8 QT	33.0	96.3 a	100.0 a	100.0 a	100.0 a
7	Untreated Control	--	38.7	0.0 d	0.0 e	6.7 c	11.3 b

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 4.** Effect of glyphosate + residual treatment on post and pre-emergent control of creeping bentgrass. Verona, WI 2007.

Trt.#	Trt. Name	Rate (units/Acre)	Initial	% Creeping Bentgrass Control			
			17 July	27 July	4 Aug	15 Aug	22 Sep
1	MON 76207	1.2 lb AE	35.3	100.0 a	100.0 a	100.0 a	100.0 a
2	MON 79158	1.2 lb AE	35.3	100.0 a	100.0 a	98.0 a	100.0 a
3	MON 79158	2.4 lb AE	45.0	100.0 a	100.0 a	100.0 a	100.0 a
4	MON 76207+SURFLAN AS	1.2 lb AE + 2.0 QT	35.3	100.0 a	100.0 a	100.0 a	100.0 a
5	ProDeuce	4 QT	37.7	100.0 a	100.0 a	100.0 a	100.0 a
6	ProDeuce	8 QT	33.0	100.0 a	100.0 a	100.0 a	100.0 a
7	Untreated Control	--	35.3	0.0 b	0.0 b	0.0 b	5.8 b

Means followed by the same letter are not significantly different at  $P \leq 0.05$

## **Glyphosate Formulations on Creeping Bentgrass**

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Department of Horticulture  
University of Wisconsin-Madison

### **OBJECTIVE**

The objective of this study is to evaluate K-salt glyphosate formulations as possible replacements for Roundup Pro.

### **MATERIALS AND METHODS**

The glyphosate formulations–creeping bentgrass study was located at the O.J. Noer Turfgrass Facility on plot # A11. The study was conducted on a stand of creeping bentgrass maintained as a golf course fairway mowed three times per week at 0.5". There were nine treatments arranged in a randomized complete block design with four replications. Each experimental unit measured 5x10 feet. Treatments were made on 13 July 2007. All treatments were sprayed using a CO<sub>2</sub> powered backpack sprayer at 40 PSI, using XR TeeJet 8004 VS nozzles, in water equivalent to 1 gallon per 1000 square feet. Percent creeping bentgrass control was evaluated at 3, 7, 14, 28, and 56 days after the initial application. Percent creeping bentgrass control was rated visually as the percentage of the total treated experimental unit that had turned brown and appeared dead. The study was not mowed or irrigated following treatment applications to simulate a real world situation.

**Table 1.** Glyphosate treatments for study # 2007-010A9-01.

<b>Trt. #</b>	<b>Trt. Name</b>	<b>Formulation</b>	<b>Rate</b>	<b>Alt. Rate</b>
1	Roundup Pro	3 lb/gal AE	0.57 lb AE/acre	0.76 QT/acre
2	Roundup Pro	3 lb/gal AE	1.13 lb AE/acre	1.50 QT/acre
3	MON 78270	4.5 lb/gal AE	0.57 lb AE/acre	0.51 QT/acre
4	MON 78270	4.5 lb/gal AE	1.13 lb AE/acre	1.00 QT/acre
5	MON 76207	4.5 lb/gal AE	0.57 lb AE/acre	0.51 QT/acre
6	MON 76207	4.5 lb/gal AE	1.13 lb AE/acre	1.00 QT/acre
7	MON 76302	4.5 lb/gal AE	0.57 lb AE/acre	0.51 QT/acre
8	MON 76302	4.5 lb/gal AE	1.13 lb AE/acre	1.00 QT/acre
9	Untreated Check			

### **RESULTS**

The results of this study are presented in Table 2. Treatments had a statistically significant effect on percent creeping bentgrass control on all five rating dates in this study. Differences in control of creeping bentgrass were apparent as soon as four days after treatment (17 July). The low rate treatments were providing between 9 and 14% control of creeping bentgrass. The high rate treatments were providing between 21 and

23% control. The low rate K-Salt treatments performed statistically similar to the low rate Roundup Pro treatments until 11 September. The high rate K-Salt treatments were always statistically similar to the high rate Roundup Pro treatments. Maximum control of creeping bentgrass was observed on 15 Aug. Between 15 August and 11 September some re-growth of creeping bentgrass in all treatments was observed. Slightly more re-growth was observed with the low rate K-Salt treatments than with the low rate Roundup Pro treatment. On 11 September the low rate K-Salt treatments were statistically similar to the untreated control. The high rate K-Salt treatments performed statistically similar to the high rate Roundup Pro treatments at this rating date.

## CONCLUSION

The results of this study indicate that the K-Salt glyphosate formulations will be able to replace the Roundup Pro formulation when used at the 1.13 lb AE/acre rate. All high rate K-Salt treatments were statistically similar to one another as well as the Roundup Pro treatment throughout the study. For long term control, 11 September rating, treatment 4 (MON 78270) may work slightly better on creeping bentgrass but further analysis should be done to compare K-Salt treatments under various conditions

**Table 2.** Effect of glyphosate treatment on control of creeping bentgrass. Verona, WI 2007.

Trt.#	Trt. Name	Rate	% Control				
			17 July	20 July	27 July	15 Aug	11 Sept
1	Roundup Pro	0.57 lb AE/acre	11.3 b	26.3 b	50.0 b	52.5 b	20.0 b
2	Roundup Pro	1.13 lb AE/acre	22.5 a	71.3 a	95.3 a	98.8 a	89.5 a
3	MON 78270	0.57 lb AE/acre	13.8 b	20.0 b	35.0 b	45.0 b	10.0 bc
4	MON 78270	1.13 lb AE/acre	21.3 a	72.5 a	96.8 a	96.8 a	87.0 a
5	MON 76207	0.57 lb AE/acre	11.3 b	22.5 b	41.3 b	47.5 b	15.3 bc
6	MON 76207	1.13 lb AE/acre	22.5 a	68.8 a	92.0 a	94.5 a	79.5 a
7	MON 76302	0.57 lb AE/acre	9.5 b	20.0 b	35.0 b	34.8 b	10.0 bc
8	MON 76302	1.13 lb AE/acre	22.5 a	68.8 a	96.3 a	97.0 a	78.8 a
9	Untreated Check		0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
	LSD (0.05)		4.70	9.56	18.79	28.92	18.25

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

# Glyphosate Formulations for Dandelion Control

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Department of Horticulture  
University of Wisconsin-Madison

## OBJECTIVE

The objective of this study was to evaluate K-salt glyphosate formulations for controlling dandelion as possible replacements for Roundup Pro.

## MATERIALS AND METHODS

The glyphosate formulations-dandelion study was located at the O.J. Noer Turfgrass Facility on plot # A1 and A3. The study was conducted on a mixed stand of dandelion, Kentucky bluegrass, and perennial ryegrass. The vegetation was maintained at a 2.5" mowing height and was mowed weekly prior to treatment application. There were nine treatments arranged in a randomized complete block design with three replications. Treatments were made on 20 July 2007. All treatments were sprayed using a CO<sub>2</sub> powered backpack sprayer at 40 PSI, using XR TeeJet 8004 VS nozzles, in water equivalent to 1 gallon per 1000 square feet. Plots were not mowed or irrigated following treatment application. Percent control of dandelion and overall vegetation control was evaluated visually at 3, 7, 14, 28, and 56 days after the initial application.

**Table 1.** Glyphosate treatments for study #2007-01-A9-02.

Trt. #	Trt. Name	Rate	Alt. Rate
1	Roundup Pro	1.5 lb AE/acre	2.00 QT/acre
2	Roundup Pro	3 lb AE/acre	4.00 QT/acre
3	MON 78270	1.5 lb AE/acre	1.33 QT/acre
4	MON 78270	3 lb AE/acre	2.67 QT/acre
5	MON 76207	1.5 lb AE/acre	1.33 QT/acre
6	MON 76207	3 lb AE/acre	2.67 QT/acre
7	MON 76302	1.5 lb AE/acre	1.33 QT/acre
8	MON 76302	3 lb AE/acre	2.67 QT/acre
9	Untreated Control		

## RESULTS

The effect of various K-Salt glyphosate formulations on percent dandelion control is shown in Table 2. Some slight burndown of dandelions was observed for all treatments at 3 days after treatment. Significant differences between herbicide treatments were observed beginning on 27 July at 7 days after treatment. The high rates of the K-Salt formulations were showing slightly more burndown. On 3 August the high rate of Roundup Pro was providing 16.7% control and the low rate of Roundup Pro was providing 10.0% control. All other glyphosate formulations were statistically similar to the high rate of Roundup Pro except for the low rate of MON 76302. Maximum levels of

control were observed on 22 August. The high rate of Roundup Pro was providing around 90% control of dandelion and the low rate of Roundup Pro was providing around 44% control. On this date the high rates of all of the K-Salt formulations were statistically similar to the high rate of Roundup Pro. Although not statistically different, the MON 78270 formulation was providing better control than the MON 76302 formulation. The low rates of all of the K-Salt formulations performed similar to the low rate of Roundup Pro. Between 22 August and 24 September there was substantial re-growth of dandelions and as a result there were no significant differences between treatments at the 24 September rating date.

Overall vegetation control was also rated and the results are shown in Table 3. Again, maximum vegetation control was observed on 22 August. On this date the high rate of Roundup Pro was providing around 92% control of vegetation and the low rate of Roundup Pro was providing around 72% control of vegetation. The high rates of the K-Salt formulations all were statistically similar to the high rate of Roundup Pro although MON 76207 seemed to work slightly better than the other formulations. The low rates of the K-Salt formulations did not perform as well as the low rate of Roundup Pro.

## CONCLUSION

The objective of this study was to evaluate K-salt glyphosate formulations for controlling dandelion as possible replacements for Roundup Pro. The results indicate that the K-Salt formulations at the high rate perform the same as Roundup Pro. The low rates of the K-Salt formulations were statistically similar to the low rate of Roundup Pro in terms of dandelion control but it should be noted that they were actually providing 15-20% less control. Based on the results of this study MON 76207 and MON 78270 when used at high rates would be suitable replacements for Roundup Pro for dandelion control.

**Table 2.** Effect of glyphosate treatment on control of dandelion. Verona, WI 2007.

Trt.#	Trt. Name	Rate	% Dandelion Control				
			23 July	27 July	3 Aug	22 Aug	24 Sep
1	Roundup Pro	1.5 lb AE/acre	1.0 a	1.7 a	10.0 bc	43.7 bc	15.9 a
2	Roundup Pro	3 lb AE/acre	1.0 a	1.7 a	16.7 a	89.6 a	19.4 a
3	MON 78270	1.5 lb AE/acre	1.0 a	0.7 b	15.0 ab	27.8 cd	-2.8 a
4	MON 78270	3 lb AE/acre	1.0 a	1.7 a	16.7 a	82.2 a	27.8 a
5	MON 76207	1.5 lb AE/acre	1.0 a	1.0 b	11.7 a-c	33.3 cd	0.0 a
6	MON 76207	3 lb AE/acre	1.0 a	1.7 a	13.3 ab	76.3 a	26.2 a
7	MON 76302	1.5 lb AE/acre	1.0 a	1.0 b	6.7 c	22.5 cd	10.3 a
8	MON 76302	3 lb AE/acre	1.0 a	2.0 a	16.7 a	68.9 ab	27.8 a
9	Untreated Check		0.0 b	0.0 c	0.0 d	5.6 d	4.8 a

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 3.** Effect of glyphosate treatment on overall control of turf and dandelion. Verona, WI 2007.

Trt.#	Trt. Name	Rate	% Overall Control		
			27 July	3 Aug	22 Aug
1	Roundup Pro	1.5 lb AE/acre	10.7 b-d	68.3 ab	71.7 b
2	Roundup Pro	3 lb AE/acre	15.0 ab	80.0 a	91.7 a
3	MON 78270	1.5 lb AE/acre	2.0 de	56.7 bc	43.3 d
4	MON 78270	3 lb AE/acre	11.7 a-c	76.7 a	81.7 ab
5	MON 76207	1.5 lb AE/acre	3.0 c-e	55.0 c	58.3 c
6	MON 76207	3 lb AE/acre	20.0 a	80.0 a	88.3 a
7	MON 76302	1.5 lb AE/acre	4.0 c-e	60.0 bc	56.7 c
8	MON 76302	3 lb AE/acre	20.0 a	80.0 a	81.7 ab
9	Untreated Check		0.0 e	0.0 d	0.0 e

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

# Glyphosate Formulations for Tall Fescue Control

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University of Wisconsin-Madison

## OBJECTIVE

The objective of this study is to evaluate K-salt glyphosate formulations as possible replacements for Roundup Pro.

## MATERIALS AND METHODS

The glyphosate formulations-tall fescue study was located at the O.J. Noer Turfgrass Facility on plot # B30 – 32. The study was conducted on a stand of turf type tall fescue mowed at 2.5". There are nine treatments arranged in a randomized complete block design with four replications. Experimental units measured 3x12 feet. Treatments were made on 10 July 2007. All treatments were sprayed using a CO<sub>2</sub> powered backpack sprayer at 40 PSI, using XR TeeJet 8004 VS nozzles, in water equivalent to 1 gallon per 1000 square feet. Percent tall fescue control was evaluated at 3, 7, 14, 28, and 56 days after the initial application. Percent tall fescue control was rated visually as the percentage of the total treated experimental unit that had turned brown and appeared dead. Plots were not mowed or irrigated following treatment.

**Table 1.** Glyphosate treatments for study # 2007-010A9-04.

<b>Trt. #</b>	<b>Trt. Name</b>	<b>Formulation</b>	<b>Rate</b>	<b>Alt. Rate</b>
1	Roundup Pro	3 lb/gal AE	0.75 lb AE/acre	1 QT/acre
2	Roundup Pro	3 lb/gal AE	1.5 lb AE/acre	2 QT/acre
3	MON 78270	4.5 lb/gal AE	0.75 lb AE/acre	0.67 QT/acre
4	MON 78270	4.5 lb/gal AE	1.5 lb AE/acre	1.33 QT/acre
5	MON 76207	4.5 lb/gal AE	0.75 lb AE/acre	0.67 QT/acre
6	MON 76207	4.5 lb/gal AE	1.5 lb AE/acre	1.33 QT/acre
7	MON 76302	4.5 lb/gal AE	0.75 lb AE/acre	0.67 QT/acre
8	MON 76302	4.5 lb/gal AE	1.5 lb AE/acre	1.33 QT/acre
9	Untreated Check			

## RESULTS

Results from the study are presented in Table 2. There were significant differences between treatments on all five rating dates. Control of tall fescue was observed for all treatments as early as 7 days after treatment (17 July). On this date the low rate treatments were providing between 6 and 7.5% control and the high rate treatments were providing between 7.5 and 10% control. Control of tall fescue was very good by 10 days after treatment (20 July). Low rate treatments were providing only around 30-40%

control while high rate treatments were providing between 80 and 90% control. Between 17 July and 15 August the K-Salt glyphosate formulations performed statistically similar to the Roundup Pro formulations. Maximum control of tall fescue was observed on 15 Aug. On this date the high rate treatments were providing 95-98% control of tall fescue. Between 15 Aug and 11 Sept some re-growth of tall fescue was observed. Some of the low rate K-Salt formulations exhibited more re-growth than the low rate Roundup Pro formulations. The high rates of the K-Salt formulations were still statistically similar to the high rates of the Roundup Pro formulations.

## CONCLUSION

The results of this study indicate that the K-Salt formulations perform similar to the Roundup Pro formulation on tall fescue. The K-Salt formulations would be suitable replacements for the Roundup Pro formulation particularly when used at the 1.5 lb AE/acre rate.

**Table 2.** Effect of glyphosate treatment on control of tall fescue. Verona, WI 2007.

Trt.#	Trt. Name	Rate	% Control				
			17 July	20 July	27 July	15 Aug	11 Sept
1	Roundup Pro	0.75 lb AE/acre	7.5 ab	33.8 b	38.8 b	36.3 b	20.8 b
2	Roundup Pro	1.5 lb AE/acre	10.0 a	88.8 a	95.5 a	97.8 a	93.3 a
3	MON 78270	0.75 lb AE/acre	6.3 b	27.5 b	33.8 b	45.0 b	11.3 c
4	MON 78270	1.5 lb AE/acre	7.5 ab	81.3 a	92.5 a	96.8 a	88.8 a
5	MON 76207	0.75 lb AE/acre	7.5 ab	33.8 b	37.5 b	38.8 b	20.0 bc
6	MON 76207	1.5 lb AE/acre	10.0 a	86.3 a	93.5 a	96.5 a	90.8 a
7	MON 76302	0.75 lb AE/acre	7.5 ab	21.3 b	30.0 b	30.0 b	15.0 bc
8	MON 76302	1.5 lb AE/acre	10.0 a	82.5 a	88.8 a	95.3 a	90.0 a
9	Untreated Check		0.0 c	0.0 c	0.0 c	0.0 c	0.0 d
	LSD (0.05)		2.67	12.57	15.37	18.77	8.96

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .



# Glyphosate Formulations for White Clover Control

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## OBJECTIVE

The objective of this study was to evaluate K-salt glyphosate formulations as possible replacements for Roundup Pro.

## MATERIALS AND METHODS

The glyphosate formulations-white clover study was located at the O.J. Noer Turfgrass Facility on plot # A1 and A2. The study was conducted on a mixed stand of white clover, Kentucky bluegrass, and perennial ryegrass. The vegetation was previously maintained at a 2.5" mowing height and was mowed weekly. There were nine treatments arranged in a randomized complete block design with three replications. Treatments were made on 20 July 2007. All treatments were sprayed using a CO<sub>2</sub> powered backpack sprayer at 40 PSI, using XR TeeJet 8004 VS nozzles, in water equivalent to 1 gallon per 1000 square feet. Percent control of white clover was evaluated at approximately 7, 15, 30, and 60 days after the initial application. Plots were not mowed or irrigated following treatment applications.

**Table 1.** Glyphosate treatments for study #2007-01-A9-02.

Trt. #	Trt. Name	Rate	Alt. Rate
1	Roundup Pro	1.5 lb AE/acre	2.00 QT/acre
2	Roundup Pro	3 lb AE/acre	4.00 QT/acre
3	MON 78270	1.5 lb AE/acre	1.33 QT/acre
4	MON 78270	3 lb AE/acre	2.67 QT/acre
5	MON 76207	1.5 lb AE/acre	1.33 QT/acre
6	MON 76207	3 lb AE/acre	2.67 QT/acre
7	MON 76302	1.5 lb AE/acre	1.33 QT/acre
8	MON 76302	3 lb AE/acre	2.67 QT/acre
9	Untreated Control		

## RESULTS

Table 2 shows the effect of various glyphosate formulations on percent control of white clover. Some slight burn-down was observed at three days after treatment. Significant differences in terms of white clover control were not observed until around 15 days after treatment (3 Aug). This is also the date that maximum levels of white clover control were observed. On this date the high rate of Roundup Pro was providing 92% control of white clover. The high rates of all other glyphosate formulations were providing levels of control that were statistically similar to the high rate of Roundup Pro on this date. Treatments 5 and 7 were also statistically similar to the low rate of Roundup Pro on this date. Some re-growth of white clover was observed between 3 Aug and 22 Aug as

percent control had decreased slightly for all treatments. On 22 August the high rate of Roundup Pro was providing 77% control. The high rates of all other formulations were still comparable to the high rate of Roundup Pro. The low rate of Roundup Pro was providing 54% control and the only other low rate formulation that was comparable was MON 76302. In September more re-growth of white clover occurred and by 24 September there were no significant differences between treatments.

Table 3 shows the effect of the various glyphosate formulations on overall control of both turf and clover. Maximum levels of overall control were observed on 22 Aug. Performance of the high rates of the K-Salt formulations was statistically similar to the high rate of Roundup Pro. The low rates of the K-Salt formulations also were similar to the low rate of Roundup Pro.

## CONCLUSION

The objective of this study is to evaluate K-salt glyphosate formulations as possible replacements for Roundup Pro. The results of the study indicate that all of the K-Salt formulations tested perform similar to Roundup Pro at the high rate when used to control white clover. The low rates of the MON 78270 and MON 76207 formulations did not control white clover as well as the low rate of Roundup Pro.

**Table 2.** Effect of glyphosate treatment on control of white clover. Verona, WI 2007.

Trt.#	Trt. Name	Rate	% Clover Control				
			23 July	27 July	3 Aug	22 Aug	24 Sep
1	Roundup Pro	1.5 lb AE/acre	2.0 a	5.7 a	65.0 ab	53.7 ab	24.1 a
2	Roundup Pro	3 lb AE/acre	2.0 a	10.0 a	91.7 a	77.0 a	37.8 a
3	MON 78270	1.5 lb AE/acre	2.0 a	3.0 a	28.3 c	25.0 c	8.3 a
4	MON 78270	3 lb AE/acre	2.0 a	13.3 a	70.0 ab	61.0 ab	2.2 a
5	MON 76207	1.5 lb AE/acre	2.0 a	4.0 a	58.3 b	21.0 cd	-6.7 a
6	MON 76207	3 lb AE/acre	2.0 a	10.0 a	71.7 ab	66.7 a	11.1 a
7	MON 76302	1.5 lb AE/acre	2.0 a	4.0 a	51.7 bc	37.7 bc	6.4 a
8	MON 76302	3 lb AE/acre	2.0 a	15.0 a	68.3 ab	60.7 ab	-7.6 a
9	Untreated Check		0.0 b	0.0 a	0.0 d	0.0 d	13.1 a

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 3.** Effect of glyphosate treatment on overall control of turf and clover. Verona, WI 2007.

Trt.#	Trt. Name	Rate	% Overall Control		
			27 July	3 Aug	22 Aug
1	Roundup Pro	1.5 lb AE/acre	16.7 c-e	65.0 a	48.3 d
2	Roundup Pro	3 lb AE/acre	43.3 ab	73.3 a	76.7 a-c
3	MON 78270	1.5 lb AE/acre	8.3 de	36.7 b	38.3 d
4	MON 78270	3 lb AE/acre	50.0 a	70.0 a	75.0 a-c
5	MON 76207	1.5 lb AE/acre	33.3 a-c	61.7 a	56.7 b-d
6	MON 76207	3 lb AE/acre	33.3 a-c	73.3 a	80.0 a
7	MON 76302	1.5 lb AE/acre	23.3 cd	60.0 a	55.0 cd
8	MON 76302	3 lb AE/acre	28.3 bc	68.3 a	78.3 ab
9	Untreated Check		0.0 e	0.0 c	0.0 e

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

## **New Weed and Feed Formulations: Spring Trials**

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### **Objective**

The objective of this work was to compare new formulations and competitive Weed and Feed products for control of lawn weeds.

### **Materials and Methods**

The study was conducted at the O.J. Noer Turfgrass Research and Educational Facility in Verona, WI on a well established stand of Kentucky bluegrass, perennial ryegrass, and dandelions growing on a silt loam soil. The experimental design was a randomized complete block with six replications. Herbicide treatments were applied to plots that measured 3 ft by 3ft to facilitate the use of a spreader box during application.

A uniform naturally occurring population of dandelions was present in the area at the time of treatment application. The application of herbicide was timed so that the majority of the dandelions present were near peak flowering time. Treatments were applied using a shaker jar and a spreader box on 14 May 2007. Treatment applications were initiated at 8:00 a.m.. Due to dry weather conditions no dew was present for much of the month of May so we were forced to simulate dew on the foliage. To simulate dew, each plot was sprayed with water just prior to each treatment application using a CO<sub>2</sub> powered backpack sprayer with XR Teejet 8002 VS nozzles at 40 PSI tank pressure. Four spray passes were made over each plot. Treatment application was timed to be two days after a significant rainfall to insure that there was adequate soil moisture. In addition plots were not mowed for 72 hours prior to or within 48 hours after treatment application. Following the no-mow time interval plots were mowed at 2.5 inches one time per week. Irrigation was not applied for at least 24 hours after application. Irrigation was subsequently set to water one time per week at 100% of the estimated evapotranspiration rate.

Data collection included dandelion injury at 18 days after herbicide application and percent dandelion control approximately 14, 28, and 42 days after treatment (DAT). Dandelion injury was rated visually on a scale from 0-10 where 0=no injury, 2=twisting, 4=chlorosis, 6=some necrosis, 8=necrosis, and 10=brown and appears dead. Percent dandelion control was determined by counting dandelions present in the plot using a 3 ft by 3 ft grid containing 36 squares provided by Scotts. Percent control was calculated using the following equation: % Control = ((# dandelions initial - # dandelions current)/ # dandelions initial)\*100. Pictures were taken of each plot at every rating date.

**Table 1.** Treatment list for Scotts Weed and Feed: U.S. Spring Trials, Verona, WI, 2007.

<b>Trt #</b>	<b>Code</b>	<b>Description</b>	<b>Rate (lb a.i./A)</b>
1	MG07-053-A	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
2	MG07-053-C	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
3	MG07-047-A	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
4	MG07-051-A	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
5	MG07-053-B	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
6	MG07-053-E	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
7	MG07-047-B	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
8	MG07-051-B	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
9	S13074	1.11% 2,4-D + 0.17% mcpp-p + 0.07% dicamba	1.35, 0.2, 0.09
10	S12168	0.60% 2,4-D + 0.12% mcpp-p + 0.07% 2,4-DP-p	0.84, 0.17, 0.1
11	S13081	1.11% 2,4-D + 0.17% mcpp-p + 0.07% dicamba	1.35, 0.2, 0.09
12	S11703	0.64% 2,4-D + 0.31% mcpp + 0.03% dicamba	0.89, 0.43, 0.04
13	S11705	0.58% 2,4-D + 0.15% mcpp-p + 0.15% 2,4-DP-p	0.81, 0.21, 0.21
14	S07201	1.21% 2,4-D + 0.61% mcpp-p	1.51, 0.76
15	Trimec Turf Ester	18.85% 2,4-D + 18.48% 2,4-DP-p + 3.01% dicamba	0.54, 0.54, 0.13
16	Untreated		

## Results

At 18 days after treatment all of the herbicides were causing at least some chlorosis to dandelions (Table 2). Many treatments were causing severe chlorosis and some were causing slight necrosis in addition to chlorosis. Trimec Turf Ester was exhibiting the greatest weed injury and it should be noted that a number of treatments were statistically similar to Trimec Turf Ester in terms of weed injury at this date.

By 6 June 2007 we were beginning to see some control of dandelion but there were no significant differences between treatments (Table 4). There were treatment differences

when percent dandelion control was rated at 1 month after treatment on 14 June 2007. At this time treatment 14 and 15 (Trimec) were providing the greatest control of dandelion. Treatments 6 and 7 were also providing levels of control statistically similar to treatments 14 and 15, however, about 13 percent less. At 1 month after treatment application treatments 9, 10, 12 and 16 (untreated) were the only treatments providing less than 20 percent dandelion control. On 25 June treatments 14 and 15 were the only treatments providing over 60 percent weed control. All other treatments were providing 40 percent control or less. Treatments 9, 10 and 12 were not significantly different from the untreated control.

### **Conclusion**

Dandelion pressure was very intense in many of the plots making it difficult to achieve extremely high levels of control. In addition, during late morning and afternoon following treatment applications temperatures were above 85 F with full sun and 20 mph winds. The weather conditions likely dried out the leaf surface of the dandelions resulting in less time for absorption of the herbicide off of the granular carrier. The presence of actual dew rather than simulated dew may increase control levels from granular herbicides but the conditions of this study were adequate for comparing the performance of granular herbicide formulations.

Overall, treatment 14 (S07201) provided the highest levels of control and was statistically similar to the sprayed Trimec Turf Ester treatment (treatment 15). Treatment 14 provided over 20% greater control of dandelions than the next closest granular herbicide treatment. Treatments 1, 3, 9, 10, 11 and 12 performed the worst by providing less than 30 percent control of dandelion.

**Table 2.** Effect of treatment on injury of dandelions at 18 DAT on June 1, 2007 in Madison, WI. Injury was rated on a 0-10 scale (0=no injury, 2=twisting, 4=chlorosis, 6=some necrosis, 8=necrosis, 10=brown and appears dead).

Trt #	Code	Dandelion Injury
		18 DAT
1	MG07-053-A	6.0
2	MG07-053-C	5.3
3	MG07-047-A	5.7
4	MG07-051-A	5.3
5	MG07-053-B	4.5
6	MG07-053-E	5.5
7	MG07-047-B	5.2
8	MG07-051-B	4.8
9	S13074	4.2
10	S12168	4.5
11	S13081	5.3
12	S11703	4.3
13	S11705	4.8
14	S07201	6.0
15	Trimec Turf Ester	6.2
16	Untreated	0.0
	LSD (0.05)	1.1

**Table 3.** Analysis of variance for effect of treatment on post-emergent control of dandelions, Verona, WI, 2007.

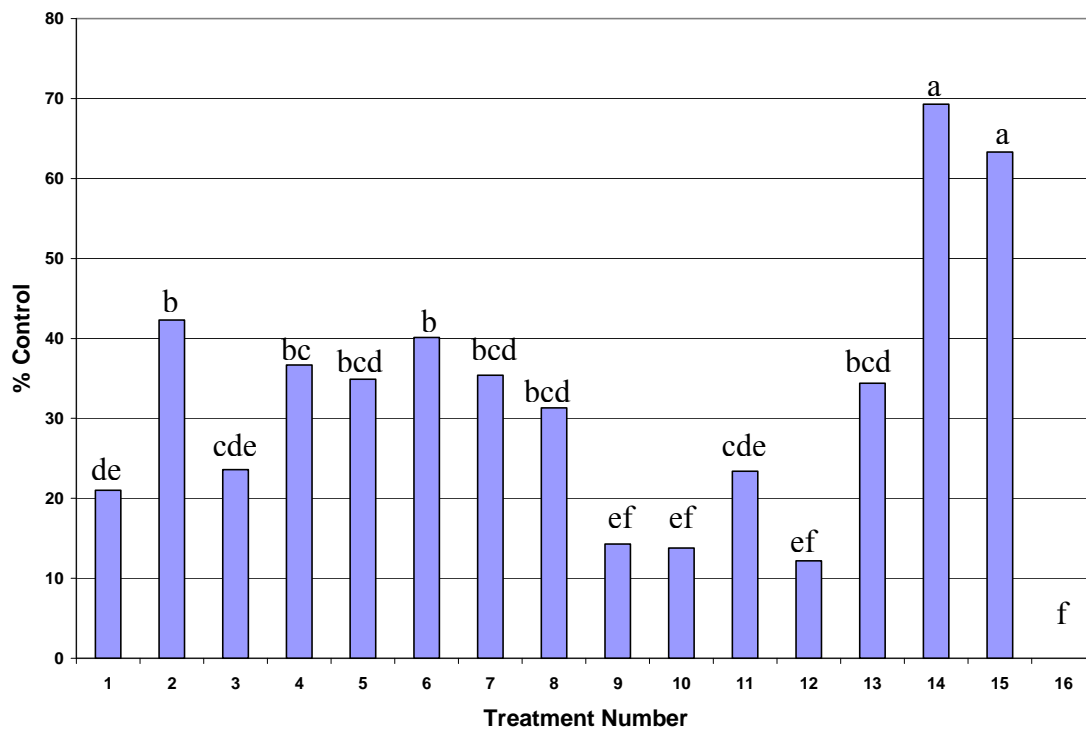
Source	6 June	14 June	25 June
Treatment	ns	**	**

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 4.** Effect of treatment on percent dandelion control, Verona, WI, 2007.

Trt #	Code	% Dandelion Control		
		6 June	14 June	25 June
1	MG07-053-A	8.1	21.8	21.0
2	MG07-053-C	14.3	33.7	42.3
3	MG07-047-A	8.1	20.2	23.6
4	MG07-051-A	16.3	29.9	36.7
5	MG07-053-B	13.4	31.0	34.9
6	MG07-053-E	12.6	36.1	40.1
7	MG07-047-B	17.8	36.9	35.4
8	MG07-051-B	10.2	22.5	31.3
9	S13074	11.0	14.3	14.3
10	S12168	11.9	12.3	13.8
11	S13081	8.4	23.7	23.4
12	S11703	5.4	14.7	12.2
13	S11705	11.6	30.9	34.4
14	S07201	18.1	49.6	69.3
15	Trimec*	16.3	49.3	63.3
16	Untreated	-0.5	-0.5	0.0
	LSD (0.05)	ns	15.3	14.9

\* Trimec Turf Ester

**Figure 1.** Effect of treatment on percent dandelion control on 25 June. Verona, WI 2007. Bars with the same on letter are not significantly different at  $P \leq 0.05$ .



# **Mesotrione Granules for At-Seeding Application in Lawn Care**

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## **OBJECTIVES**

The first objective of this study was to determine if mesotrione was safe to turfgrasses at seeding (<10% injury). A second objective was to determine which rate of mesotrione provided the best weed control of species in the test. Third, the study evaluated whether or not general weed control (grasses and broadleaves) was achieved with the herbicides in the test. The final objective was to look at how long residual herbicide activity was evident.

## **MATERIALS AND METHODS**

The study was conducted at the O.J. Noer Turfgrass Research and Educational Facility in Verona, WI. The soil type was a silt loam. The experimental design was a randomized complete block with four replications.

Just prior to the time of herbicide treatment application on 22 May 2007 the study area was seeded to a mixture Kentucky bluegrass, fine fescue, and perennial ryegrass. The mixture used was the 'Madison Parks' mix from Olds Seed Solutions. The cultivars included: 10% Odyssey KBG, 5% Arcadia KBG, 5%Mercury KBG, 5% SR2100 KBG, 5% America KBG, 10% Cannon KBG, 10% Wild Horse KBG, 15% SR5210 creeping red fescue, 10% Boreal creeping red fescue, 15% SR4550 perennial ryegrass, and 15% Cutter perennial ryegrass. Granular herbicide treatments were applied uniformly to the soil using shaker jars following seeding. Treatment names and rates can be seen in Table 1. Following treatment applications the study area was mulched with straw so that 50% of the soil surface was covered. Irrigation was supplied five times per day for two minutes per time until germination was complete. Following establishment, the study was irrigated one time per week to replace 100% of the evapotranspiration rate.

Turfgrass phytotoxicity was rated as percent bleaching at 1, 2, 3, 4, and 6 weeks after seeding (data not shown). Percent desirable turf cover was evaluated at 1, 2, 3, 4, and 6 weeks after seeding. Percent weed cover by species was estimated visually by species at 2, 4, 6, 8, and 12 weeks after seeding. In addition one percent annual bluegrass rating was made on 4 Aug 2007 when annual bluegrass was very visible.

**Table 1.** Treatment list for Mesotrione Granules for At-Seeding Applications in Lawn Care. Verona, WI 2007.

Trt #	Trtreatment	Type	% a.i. w/w	Rate(g a.i./ha)	Rate( lbs prod/1000 ft <sup>2</sup> )
1	AND7001	GR	0.12	234	4
2	AND7001	GR	0.12	176	3
3	AND7001	GR	0.12	700	12
4	AND7002	GR	0.12	234	4
5	AND7002	GR	0.12	176	3
6	AND7007	GR	3.5	5640	3.3
7	AND7018	GR	3.5	5640	3.3
8	AND7003	GR	2.98	5800	4
9	AND7003	GR	2.98	17500	12
10	AND7004	GR	1.52	2970	4
11	AND7004	GR	1.52	8900	12
12	AND7005	GR	2.98	5800	4
13	AND7005	GR	2.98	17500	12
14	AND7006	GR	1.52	2970	4
15	AND7006	GR	1.52	8900	12
16	Fert. Undef.	GR	---	4 lb/1000ft <sup>2</sup>	4
17	Fert. Undef.	GR	---	12 lb/1000ft <sup>2</sup>	12
18	Untreated	--	---	---	---

## RESULTS

Phytotoxicity ratings were taken throughout the study but there were no visual symptoms of phytotoxicity other than a reduction in turf cover. Therefore, any phytotoxic effects are accounted for in the percent turf cover ratings (Table 2). Treatments had some effect on the percent of desirable turf cover as soon as two weeks after seeding (7 June). Some treatments (mainly high rates of a.i./ha) were resulting in less turf germination. By four weeks after seeding (21 June) control plots were exhibiting around 85% desirable turf cover and treatment differences were very noticeable. Treatments applied at 5800 g a.i./ha or greater (treatments 8, 9, 11, 13, 15) all had 50 percent cover or less with the exception of treatment 8. On this date treatments 3, 5, 8 and 14 also had 70 percent or less desirable turf cover. By eight weeks after seeding (19 July) the percentage of desirable turf cover in untreated control plots was around 90 percent. Percent desirable turf cover in many of the treated plots was greater than in the control plots with the exception of treatments 6, 9, 11, 13, and 15. Many of the treatments with less desirable turf cover than the untreated control were treated with high rates of active ingredient.

Broadleaf weed ratings were taken throughout the study and results are reported as the average percentage of broadleaf weeds in each treatment (Table 3). Significant differences in terms of broadleaf weed control were evident as early as four weeks after seeding (21 June). Broadleaf weed pressure increased slightly in the plot area by eight weeks after seeding (19 July). The untreated control plot had an average of 2.5 percent broadleaf weeds on this date. Treatments 16 and 17 which were fertilizer control plots had 5.5 and 2.0 percent broadleaf weeds respectively. Treatments 6 and 7 had 3.0 and 5.0 percent broadleaf weeds respectively. All other treatments provided essentially 100% control of broadleaf weeds. Although broadleaf weed pressure decreased slightly by 27 August, a similar trend was still observed.

The presence of yellow nutsedge was rated throughout the study and results are reported as the average percentage of yellow nutsedge in each treatment (Table 4). Treatment differences were seen as early as two weeks after seeding where all treatments except for treatments 6 and 7 were providing 100 percent control of yellow nutsedge compared to the untreated control. Treatments 6 and 7 were providing some control of yellow nutsedge but were not statistically similar to the other herbicide treatments. Yellow nutsedge pressure increased over time and by 19 July the untreated control plots contained an average of six percent yellow nutsedge. The low and high rate fertilizer controls contained 6.0 and 1.5 percent yellow nutsedge respectively. Treatments 6 and 7 contained 3.5 and 8.0 percent yellow nutsedge respectively. All other treatments were providing good control of yellow nutsedge compared to the untreated control and were statistically similar to one another. Yellow nutsedge pressure in the study decreased significantly by 12 weeks after seeding due to management and environmental factors so yellow nutsedge was difficult to see in the plots resulting in no significant treatment differences.

The effect of treatment on the presence of crabgrass is shown in Table 5. Crabgrass pressure was extremely light and was mainly noticed in treatment 16 which was the low rate fertilizer control. All other treatments provided excellent control of crabgrass.

The percentage of annual bluegrass (*Poa annua*) in each plot was rated on 4 Aug (Table 6). On this date the untreated control contained an average of about 12 percent annual bluegrass. The low and high rate fertilizer controls contained 21 and 16 percent annual bluegrass respectively. Treatments 6 and 7 contained 25 and 11.5 percent annual bluegrass respectively which indicated that they either enhanced annual bluegrass infestation or did nothing to control it. Treatments 1 and 2, which were the low rates of AND7001, contained 4.0 and 7.8 percent annual bluegrass respectively indicating only slight annual bluegrass control. The high rate of AND7001 provided excellent control of annual bluegrass. Treatment 5, the low rate of AND7002 only provided marginal control of annual bluegrass. Treatment 14, which was the low rate of AND7006, contained 9.3 percent annual bluegrass which was not statistically different from the untreated control. The high rate of AND7006 provided excellent control of annual bluegrass along with the rest of the formulations not mentioned above.

## CONCLUSION

Some of the treatments in this study resulted in reduced germination and slow establishment. Since reduced germination was the only form of phytotoxicity observed, percent desirable turf cover served as the primary measure of the phytotoxicity of a treatment. In general, any treatment that resulted in less than 90% turf cover after 8 weeks was considered too phytotoxic to be acceptable for lawn care use. In some cases treated plots had more desirable turf cover than the untreated control. This is a result of both weed control and application of fertilizer as a carrier that promoted turf growth. Many treatments using high rates of active ingredient provided excellent broadleaf and grassy weed control but their effects on germination made them unacceptable. There were many low and medium rate treatments that provided excellent weed control while still allowing for acceptable germination of desirable turf. These treatments will be discussed later.

In terms of broadleaf weed control, all treatments except for the controls and treatments 6 and 7 provided excellent control of broadleaf weeds. Most herbicide treatments even provided excellent control of crabgrass. In terms of yellow nutsedge control, all treatments other than the control treatments and treatments 6 and 7 provided acceptable control. It appears that higher rates of active ingredient provide slightly better control however. Annual bluegrass control proved to be an overriding factor for evaluating efficacy of these herbicides. A significant amount of annual bluegrass was present in the control plots. Many of the herbicide treatments resulted in excellent control of annual bluegrass. Some of the low rate treatments allowed slightly more annual bluegrass to germinate but there was still an element of control in comparison to the untreated plots. There were a number of treatments that provided excellent control of annual bluegrass and other weeds while not causing significant phytotoxicity. Such a treatment could prove extremely valuable in the lawn care industry and especially the sports turf industry where suppressing annual bluegrass during re-seeding can be a very difficult challenge.

Treatments that provided good across the board weed control and did not cause significant phytotoxicity include: 3, 4, 5, 8, 10, and 12. Treatments 3, 4, and 5 are of particular interest because they were applied at relatively low rates of a.i. per hectare. Further tests looking at pre-emergent control of yellow nutsedge and especially annual bluegrass would be of great interest to many turf managers in our region. The performance of the treatments over multiple years and growing conditions should be evaluated.

**Table 2.** Effect of at seeding application of mesotrione granule treatments on percent desirable turf cover, Verona, WI, 2007.

Trt #	Code	Rate(g a.i./ha)	% Turf Cover				
			7 June	14 June	21 June	9 July	19 July
1	AND7001	234	12.0 abc	50.0 abcd	75.0 abcd	96.5 a	95.8 ab
2	AND7001	176	15.0 ab	53.8 abc	81.3 abc	95.3 a	95.8 ab
3	AND7001	700	11.3 abcd	47.5 abcd	62.5 de	86.8 b	93.3 abc
4	AND7002	234	13.8 abc	46.3 abcd	80.0 abc	96.5 a	97.0 a
5	AND7002	176	8.3 cd	42.5 bcd	68.8 bcd	94.5 ab	91.3 abcd
6	AND7007	5640	7.5 cd	47.5 abcd	81.3 abc	92.0 ab	88.8 bcde
7	AND7018	5640	11.3 abcd	51.3 abcd	80.0 abc	93.3 ab	91.3 abc
8	AND7003	5800	16.3 a	53.8 abc	70.0 bcd	93.8 ab	95.0 abc
9	AND7003	17500	8.8 bcd	36.3 cde	50.0 ef	71.3 c	85.0 def
10	AND7004	2970	13.8 abc	52.5 abc	72.5 abcd	95.8 a	96.5 a
11	AND7004	8900	8.0 cd	33.8 de	50.0 ef	73.8 c	82.5 efg
12	AND7005	5800	11.3 abcd	45.0 bcd	71.3 abcd	96.5 a	97.0 a
13	AND7005	17500	4.8 d	21.3 e	32.5 g	66.3 c	77.5 g
14	AND7006	2970	9.8 abcd	41.3 bcd	67.5 cd	96.5 a	96.0 a
15	AND7006	8900	5.0 d	22.5 e	38.8 fg	67.5 c	78.8 fg
16	Fert. Undef.	4 lb/1000ft <sup>2</sup>	13.8 abc	63.8 a	87.5 a	92.5 ab	88.3 cde
17	Fert. Undef.	12 lb/1000ft <sup>2</sup>	11.3 abcd	56.3 ab	78.8 abcd	90.0 ab	90.8 abcd
18	Untreated	---	13.8 abc	55.0 ab	84.3 ab	92.0 ab	91.3 abcd
	LSD (0.05)		6.63	18.10	16.48	7.78	7.14

Means followed by the same letter are not significantly different at  $P \leq 0.05$

**Table 3.** Effect of at seeding application of mesotrione granule treatments on broad leaf weed cover, Verona, WI, 2007.

Trt #	Code	Rate(g a.i./ha)	% Broadleaf Weeds				
			7 June	21 June	9 July	19 July	27 Aug
1	AND7001	234	0.0	0.0 d	0.0 c	0.0 e	0.0 b
2	AND7001	176	0.0	0.8 cd	0.3 c	0.5 de	0.0 b
3	AND7001	700	0.0	0.0 d	0.0 c	0.0 e	0.0 b
4	AND7002	234	0.0	0.0 d	0.0 c	0.0 e	0.3 b
5	AND7002	176	0.0	0.0 d	0.3 c	0.0 e	0.0 b
6	AND7007	5640	0.5	1.5 bc	2.0 b	3.0 bc	0.5 b
7	AND7018	5640	0.5	3.0 a	3.5 a	5.0 ab	3.8 a
8	AND7003	5800	0.0	0.5 cd	0.3 c	0.0 e	0.0 b
9	AND7003	17500	0.0	0.0 d	0.0 c	0.0 e	0.0 b
10	AND7004	2970	0.0	0.0 d	0.0 c	0.3 e	0.0 b
11	AND7004	8900	0.0	0.0 d	0.0 c	0.0 e	0.0 b
12	AND7005	5800	0.0	0.0 d	0.0 c	0.0 e	0.0 b
13	AND7005	17500	0.0	0.0 d	0.0 c	0.0 e	0.0 b
14	AND7006	2970	0.0	0.5 cd	0.5 c	0.5 de	0.0 b
15	AND7006	8900	0.0	0.0 d	0.0 c	0.3 e	0.0 b
16	Fert. Undef.	4 lb/1000ft <sup>2</sup>	0.5	2.5 ab	1.8 b	5.5 a	1.8 ab
17	Fert. Undef.	12 lb/1000ft <sup>2</sup>	0.8	1.3 c	1.8 b	2.0 cde	0.5 b
18	Untreated	---	0.3	1.0 cd	2.0 b	2.5 cd	3.0 a
	LSD (0.05)		ns	1.02	1.22	2.19	2.04

Means followed by the same letter are not significantly different at  $P \leq 0.05$

**Table 4.** Effect of at seeding application of mesotrione granule treatments on percent yellow nutsedge cover, Verona, WI, 2007.

Trt #	Code	Rate(g a.i./ha)	% Yellow Nutsedge				
			7 June	21 June	9 July	19 July	27 Aug
1	AND7001	234	0.0 c	0.3 d	1.0 c	1.5 cd	0.0
2	AND7001	176	0.0 c	0.0 d	0.8 c	0.3 d	0.0
3	AND7001	700	0.0 c	0.0 d	0.3 c	0.0 d	0.0
4	AND7002	234	0.3 c	0.8 d	2.3 bc	1.5 cd	0.5
5	AND7002	176	0.0 c	0.0 d	1.3 c	2.0 cd	0.0
6	AND7007	5640	1.0 b	3.5 b	6.5 a	3.5 bc	0.5
7	AND7018	5640	1.5 b	6.5 a	5.5 a	8.0 a	0.0
8	AND7003	5800	0.0 c	0.5 d	1.3 c	0.8 cd	0.0
9	AND7003	17500	0.0 c	0.0 d	0.0 c	0.5 cd	0.0
10	AND7004	2970	0.0 c	1.0 d	1.5 bc	2.5 cd	0.0
11	AND7004	8900	0.0 c	0.0 d	0.0 c	0.0 d	0.0
12	AND7005	5800	0.0 c	0.5 d	1.0 c	1.0 cd	0.0
13	AND7005	17500	0.0 c	0.0 d	0.0 c	0.0 d	0.0
14	AND7006	2970	0.0 c	0.5 d	1.0 c	0.5 cd	0.0
15	AND7006	8900	0.0 c	0.0 d	0.3 c	0.3 d	0.0
16	Fert. Undef.	4 lb/1000ft <sup>2</sup>	0.0 c	3.5 b	4.3 ab	6.0 ab	0.0
17	Fert. Undef.	12 lb/1000ft <sup>2</sup>	0.0 c	1.3 cd	1.8 bc	1.5 cd	0.3
18	Untreated	---	2.3 a	3.3 bc	5.8 a	6.0 ab	0.0
	LSD (0.05)		0.70	2.10	2.78	3.13	ns

Means followed by the same letter are not significantly different at  $P \leq 0.05$

**Table 5.** Effect of at seeding application of mesotrione granule treatments on percent crabgrass cover, Verona, WI, 2007.

Trt #	Code	Rate(g a.i./ha)	% Crabgrass				
			7 June	21 June	9 July	19 July	27 Aug
1	AND7001	234	0.0	0.0 c	0.0 b	0.0 b	0.0
2	AND7001	176	0.0	0.0 c	0.0 b	0.0 b	0.0
3	AND7001	700	0.0	0.0 c	0.0 b	0.0 b	0.0
4	AND7002	234	0.0	0.3 bc	0.3 b	0.3 b	0.0
5	AND7002	176	0.0	0.3 bc	0.0 b	0.0 b	0.0
6	AND7007	5640	0.0	0.0 c	0.0 b	0.0 b	0.0
7	AND7018	5640	0.3	0.5 bc	0.0 b	0.0 b	0.0
8	AND7003	5800	0.0	0.0 c	0.0 b	0.0 b	0.0
9	AND7003	17500	0.0	0.0 c	0.0 b	0.0 b	0.0
10	AND7004	2970	0.0	0.0 c	0.0 b	0.0 b	0.0
11	AND7004	8900	0.0	0.0 c	0.0 b	0.0 b	0.0
12	AND7005	5800	0.0	0.0 c	0.0 b	0.0 b	0.0
13	AND7005	17500	0.0	0.0 c	0.0 b	0.0 b	0.0
14	AND7006	2970	0.0	0.0 c	0.0 b	0.0 b	0.0
15	AND7006	8900	0.0	0.0 c	0.0 b	0.0 b	0.0
16	Fert. Undef.	4 lb/1000ft <sup>2</sup>	0.5	2.0 a	2.8 a	4.0 a	3.75
17	Fert. Undef.	12 lb/1000ft <sup>2</sup>	0.0	0.8 b	0.3 b	0.0 b	0.0
18	Untreated	---	0.0	1.5 a	0.0 b	1.0 b	0.0
	LSD (0.05)		ns	0.66	0.79	1.60	ns

Means followed by the same letter are not significantly different at  $P \leq 0.05$



**Table 6.** Effect of at seeding application of mesotrione granule treatments on percent annual bluegrass cover, Verona, WI, 2007.

Trt #	Code	Rate(g a.i./ha)	% Annual Bluegrass
			4 Aug
1	AND7001	234	4.0 cd
2	AND7001	176	7.8 bcd
3	AND7001	700	0.5 d
4	AND7002	234	1.5 d
5	AND7002	176	3.5 cd
6	AND7007	5640	25.0 a
7	AND7018	5640	11.5 bc
8	AND7003	5800	1.5 d
9	AND7003	17500	1.3 d
10	AND7004	2970	1.5 d
11	AND7004	8900	1.5 d
12	AND7005	5800	0.0 d
13	AND7005	17500	0.3 d
14	AND7006	2970	9.3 bcd
15	AND7006	8900	1.3 d
16	Fert. Undef.	4 lb/1000ft <sup>2</sup>	21.3 a
17	Fert. Undef.	12 lb/1000ft <sup>2</sup>	16.3 ab
18	Untreated	---	11.8 bc
	LSD (0.05)		9.27

Means followed by the same letter are not significantly different at  $P \leq 0.05$

## **Mesotrione Safety at Seeding of Turfgrass Blends/Mixtures**

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### **OBJECTIVES**

The primary objectives of this study were to determine if mesotrione is safe to turf when applied at the time of seeding and if mesotrione is safe when applied shortly after the first mowing of a seeded turf stand. A secondary objective is to determine if mesotrione can provide acceptable (>90%) weed control.

### **MATERIALS AND METHODS**

The study was conducted at the O.J. Noer Turfgrass Research and Educational Facility in Verona, WI. The soil type was a silt loam. The experimental design was a randomized strip-block with four replications. Perennial ryegrass and a 3 way mix 'Madison Parks' were planted in strips across each replication so that half of each herbicide treated plot was seeded to perennial ryegrass and half was seeded to the 3 way mix. Experimental units (grass within herbicide treatment) measured 5'x5'. A one foot border was left between each area treated with herbicide to eliminate the effects of overspray.

Grass types in this study were a perennial ryegrass blend and a 3 way mix of Kentucky bluegrass, perennial ryegrass, and fine fescue. The cultivars in the three way mix included: 10% Odyssey KBG, 5% Arcadia KBG, 5%Mercury KBG, 5% SR2100 KBG, 5% America KBG, 10% Cannon KBG, 10% Wild Horse KBG, 15% SR5210 creeping red fescue, 10% Boreal creeping red fescue, 15% SR4550 perennial ryegrass, and 15% Cutter perennial ryegrass. The cultivars in the perennial ryegrass blend included: 34.7% Harrier, 34.13% Peregrine, and 28.6% SR4600. Grass strips were seeded using a drop spreader on 17 May. The 3 way mix was seeded at a rate of 4 lb seed/1000 ft<sup>2</sup> and the perennial ryegrass was seeded at a rate of 7 lbs seed/1000 ft<sup>2</sup>. Starter fertilizer was applied at a rate of 1 lb P<sub>2</sub>O<sub>5</sub>/1000 ft<sup>2</sup> just prior to seeding. The grass seed was lightly raked in following seeding and herbicide treatments were applied over the dried soil and seed.

Herbicide treatments were applied using a CO<sub>2</sub> powered backpack sprayer at 42 PSI tank pressure with a 3 nozzle spray boom capable of spraying a 5 ft swath. Nozzles used were XR TeeJet 8004VS nozzles. All treatments were applied in water equivalent to 1 gal/1000 ft<sup>2</sup>. Following herbicide applications the entire study area was covered with Futerra<sup>®</sup> erosion control blankets and ½ inch water was applied using an automatic in-ground irrigation system. For the remainder of the establishment period irrigation was supplied 5 times per day for 2 minutes each time. The first mowing of the study occurred on 13 June. The sequential applications scheduled to be made after the first mowing were applied on 14 June. At this rating date the herbicide was given 2 hours to dry on the leaf surface and was subsequently watered in with ½ inch of water using the automated

in-ground irrigation system. From this point on irrigation was supplied 1 time per week to replace 100% of the estimated evapotranspiration rate.

Turfgrass phytotoxicity and percent cover were rated at 1, 2, 3, 4, 6, and 8 weeks after seeding. Turfgrass phytotoxicity was rated on a scale from 1-10 where 1=no phyto, 10=totally dead, and >3=unacceptable. Percent cover was rated on a scale from 0-100% where 0=bare soil, and 100=dense healthy turf. Percent control of various weeds was rated at 2, 3, 4, 6, and 8 weeks after treatments. Weeds rated included broadleaf weeds, crabgrass, and yellow nutsedge. The percentage of weeds in each plot was estimated visually and percent control was calculated by dividing the percent of weeds in treated plots by the percent in the control plot for that replication, multiplying the dividend by 100, and subtracting the product by 100.

**Table 1.** Treatment list for Mesotrione Safety at Seeding of Turfgrass Blends/Mixtures. Verona, WI 2007.

<b>Trt #</b>	<b>Trtreatment</b>	<b>Rate(oz a.i./A)</b>	<b>Timing</b>
1	Mesotrione 4 SC <sup>†</sup>	2.5	Seeding
2	Mesotrione 4 SC	3.0	Seeding
3	Mesotrione 4 SC	4.0	Seeding
4	Siduron	48.0	Seeding
5	Mesotrione 4 SC	2.5 + 2.5	Seeding + 1 <sup>st</sup> mowing
6	Mesotrione 4 SC	3.0 +3.0	Seeding + 1 <sup>st</sup> mowing
7	Untreated Control		

<sup>†</sup>Non-ionic surfactant was added to all mesotrione treatments at 0.25% v/v.

## RESULTS

Phytotoxicity from some of the treatments was observed through 14 June and an interaction between treatment and grass type was observed on 7 June (Table 2). The only treatment that caused any significant phytotoxicity in the study was treatment 3 (high rate of mesotrione) (Table3). On 25 May an observation was made that indicated that treatment 3 caused more phytotoxicity to perennial ryegrass than it did to the 3 way mixture (Table 4).

Percent desirable turf cover was also evaluated as a measure of phytotoxicity to turf during establishment. Both treatment and grass type affected the percent of desirable turf cover (Table 5). In addition there were interactions between treatment and grass type on 31 May and 9 July (Table 7). At one week after seeding (25 May) treatment did not have an effect on percent turf cover. At two weeks after seeding (31 May) treatment began to have an effect on percent cover. A slight reduction in turf cover was observed with treatment 2 and an even greater reduction in turf cover was observed with treatment 3 (high rate of mesotrione). There was also a slight reduction in turf cover from the Siduron treatment on this rating date. For the remainder of the study, treatment 3 is the only treatment that was causing a reduction in turf cover compared to the untreated control. In some cases, percent desirable turf cover was greater in plots treated with

mesotrione than in the untreated control due to control of weeds. Perennial ryegrass provided significantly more turf cover than the 3 way mix throughout the study. Table 7 shows that at 2 weeks after seeding the reduction in turf cover due to treatment 3 is more pronounced on perennial ryegrass than on the 3 way mix. However, later in the season the effects of treatment 3 on percent cover were more pronounced on the 3 way mix than on the perennial ryegrass.

Herbicide treatment had an effect on broadleaf weed control throughout the study (Table 8). All treatments provided better weed control than the untreated plot (Table 9). Although mesotrione treatments were all statistically similar to one another, the higher rates tended to provide slightly higher levels of control.

Crabgrass was present in some plots but the infestation was not uniform enough to detect significant differences among treatments (Table 10).

Herbicide treatment affected yellow nutsedge control throughout the study (Table 11). All mesotrione treatments provided at or near 100 percent control of yellow nutsedge. Siduron only provided around 50 percent control of yellow nutsedge.

## CONCLUSION

The primary objective of this study was to determine if mesotrione is safe to turf when applied at seeding and to determine if sequential applications made shortly after the first mowing are safe. The results indicate that all treatments of mesotrione in this study other than the single treatment of 4 oz a.i./A are safe to turfgrass when applied at seeding. The additional application of mesotrione after the first mowing (treatments 5 and 6) also did not adversely affect turf growth. Treatment 3 caused significant phytotoxicity and a reduction in percent cover throughout the study. Phytotoxicity was observed as a lack of germination, bleaching/purple color of turf shoots, and reduced growth. The three way mix seemed to be less affected by the high rate of mesotrione than perennial ryegrass early in the study but after about 7 weeks, the effects of treatment 3 were more visible on the 3 way mix. Perennial ryegrass seems to be more susceptible to injury from mesotrione so injury is more visible on ryegrass compared to other grasses during early establishment. As the effects of the herbicide wear off the ryegrass recovers more quickly than Kentucky bluegrass and fine fescue because of its rapid growth rate. In addition the small percentage of perennial ryegrass in the 3 way mix was likely reduced or eliminated by treatment 3 due to phytotoxicity during germination and early establishment.

The secondary objective of the study was to evaluate the effect of the various mesotrione treatments on weed control. All mesotrione treatments provided excellent control of both broadleaf weeds and yellow nutsedge. Although statistically significant differences were not observed among the different mesotrione treatments, the higher rates and sequential applications seemed to provide more consistent weed control.

When applied at appropriate rates, mesotrione is both safe to turf and effective at controlling common weeds. Additional work should be done to evaluate the effects of mesotrione on other species or specific cultivars of turf

**Table 2.** Analysis of variance for effect of treatment, grass type, and interactions between treatment and grass type on phytotoxicity to desirable turf. Verona, WI, 2007.

Source	25 May	31 May	7 June	14 June	29 June	9 July
Treatment(TRT)	**	**	**	**	---	---
Grass(GR)	ns	ns	ns	ns	---	---
TRT*GR	ns	ns	*	ns	---	---

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 3.** Effect of herbicide treatment on turfgrass phytotoxicity. Rating scale: 1-10 where 1=no phyto, 10=totally dead and >3=unacceptable. Verona, WI 2007.

Treatment	Rate(oz a.i./A)	Turf Phytotoxicity					
		25 May	31 May	7 June	14 June	29 June	9 July
1. Mesotrione 4 SC <sup>†</sup>	2.5	1.1 b	1.1 b	1.1 b	1.0 b	---	---
2. Mesotrione 4 SC	3.0	1.0 b	1.0 b	1.3 b	1.1 b	---	---
3. Mesotrione 4 SC	4.0	4.5 a	4.9 a	5.9 a	4.1 a	---	---
4. Siduron	48.0	1.0 b	1.0 b	1.1 b	1.0 b	---	---
5. Mesotrione 4 SC	2.5 + 2.5	1.4 b	1.2 b	1.0 b	1.0 b	---	---
6. Mesotrione 4 SC	3.0 + 3.0	1.3 b	1.0 b	1.1 b	1.0 b	---	---
7. Untreated Control		1.0 b	1.0 b	1.0 b	1.0 b	---	---
LSD (0.05)		0.47	0.82	0.66	0.39	---	---

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 4.** Interaction between herbicide treatment and grass type on turfgrass phytotoxicity. Rating scale: 1-10 where 1=no phyto, 10=totally dead and >3=unacceptable. Verona, WI 2007.

Trtreatment	Rate(oz a.i./A)	Grass Type	Turf Phytotoxicity
			25 May
1. Mesotrione 4 SC	2.5	Perennial Rye	1.3 c
2. Mesotrione 4 SC	3.0	Perennial Rye	1.5 c
3. Mesotrione 4 SC	4.0	Perennial Rye	7.0 a
4. Siduron	48.0	Perennial Rye	1.3 c
5. Mesotrione 4 SC	2.5 + 2.5	Perennial Rye	1.0 c
6. Mesotrione 4 SC	3.0 +3.0	Perennial Rye	1.3 c
7. Untreated Control		Perennial Rye	1.0 c
1. Mesotrione 4 SC	2.5	3 way mix	1.0 c
2. Mesotrione 4 SC	3.0	3 way mix	1.0 c
3. Mesotrione 4 SC	4.0	3 way mix	4.5 b
4. Siduron	48.0	3 way mix	1.0 c
5. Mesotrione 4 SC	2.5 + 2.5	3 way mix	1.0 c
6. Mesotrione 4 SC	3.0 +3.0	3 way mix	1.0 c
7. Untreated Control		3 way mix	1.0 c
LSD within TRT			1.16
LSD among TRT			0.94

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 5.** Analysis of variance for effect of treatment, grass type, and interactions between treatment and grass type on the percentage of desirable turf cover. Verona, WI, 2007.

Source	25 May	31 May	7 June	14 June	29 June	9 July	19 July
Treatment(TRT)	ns	**	**	**	**	**	**
Grass(GR)	**	**	**	**	**	*	*
TRT*GR	ns	**	ns	ns	ns	**	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 6.** Effect of herbicide treatment and grass type of percent turfgrass cover. Rating scale: 0-100% where 0=bare soil, 100=healthy dense turf. Verona, WI 2007.

Treatment	Rate(oz a.i./A)	% Cover						
		25 May	31 May	7 June	14 June	29 June	9 July	19 July
1. Mesotrione 4 SC <sup>†</sup>	2.5	3.9	18.1 ab	58.1 a	83.9 a	93.5 a	98.6 a	98.1 a
2. Mesotrione 4 SC	3.0	3.5	16.9 bc	55.6 a	83.1 a	94.5 a	99.3 a	99.3 a
3. Mesotrione 4 SC	4.0	3.5	8.9 d	35.0 b	60.0 b	69.6 b	84.1 b	89.4 c
4. Siduron	48.0	3.5	16.3 c	54.8 a	81.3 a	88.8 a	98.6 a	97.4 ab
5. Mesotrione 4 SC	2.5 + 2.5	3.5	18.8 a	58.1 a	84.0 a	91.1 a	99.1 a	99.0 a
6. Mesotrione 4 SC	3.0 +3.0	3.3	17.5 abc	55.6 a	82.3 a	89.6 a	99.0 a	98.5 a
7. Untreated Control		3.9	19.1 a	61.3 a	83.3 a	90.6 a	96.9 a	94.4 b
LSD (0.05)		ns	1.83	7.4	5.22	7.94	2.80	3.67
<b>Grass Type</b>								
Perennial Rye		5.1	27.1	68.8	91.9	96.6	98.8	98.7
3 way mix		2.0	5.9	39.3	67.5	79.9	94.3	94.6
LSD (0.05)		0.32	4.97	7.15	5.83	9.13	3.66	3.37

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 7.** Interaction between herbicide treatment and grass type on percent turf cover. Rating scale: 0-100% where 0=bare soil, 100=healthy dense turf. Verona, WI 2007.

Treatment	Rate(oz a.i./A)	Grass Type	% Cover	
			31 May	9 July
1. Mesotrione 4 SC	2.5	Perennial Rye	30.0 ab	100.0 a
2. Mesotrione 4 SC	3.0	Perennial Rye	27.5 bc	100.0 a
3. Mesotrione 4 SC	4.0	Perennial Rye	15.0 d	92.0 c
4. Siduron	48.0	Perennial Rye	26.3 c	100.0 a
5. Mesotrione 4 SC	2.5 + 2.5	Perennial Rye	31.3 a	100.0 a
6. Mesotrione 4 SC	3.0 +3.0	Perennial Rye	28.8 abc	100.0 a
7. Untreated Control		Perennial Rye	31.3 a	99.3 ab
1. Mesotrione 4 SC	2.5	3 way mix	6.3 e	97.3 ab
2. Mesotrione 4 SC	3.0	3 way mix	6.3 e	98.5 ab
3. Mesotrione 4 SC	4.0	3 way mix	2.8 f	76.3 d
4. Siduron	48.0	3 way mix	6.3 e	97.3 ab
5. Mesotrione 4 SC	2.5 + 2.5	3 way mix	6.3 e	98.3 ab
6. Mesotrione 4 SC	3.0 +3.0	3 way mix	6.3 e	98.0 ab
7. Untreated Control		3 way mix	7.0 e	94.5 bc
LSD within TRT			5.48	2.57
LSD among TRT			2.66	4.63

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 8.** Analysis of variance for effect of treatment, grass type, and interactions between treatment and grass type on percent control of broadleaf weeds. Verona, WI, 2007.

Source	31 May	7 June	14 June	29 June	9 July
Treatment(TRT)	*	**	**	**	**
Grass(GR)	ns	ns	ns	ns	ns
TRT*GR	ns	ns	ns	ns	*

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .



**Table 9.** Effect of herbicide treatment on broadleaf weed control. Rating scale: 0-100% where 0=no reduction in weeds compared to the control, 100=no broadleaf weeds. Verona, WI 2007.

Treatment	Rate(oz a.i./A)	% Broadleaf Control				
		31 May	7 June	14 June	29 June	9 July
1. Mesotrione 4 SC <sup>†</sup>	2.5	79.2 a	87.5 a	87.5 a	95.0 a	75.0 a
2. Mesotrione 4 SC	3.0	100.0 a	87.5 a	87.5 a	100.0 a	87.5 a
3. Mesotrione 4 SC	4.0	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
4. Siduron	48.0	68.8 ab	93.8 a	87.5 a	82.5 a	75.0 a
5. Mesotrione 4 SC	2.5 + 2.5	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
6. Mesotrione 4 SC	3.0 + 3.0	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
7. Untreated Control		37.5 b	25.0 b	50.0 b	50.0 b	0.0 b
LSD (0.05)		38.94 b	26.16	31.04	25.37	28.46

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

**Table 10.** Analysis of variance for effect of treatment, grass type, and interactions between treatment and grass type on the presence of crabgrass. Verona, WI, 2007.

Source	31 May	7 June	14 June	29 June	9 July
Treatment(TRT)	ns	ns	ns	ns	ns
Grass(GR)	ns	ns	ns	ns	ns
TRT*GR	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 11.** Analysis of variance for effect of treatment, grass type, and interactions between treatment and grass type on percent control of yellow nutsedge. Verona, WI, 2007.

Source	31 May	7 June	14 June	29 June	9 July
Treatment(TRT)	**	**	**	**	**
Grass(GR)	ns	ns	ns	ns	ns
TRT*GR	ns	ns	ns	ns	ns

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 12.** Effect of herbicide treatment on yellow nutsedge control. Rating scale: 0-100% where 0=no reduction in weeds compared to the control, 100=no yellow nutsedge. Verona, WI 2007.

Treatment	Rate (oz a.i./A)	% Yellow Nutsedge Control				
		31 May	7 June	14 June	29 June	9 July
1. Mesotrione 4 SC <sup>†</sup>	2.5	100.0 a	100.0 a	100.0 a	100.0 a	97.5 a
2. Mesotrione 4 SC	3.0	75.0 a	100.0 a	100.0 a	100.0 a	100.0 a
3. Mesotrione 4 SC	4.0	100.0 a	100.0 a	100.0 a	87.5 a	100.0 a
4. Siduron	48.0	64.6 ab	49.0 b	52.3 b	52.5 b	50.2 b
5. Mesotrione 4 SC	2.5 + 2.5	93.8 a	100.0 a	100.0 a	100.0 a	100.0 a
6. Mesotrione 4 SC	3.0 + 3.0	87.5 a	100.0 a	100.0 a	100.0 a	100.0 a
7. Untreated Control		25.0 b	12.5 c	0.0 c	0.0 c	0.0 c
LSD (0.05)		41.48	24.23	10.60	16.84	11.98

Means followed by the same letter are not significantly different at  $P \leq 0.05$ .

## Evaluation of *Poa annua* Control with Velocity Herbicide

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University of Wisconsin – Madison

### OBJECTIVE

The objective of this study was to evaluate applications of Velocity herbicide with and without Sprint 330 for control of annual bluegrass on creeping bentgrass fairways.

### MATERIALS AND METHODS

The study took place at the O.J. Noer Turfgrass Research and Education Facility in Verona, Wisconsin on a mixed stand of creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*). Plugs of creeping bentgrass had been planted on the site and over the course of 3 years *Poa annua* had filled in between the plugs as a result of winterkill on the ryegrass that was originally planted between the plugs. The soil type was a silt loam. The turf is mown at ½” three times per week, received 2 lbs N/1000 ft<sup>2</sup>/year and is not treated with additional fungicide. Irrigation was applied to prevent drought stress. Seven treatments were arranged in a randomized complete block design with four replications (Table 2). Each experimental unit (plot) measured 5x10 feet. Treatments were applied beginning on 20 June 2007 with a CO<sub>2</sub> backpack sprayer, using XR TeeJet 8004 VS nozzles, at 38 PSI, in water equivalent to 1.5 gallons/1000 ft<sup>2</sup>.

Bentgrass phytotoxicity, percent *Poa annua* control, and *Poa annua* injury were evaluated at approximately 3, 7, 14, 21, 28, 42, and 56 days after initial treatments began. Percent *Poa annua* control was determined by visually rating the percentage of living *Poa annua* in the plot on a given rating date then using the number in the following equation: % Control = 100\*[1-(%poa on rating date/initial %poa)]. Bentgrass phytotoxicity was rated on a scale from 1-9, where 1=no injury, 9=dead turf, and 3 or greater = unacceptable injury. *Poa annua* injury was rated on a scale from 1-9, where 1=no injury and 9=all *Poa annua* is totally dead. Soil and air temperatures were recorded at each application date.

**Table 1.** Application record for Evaluation of *Poa* Control with Velocity Herbicide. Verona, WI 2007.

Date	Treatment Applied	Soil Temp °C	Air Temp °C
20 June	1, 2, 3, 4, 5, 6	25.6	29.1
27 June	4, 5, 6	23.9	23.8
4 July	1, 2, 3, 4, 5, 6	25.7	28.7
12 July	4, 5, 6	20.7	20.6
18 July	1, 2, 3, 4, 5, 6	25.2	28.7
27 July	4, 5, 6	22.6	23.6

**Table 2.** Treatment list for Evaluation of Poa Control with Velocity Herbicide. Verona, WI 2007.

Trt. #	Product	Rate/Application	Timing
1	Sprint 330	2 oz/1000 ft <sup>2</sup>	3 apps 14 day interval
2	Velocity 17.6 SG	30 g a.i./Acre	3 apps 14 day interval
3	Velocity + Sprint 330	30 g + 2 oz	3 apps 14 day interval
4	Sprint 330	2 oz/1000 ft <sup>2</sup>	6 apps 7 day interval
5	Velocity 17.6 SG	10 g a.i./Acre	6 apps 7 day interval
6	Velocity + Sprint 330	10 g + 2 oz	6 apps 7 day interval
7	Untreated Control		

## RESULTS

The effect of treatment on percent *Poa annua* control is shown in Table 3 and Figure 1. Five days after the initial application we were not seeing any control of *Poa annua*. On 3 July we were beginning to see some control of *Poa annua* by treatments 2, 3, and 6 but there was no significant difference between treatments. On 10 and 21 July we were seeing increased levels of control by the various treatments. There was some *Poa annua* die off in July due to drought and disease which is likely the cause of the relatively high percent control ratings in the untreated control plots. On 3 August, after all treatments had been made, there were significant differences between various treatments for the first time. All treatments containing Velocity were providing between 60 and 68 percent control and were statistically similar to one another. The Sprint 330 only treatments were statistically similar to the untreated control. On 15 August we observed a slight decrease in percent control of *Poa annua* for all treatments. Treatment 2 was providing the greatest control of *Poa annua* (66 percent) and all treatments containing Velocity were statistically similar. Treatments 3 and 5 however were also statistically similar to the untreated control so the level of control would be considered unacceptable. Treatments 1 and 4 also were statistically similar to the untreated control on 15 August indicating that Sprint 330 alone does not affect the *Poa annua* population.

Essentially no bentgrass phytotoxicity was observed through 21 July (Table 3). On 3 August some slight browning of creeping bentgrass was observed from treatments 1, 4, and 6 but the browning effect was minor and well within acceptable levels.

*Poa annua* injury was evaluated as an indicator of treatment efficacy and the results are presented in Table 5. At 5 days after treatment on 25 June, the treated plots were not different from the untreated control. By 27 June we were beginning to see significant *Poa annua* injury from treatments 2, 3, and 5. On 3 July treatments 2, 3, 5, and 6 were causing significant *Poa annua* injury. Treatment 2 was causing the most injury followed by treatments 3 and 5. Treatment 6 was not statistically similar to treatment 2. On 10 July treatments 2 and 5 were causing the most injury to *Poa annua*. On 21 July treatment 2 was causing significantly more injury than any other treatment. Treatment 5 was also causing some injury but was not statistically the same as treatment 2. All other

treatments were similar to the untreated control. On 3 Aug, when the final *Poa annua* injury rating was taken, all of the treatments for the season had been applied. All treatments containing Velocity were causing significant injury and were statistically similar to one another. Sprint 330 only treatments were the same as the untreated control.

## CONCLUSION

The objective of this study was to evaluate applications of Velocity herbicide with and without Sprint 330 for control of *Poa annua* on creeping bentgrass fairways. On 3 August we saw no difference in terms of *Poa annua* control between treatments with and without Sprint 330 nor did we see any difference between overall application rates and timings. It appeared that there was a decrease in control of *Poa annua* between 3 August and 15 August. This was likely due to re-growth as a result of the extremely wet conditions at the research site in early August (weather data available). On 15 August treatment 2, which was 3 applications of 30 g a.i. Velocity alone, was providing the greatest control of *Poa annua*. Treatment 6, which was 6 applications of 10 g a.i. Velocity + Sprint 330, was the only other treatment that was providing levels of control that were statistically greater than the untreated control although control levels for treatment 6 were below 50 percent. The results from the percent control ratings suggest that adding Sprint 330 to the spray mix does not increase *Poa annua* control under the conditions of this study. However, the results also show no indication of a significant decrease in percent control when Sprint 330 is added.

No unacceptable phytotoxicity to the desirable bentgrass was observed in the study. Some slight browning of the bentgrass turf was noted in plots treated with Sprint 330 but the discoloration was within acceptable levels and did not persist. Since Sprint 330 is an Iron chelate the browning effect was likely a result of oxidized Iron on the leaves of the turf.

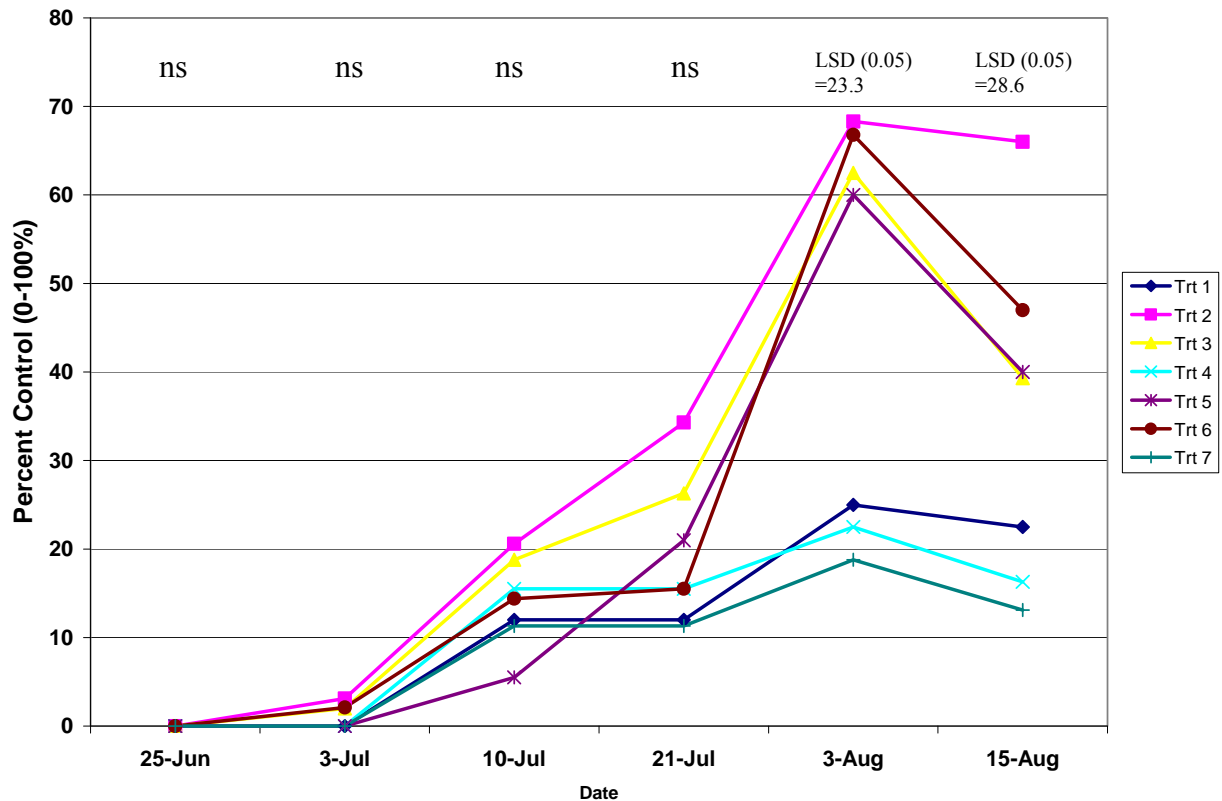
In terms of *Poa annua* injury the results from this study indicate that adding Sprint 330 to the mix may delay injury to *Poa annua* especially when Velocity is applied in 3 applications of 30 g a.i. on a 14 day interval (Table 5). The presence of Sprint 330 in a treatment did not affect *Poa annua* injury when treatment was split into 6 applications of 10 g a.i. on a 7 day interval. By the end of the study all treatments were showing similar injury to *Poa annua* so the effect of Sprint 330 on *Poa annua* injury appears to be short lived.

Overall, applying Velocity using 30 g a.i./1000 ft<sup>2</sup> without Sprint 330 provided the fastest burndown and slightly better control of *Poa annua*. There was not any statistically significant evidence however that indicated that Sprint 330 affects *Poa annua* control either way. The effect of Sprint 330 should be looked at under a wide variety of environments and its effect on multiple rates of Velocity application should be analyzed in more detail. An experiment designed specifically to look at interactions between Velocity rate and Sprint 330 application may be useful.

**Table 3.** Effect of treatment on percent *Poa annua* control with Velocity herbicide. Verona, WI, 2007.

Trt #	% Control					
	25 June	3 July	10 July	21 July	3 Aug	15 Aug
1	0.0	0.0	12.0	12.0	25.0 b	22.5 bc
2	0.0	3.1	20.6	34.3	68.3 a	66.0 a
3	0.0	2.0	18.8	26.3	62.5 a	39.3 abc
4	0.0	0.0	15.5	15.5	22.5 b	16.3 c
5	0.0	0.0	5.5	21.0	60.0 a	40.0 abc
6	0.0	2.1	14.4	15.5	66.8 a	47.0 ab
7	0.0	0.0	11.3	11.3	18.8 b	13.1 c
LSD (0.05)	ns	ns	ns	ns	23.3	28.6

Means followed by the same on letter within columns are not significantly different at  $P \leq 0.05$ .



**Figure 1.** Effect of treatment on percent control of *Poa annua*. Verona, WI 2007.

**Table 4.** Analysis of variance for effect of treatment on bentgrass phytotoxicity. Verona, WI, 2007.

Source	25 Jun	27 Jun	3 July	10 July	21 July	3 Aug
Treatment	ns	ns	ns	ns	ns	*

\* Significant at  $P \leq 0.05$ , \*\* significant at  $P \leq 0.01$ .

**Table 5.** Effect of treatment on *Poa annua* injury. Rating scale: 1=no injury, 9= all *Poa annua* is totally dead. Verona, WI, 2007.

Trt #	<i>Poa annua</i> injury (1-9)					
	25 June	27 June	3 July	10 July	21 July	3 Aug
1	2.0	1.0 d	1.8 cd	1.5 b	1.3 c	1.3 b
2	3.0	3.8 a	3.3 a	3.8 a	5.3 a	6.3 a
3	1.5	2.8 b	2.8 ab	2.0 b	1.8 bc	5.3 a
4	2.3	2.0 bc	1.5 cd	1.3 b	1.3 c	1.5 b
5	2.3	2.8 b	2.8 ab	2.5 ab	2.8 b	5.5 a
6	1.8	2.0 bc	2.3 bc	1.5 b	1.8 bc	5.5 a
7	1.8	1.8 cd	1.3 d	1.8 b	1.0 c	1.3 b
LSD (0.05)	ns	1.00	0.95	1.40	1.20	1.33

Means followed by the same on letter within columns are not significantly different at  $P \leq 0.05$ .

# **Insect Pest Management**



# Evaluation of Insecticides for Control of Mound Building Ants in Turf

R. Chris Williamson  
Department of Entomology

## INTRODUCTION

The cornfield ant (a.k.a. the turfgrass ant), *Lasius neoniger*, can be highly problematic on golf course turf including putting greens, tee boxes and even fairways. Worker ants construct mounds that resemble miniature inverted volcanoes that are not only aesthetic eyesores and can disrupt ball roll, but can impede the ability of the turf to photosynthesize as mounds are smeared into the turf by daily mowing or rolling ultimately causing turf death. Furthermore, dulling or damage to reels and bed knives may result.

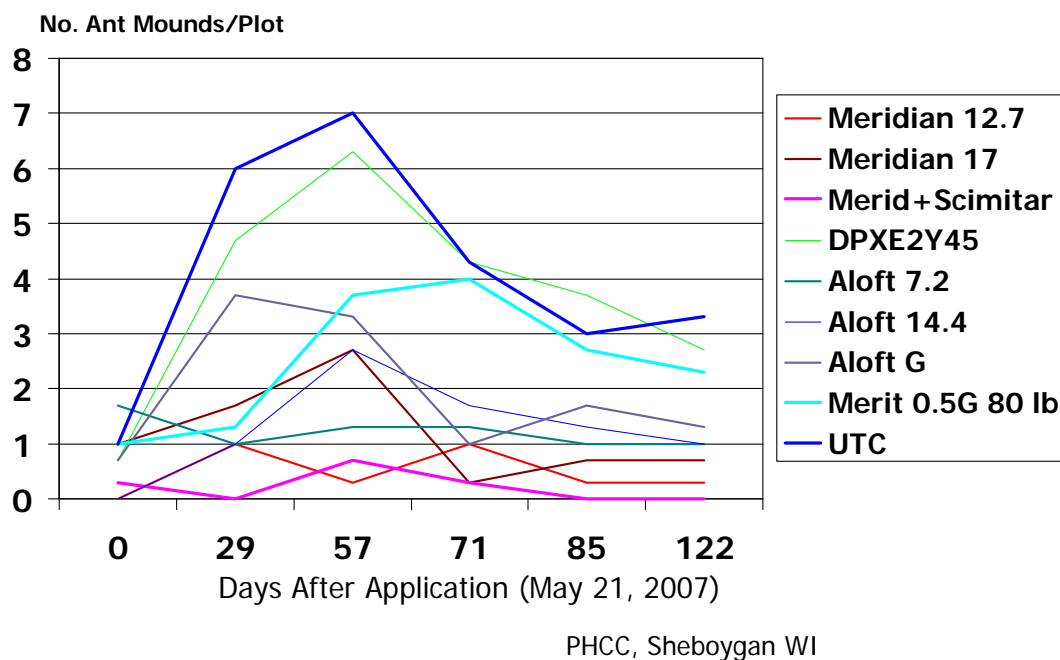
## MATERIALS AND METHODS

Trial Location: Pine Hills Country Club, Sheboygan, WI (Rod Johnson, CGCS)  
Design: Pseudo-Randomized Complete Block Design with 4 replications (two blocks on opposing sides of golf course fairway adjacent to rough)  
Treatment Application Date: May 21, 2007  
Application Method: CO<sub>2</sub> backpack sprayer equipped with TeeJet 8003 flat fan nozzles  
Spray Volume: 2.0 gallons water per 1000 square feet  
Granular treatments were applied with shaker-jar applicator  
Post-treatment Irrigation: 0.15-0.2 inches water  
Turf Type: Irrigated creeping bentgrass/*Poa annua* fairway maintained at 0.38- 0.5 inches  
Data Collected: Weekly counts of the number of ant mounds per plot. Excessive rainfall in early August prevented evaluation.

<b>Treatment</b>	<b>Rate (product)</b>
Meridian 25WG	12.7 oz/A
Meridian 25WG	17.0 oz/A
Scimitar 0.88CS	10.0. fl oz/A
Meridian 25WG + Scimitar 0.88CS	17.0 oz + 10.0 fl oz/A
Acelepryn	8.0 fl oz/A
Aloft GC SC	7.2 fl oz/A
Aloft GC SC	14.4 fl oz/A
Aloft GC G	60.0 lbs./A
Merit 0.5G	100.0 lbs./A
Untreated Control	---

## RESULTS AND DISCUSSION

### Insecticides for ant control in turfgrass



## CONCLUSION

The two rates of Meridian (12.7 and 17.0 oz/A), Meridian + Scimitar, and the two rates of Aloft GC SC (7.2 and 14.4 fl oz/A) provided excellent suppression of ant mounds throughout the duration of the study. Initially, the Merit 0.5G provided excellent suppression of ant mound, however after 29 DAT, performance declined dramatically for the remainder of the study. The results of this study are encouraging, there are a few insecticides that may provide effective control of ants on golf course turf.

# **Evaluation of Insecticides for Control of Black Cutworm in Low-Cut Turf**

R. Chris Williamson  
Department of Entomology

## **INTRODUCTION**

The black cutworm is a problematic insect on golf course turf, especially creeping bentgrass putting greens, tee boxes and even fairways. Black cutworm larvae damage turf by feeding on the leaves of turfgrass plants cropping them down and creating suppressions or pockmarks that disrupt ball roll. The objective of this study was to evaluate the performance of several insecticides for control of black cutworm.

## **MATERIALS AND METHODS**

Trial Location: O.J. Noer Turfgrass Research and Education Facility, Verona, WI  
Design: Randomized Complete Block Design with 4 replications  
Artificial Infestation Method: Eight 2<sup>nd</sup>-3<sup>rd</sup> instar black cutworm larvae were placed in eight inch PVC cylinders on September 4, 2007 and allowed to acclimate for 48 hours prior to treatment application  
Treatment Application Date: September 6, 2007  
Harvest Dates: September 7 (1 DAT) and September 14, 2007 (7 DAT)  
On September 13, five 2<sup>nd</sup>-3<sup>rd</sup> instar black cutworm larvae were placed in existing eight inch PVC cylinders  
Application Method: Hand-held pump sprayer calibrated to deliver 2.0 gallons water per 1000 square feet  
Granular products were applied with shaker-jar applicator  
Post-treatment Irrigation: 0.10 inches water  
Turf Type: Creeping bentgrass maintained at fairway height 0.38-0.5 inches  
Irrigation Regime: ~ 0.1 inches water/day or replacement of evapotranspiration rate (ET)

## RESULTS AND DISCUSSION

<b>Treatment</b>	<b>Application Rate (product)</b>	<b>Mean # larvae alive/cylinder (n=8)</b>	<b>% Control</b>
1 DAT			
Provaunt	2.0 oz/A	0.5	93.1
Arena 50WG	8.0 oz/A	0	100
Talstar EZ	100.0 lbs./A	0	100
Untreated Control	---	7.25	---
<b>Treatment</b>	<b>Application Rate (product)</b>	<b>Mean # larvae alive/cylinder (n=5)</b>	<b>% Control</b>
7 DAT			
Provaunt	2.0 oz/A	0	100
Arena 50WG	8.0 oz/A	0	100
Talstar EZ	100.0 lbs./A	0	100
Untreated Control	---	5.0	---

## CONCLUSION

ALL of the insecticide treatments evaluated provided excellent control of black cutworm larvae at 1 and 7 days after treatment (DAT).

# **Evaluation of Preventative White Grub Insecticide Treatments for Control of Japanese Beetle Larvae in Turf**

R. Chris Williamson  
Department of Entomology

## **INTRODUCTION**

White grubs, including Japanese beetle, May/June beetle and black turfgrass ataenius larvae, can cause extensive damage to turf as a result of root feeding. In addition, their mere presence frequently attracts vertebrate pests including raccoons, skunks, birds as well as others that cause more extensive damage to turf due to foraging activity. The objective of this study is to evaluate the performance (efficacy) of several white grub control products (insecticides) against Japanese beetle.

## **MATERIALS AND METHODS**

Trial Location: The Bridges Golf Course, Madison, WI (Mark Schwarting, Supt.)  
Design: Randomized Complete Block Design with 4 replications  
Insecticide Application Date: April 20, 2007  
Application Method: CO<sub>2</sub> backpack sprayer equipped with TeeJet 8003 flat fan nozzles  
Spray Volume: 2.0 gallons per 1000 square feet  
Post-treatment Irrigation: 0.15-0.2 inches water  
White Grub Species: 100% Japanese beetle  
Turf Type: Irrigated Kentucky bluegrass maintained at 2.5-3.0 inches  
Harvest Date: September 24, 2007  
Data Collected: Number of Japanese beetle larvae alive per one square foot

## **RESULTS AND DISCUSSION**

<b>Treatment</b>	<b>Application Rate (product)</b>	<b>Mean # larvae alive/ft<sup>2</sup></b>	<b>% Control</b>
Meridian 25WG	12.0 oz/A	1.75	95.9
Meridian 25WG	17.0 oz/A	0.25	99.4
Merit 75WP	8.5 oz/A	0.25	99.4
Arena 50WG	8.0 oz/A	0	100
Untreated Control	---	43.5	---

## **CONCLUSIONS**

ALL of the insecticide treatments evaluated provided excellent control (> 95%) of Japanese beetle larvae when applied April 20, well before the optimal application timing (i.e., mid-June – early-July).

# Evaluation of White Grub Insecticides for Preventative Control of Japanese Beetle in Turf

R. Chris Williamson  
Department of Entomology

## INTRODUCTION

White grubs, including Japanese beetle, May/June beetle and black turfgrass ataenius larvae, can cause extensive damage to turf as a result of root feeding. In addition, their mere presence frequently attracts vertebrate pests including raccoons, skunks, birds as well as others that cause more extensive damage to turf due to foraging activity. The objective of this study is to evaluate the performance (efficacy) of several white grub control products (insecticides) against Japanese beetle.

## MATERIALS AND METHODS

Trial Location: Naga-Waukee GC, Pewaukee, WI (Chris Fandre, Supt.)  
Design: Randomized Complete Block Design with 4 replications  
Insecticide Application Dates: May 10 and 31, June 19 and July 7, 2007  
Application Method: CO<sub>2</sub> backpack sprayer equipped with TeeJet 8003 flat fan nozzles  
Spray Volume: 2.0 gallons per 1000 square feet  
Post-treatment Irrigation: 0.15-0.2 inches water  
White Grub Species: 100% Japanese beetle  
Turf Type: Irrigated Kentucky bluegrass/*Poa annua* fairway maintained at 0.63-0.89 inches  
Harvest Date: September 12, 2007  
Data Collected: Number of Japanese beetle larvae alive per one square foot

## RESULTS AND DISCUSSION

Treatment	Application Rate (product)	Application Date	Mean # grubs alive/ft <sup>2</sup>	% Control
Acelepryn	8.0 fl oz/A	May 10	1.0	94.2
Acelepryn	12.0 fl oz/A	May 10	0	100
Merit 75WP	6.4 oz/A	May 10	10.5	39.1
Meridian 25WG	16.0 oz/A	May 10	2.75	84.0
Acelepryn	8.0 fl oz/a	May 31	0	100
Acelepryn	12.0 fl oz/A	May 31	0	100
Merit 75WP	6.4 oz/A	May 31	9.25	46.4
Meridian 25WG	16.0 oz/A	May 31	0	100
Acelepryn	8.0 fl oz/A	June 19	0	100
Acelepryn	12.0 fl oz/A	June 19	0	100
Dylox 80WP	10.2 lbs./A	June 19	17.5	0
Meridian 25WG	16.0 oz/A	June 19	0	100
Acelepryn	8.0 fl oz/A	July 7	0	100

Acelepryn	12.0 fl oz/A	July 7	0	100
Dylox 80WP	10.2 lbs./A	July 7	16.5	4.3
Meridian 25WG	16.0 oz/A	July 7	0	100
Untreated Control		---	17.25	---

## CONCLUSION

Merit 75WP (6.4 oz/A) performed poorly (< 47% control) when applied May 10 and 31, however; this application timing is not suggested. Optimal timing for the application of white grub insecticides for control of Japanese beetle is prior to or at egg hatch (mid-June to late-July). Acelepryn (a DuPont insecticide that is expected to be registered in early 2008) provided excellent control (< 94%) regardless of rate or application timing. Meridian 25WG also provided excellent control regardless of application timing. As expected, Dylox (10.2 lb/A) did not provide effective control when applied June 19 or July 7, these application date were merely too early since no Japanese beetle larvae were present at time of application.

# Evaluation of White Grub Insecticides for Corrective Control of Japanese Beetle in Turf

R. Chris Williamson  
Department of Entomology

## INTRODUCTION

White grubs, including Japanese beetle, May/June beetle and black turfgrass ataenius larvae, can cause extensive damage to turf as a result of root feeding. In addition, their mere presence frequently attracts vertebrate pests including raccoons, skunks, birds as well as others that cause more extensive damage to turf due to foraging activity. The objective of this study is to evaluate the curative (corrective) performance (efficacy) of several white grub control products (insecticides) against Japanese beetle.

## MATERIALS AND METHODS

Trial Location: Yahara Golf Course, Madison, WI (Trygve Ekern, Supt.)  
Design: Randomized Complete Block Design with 4 replications  
Treatment Application Date: September 11, 2007  
Harvest Date: September 27, 2007, 16 days after treatment (DAT)  
Application Method: CO<sub>2</sub> backpack sprayer equipped with TeeJet 8003 flat fan nozzles  
Spray Volume: 2.0 gallons water per 1000 square feet  
Granular products were applied with shaker-jar applicator  
Post-treatment Irrigation: 0.15-0.2 inches water  
White Grub Species: 100% Japanese beetle  
Turf Type: Irrigated Kentucky bluegrass/Creeping bentgrass/*Poa annua* fairway maintained at 0.6-0.9 inches  
Irrigation Regime: ~ 0.5 inches/wk, no irrigation was applied during or immediately following a rainfall event

## RESULTS AND DISCUSSION

Treatment	Rate (product)	Mean # alive/ft <sup>2</sup>	% Control
Merit 0.5G	79.7 lbs./A	9.25	52.6
Dylox	130 lbs./A	6.5	66.7
Arena 50WG	8.0 oz/A	7.5	61.5
Acelepryn	12.0 fl oz/A	5.5	71.8
Meridian 25WG	17.0 oz/A	6.25	67.9
UNT	---	19.5	---



## CONCLUSIONS

With the exception of the Merit 0.5G treatment, all other corrective insecticide treatments provided > 61% control. Overall, the level of corrective control exhibited by most products was encouraging since one of the industry standards (Dylox) for corrective control typically only provides 50-75% control.

# Fertility Trials

# **Evaluation of Six Aquatrols Experimental Surfactants**

Douglas J. Soldat  
Department of Soil Science

## **INTRODUCTION**

The prevalence of hydrophobic conditions in sand root zones of golf course putting greens has led to continued research and development of surfactants intended to prevent the development of localized dry spot (LDS). The objective of this research was to evaluate the efficacy of six experimental surfactants at preventing LDS in Wisconsin's climate.

## **MATERIALS AND METHODS**

A USGA-specification sand putting green was constructed at the O.J. Noer Research Facility in May 2006 and seeded to 'Pennncross' creeping bentgrass. The plots were 3 ft. by 6 ft. with 1 ft. borders between on all sides of each plot to minimize any off-target applications of surfactants. The plots were arrayed in a randomized complete block design with three replications. The treatments consisted of six different experimental surfactants applied and an untreated control. Surfactants were applied every four weeks beginning in late May with a final application in September, for a total of four applications.

The putting green was mowed at 0.120 inches six days per week. Irrigation was applied at 50% of estimated ET during the month of June, and at 30% of estimated ET from July through the end of the season. Turfgrass color and quality were evaluated weekly along with five volumetric soil moisture measurements of the top two inches of the root zone. The percentage of LDS in each plot was also estimated on a weekly basis. The water drop penetration test was conducted on soil cores monthly during the study. This test is used to quantify the degree of water repellency of the soil. To conduct the test, small drops of water were placed at 1 cm intervals down to a depth of 5 cm of an air dried soil core. A stopwatch was used to record the amount of time required for each drop to fully penetrate the soil core.

## **RESULTS**

Two-thousand seven was a year of weather extremes for most of the state of Wisconsin. At the O.J. Noer Center, we experienced fairly normal spring conditions where rainfall exceeded ET. However, our normal spring was followed by a minor drought in the early summer (Fig. 1). The drought conditions were relieved at the beginning of August, but the relief proved excessive as seventeen inches of rain were recorded in as many days. September and October brought some normalcy back to the region, and growing

conditions remained good for the remainder of the season. The weather provided a unique opportunity to collect data on the effect of surfactants in both very dry and very wet conditions.

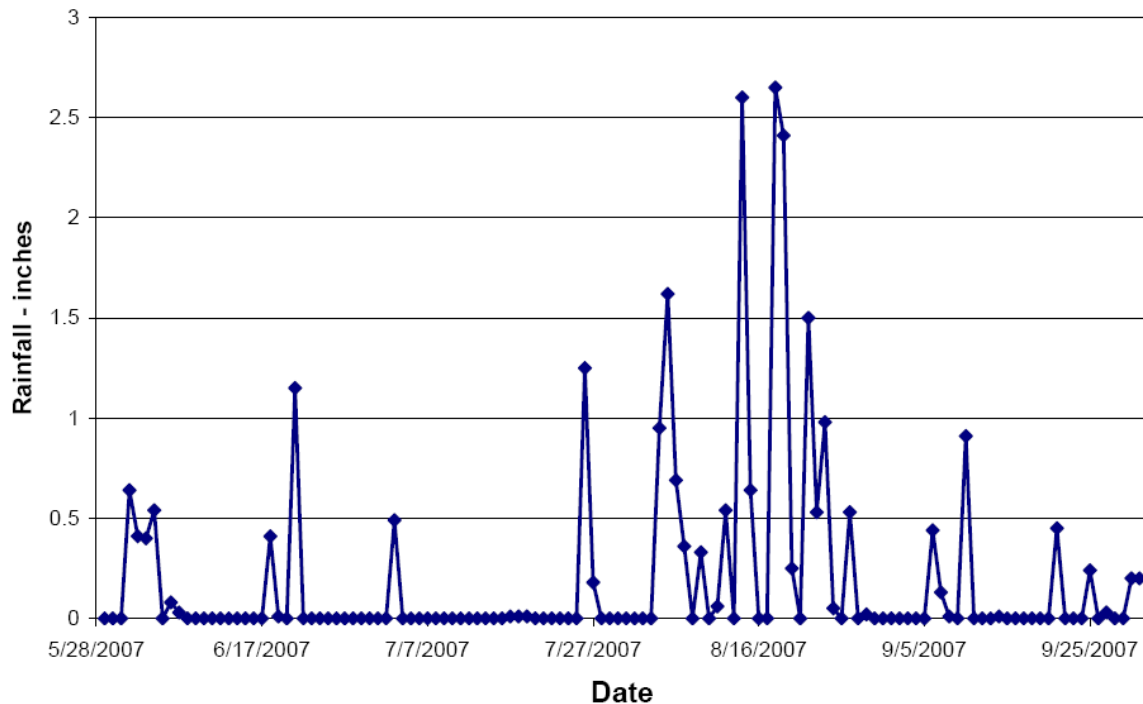


Figure 1. Precipitation at the O.J. Noer Turfgrass Research Center during the study period. The beginning of the study was very dry, followed by a very wet late summer.

The deficit irrigation program coupled with the dry early-season conditions led to the rapid development of LDS. Symptoms of LDS appeared in mid-June on all plots (Table 1), but were apparent on over 50% of the untreated plots while remaining <10% on most of the experimental plots (Table 1). There were no significant differences in percentage of plots affected by LDS among the experimental surfactants tested, however ACA 1820 and ACA 2667 showed the lowest LDS formation.

No statistical differences were observed in chlorophyll index (Table 2) or turfgrass quality (Table 3) among the surfactant treated plots. However, surfactant treated plots generally were greater on several dates for both variables than the untreated control plots. The turfgrass quality was below acceptable levels for most rating dates. This is a combination of the putting green being relatively new (1 yr) and the deficit irrigation regime. Although turfgrass quality was reduced, the amount of water saved was on between 50 and 70% of what would be normally used to keep the putting green at the highest possible quality. It is likely that the perception of acceptable turf quality will need to be lowered as watering restrictions are implemented. The picture shown in Fig. 2 was taken in late July where turf quality ratings for treated plots were around 5 and untreated plots below 2.



Figure 2. A surfactant-treated plot on the left and an untreated control on the right. A one foot border is visible between the two plots. Similar differences can be seen in the unmarked plots in the top of the picture.

Soil moisture measurements were not statistically different at any time for the surfactant treated plots. However, untreated plots had statistically lower soil volumetric water content than the treated plots on approximately one-third of the collection dates. Large portions of the root zones became hydrophobic, and were not easily re-wettable. Few significant differences in soil moisture level appeared after August 21. This was likely due to the very wet conditions in Southern Wisconsin during that time (Fig. 1).

Water drop penetration tests revealed no statistical differences existed before the trial was initiated (Table 5). However, in July (Table 6) surfactants significantly reduced time until water penetration at all depths tested (an obvious indicator of soil wettability). Trends were similar for measurements taken in August (Table 7), although reductions were not significant at all depths. In October, very few differences were evident between treated and untreated plots (Table 8). This finding could be related to the fact that surfactant applications were not made for over five weeks when cores were taken, or due to the fact that the heavy rainfall eliminated hydrophobicity in all samples.

Table 1. Percentage of plots affected by LDS on several individual rating dates in 2007. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Tukey HSD.

Treatment	June 5	June 15	July 17	July 24	July 31	Aug 8	Aug 14	Aug 21	Aug 28	Sept 12	Sept 20	Sept 26	Oct 3
ACA 1820	0 a	0 a	3.3 b	1.7 b	1.7 b	0.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b
ACA 1936	0 a	3.3 a	11.7 b	6.7 b	6.7 b	8.3 b	5.0 b	3.3 ab	1.7 a	1.7 b	1.7 a	1.7 ab	1.7 ab
ACA 1937	0 a	3.3 a	5.0 b	8.3 b	5.0 b	5.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b
ACA 1964	0 a	6.7 a	10.0 b	6.7 b	8.3 b	5.0 b	1.7 b	1.7 ab	1.7 a	1.7 b	1.7 a	0.0 b	0.0 b
ACA 2634	0 a	13.3 a	1.7 b	5.0 b	6.7 b	1.7 b	0.0 b	0.0 b	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b
ACA 2667	0 a	0.0 a	3.3 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b
Control	0 a	6.7 a	68.3 a	53.3 a	63.3 a	50.0 a	36.7 a	28.3 a	23.3 a	23.3 a	16.7 a	15.0 a	13.3 a

Table 2. Chlorophyll index (CI) readings taken with Spectrum Technologies CM1000 meter. Larger numbers represent darker green color. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Tukey HSD.

Treatment	June 12	June 19	June 26	July 10	July 17	July 24	July 31	Aug 8
ACA 1820	173.8 a	194.0 a	239.8 a	175.2 a	176.4 a	201.7 a	190.2 a	188.6 a
ACA 1936	186.9 a	204.3 a	250.5 a	167.0 a	171.7 ab	204.2 a	189.3 a	190.2 a
ACA 1937	176.8 a	197.7 a	242.9 a	179.8 a	177.1 a	200.3 a	194.1 a	193.6 a
ACA 1964	174.8 a	197.1 a	248.5 a	186.5 a	181.1 a	202.4 a	195.1 a	192.9 a
ACA 2634	180.1 a	199.0 a	240.8 a	183.1 a	178.2 a	197.9 a	192.9 a	189.7 a
ACA 2667	174.8 a	197.6 a	242.8 a	184.1 a	183.0 a	209.8 a	200.7 a	193.5 a
Control	179.7 a	201.7 a	246.3 a	197.2 a	143.6 b	145.1 b	143.0 b	150.9 b

Table 2. Cont.

Treatment	Aug 14	Aug 21	Aug 28	Sept 12	Sept 20	Sept 26	Oct 3	Avg
ACA 1820	177.1 ab	210.1 a	221.4 a	159.4 a	160.4 a	235.9 a	217.0 a	194.6 a
ACA 1936	184.4 a	217.9 a	228.7 a	171.3 a	172.7 a	250.6 a	228.9 a	201.2 a
ACA 1937	186.9 a	222.3 a	243.4 a	173.2 a	172.6 a	267.6 a	238.1 a	204.5 a
ACA 1964	187.4 a	218.4 a	234.9 a	167.7 a	167.9 a	246.9 a	225.6 a	201.8 a
ACA 2634	180.7 ab	218.4 a	230.4 a	164.9 a	168.3 a	260.5 a	245.5 a	202.0 a
ACA 2667	190.7 a	218.1 a	236.2 a	162.3 a	163.8 a	245.5 a	230.4 a	202.2 a
Control	153.4 b	186.6 b	196.7 a	166.0 a	167.6 a	231.3 a	213.2 a	180.3 a

Table 3. Turf quality ratings on a 1-9 scale where a 9 represents the highest quality turfgrass possible, a 6 represents minimally acceptable turf quality. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Tukey HSD.

Treatment	June 5	June 12	June 20	June 29	July 10	July 17	July 24	July 31
ACA 1820	5.3 a	4.0 a	5.0 a	6.0 a	3.7 a	4.8 a	4.5 a	4.7 a
ACA 1936	5.5 a	4.8 a	5.0 a	6.0 a	3.0 a	4.3 a	4.0 a	4.3 a
ACA 1937	5.2 a	4.5 a	5.2 a	6.2 a	3.3 a	4.7 a	4.7 a	4.7 a
ACA 1964	5.3 a	4.5 a	5.0 a	6.3 a	4.2 a	5.0 a	4.7 a	4.7 a
ACA 2634	5.7 a	4.5 a	5.2 a	5.8 a	3.7 a	5.0 a	4.3 a	4.5 a
ACA 2667	5.7 a	4.7 a	5.2 a	6.0 a	4.2 a	5.0 a	4.8 a	4.2 a
Control	5.7 a	4.8 a	4.5 a	6.2 a	3.2 a	2.2 b	1.8 b	2.2 b

Table 3. Continued.

Treatment	Aug 8	Aug 14	Aug 21	Aug 28	Sept 12	Sept 20	Sept 26	Oct 3	Avg
ACA 1820	5.0 a	5.2 a	4.5 ab	5.2 ab	4.8 a	4.5 a	5.3 ab	5.7 ab	4.9 a
ACA 1936	4.3 ab	4.5 a	4.7 ab	5.2 ab	4.7 a	4.7 a	5.7 a	5.8 ab	4.8 ab
ACA 1937	4.7 a	5.3 a	5.2 a	5.7 a	4.8 a	4.7 a	6.0 a	6.2 a	5.0 a
ACA 1964	5.0 a	5.0 a	4.7 ab	5.2 ab	4.7 a	4.7 a	5.8 a	5.8 ab	5.0 a
ACA 2634	5.0 a	4.2 a	4.8 ab	5.5 a	4.8 a	4.7 a	6.0 a	6.0 ab	5.0 a
ACA 2667	5.2 a	5.3 a	5.0 a	5.5 a	4.8 a	4.5 a	5.7 a	5.7 ab	5.1 a
Control	2.2 b	2.2 b	3.0 b	3.3 b	3.7 a	3.5 a	3.8 b	4.3 b	3.5 b

Table 4. Volumetric soil moisture readings throughout the 2007 season. Column means are averages of five measurements. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Tukey HSD.

Treatment	June 12	June 19	June 26	July 10	July 17	Aug 8	Aug 14	Aug 21	Sept 26	Oct 3	Avg
ACA 1820	5.0 a	12.0 a	13.3 a	3.3 a	12.5 a	12.4 a	14.0 a	13.0 a	13.3 ab	14.8 a	11.4 a
ACA 1936	5.3 a	12.1 a	13.3 a	3.0 a	12.5 a	13.3 a	14.7 a	13.1 a	15.4 a	16.1 a	11.9 a
ACA 1937	5.0 a	12.3 a	12.2 a	3.1 a	12.4 a	12.2 a	14.2 a	11.5 a	14.6 ab	15.5 a	11.3 a
ACA 1964	5.4 a	12.1 a	12.8 a	4.2 a	12.4 a	12.7 a	15.0 a	12.8 a	14.9 ab	15.2 a	11.7 a
ACA 2634	5.2 a	11.7 a	12.2 a	3.5 a	12.5 a	12.3 a	13.9 a	13.1 a	14.1 ab	15.1 a	11.4 a
ACA 2667	5.7 a	11.9 a	12.8 a	3.6 a	12.5 a	13.3 a	15.1 a	13.2 a	14.6 ab	15.5 a	11.8 a
Control	4.7 a	10.5 a	12.2 a	3.2 a	5.9 b	8.0 b	9.4 b	10.3 a	12.6 b	15.1 a	9.2 b

Table 5. Water drop penetration test results prior to the initiation of the trial. Cores were taken on May 22, 2007.

	<b>Depth of Water Droplet on Soil Core</b>					
<b>Treatment</b>	<b>0 cm</b>	<b>1 cm</b>	<b>2 cm</b>	<b>3 cm</b>	<b>4 cm</b>	<b>5 cm</b>
	Time until water drop penetration - seconds					
ACA 1820	53.8 a	28.1 a	8.1 a	7.0 a	5.9 a	3.6 a
ACA 1936	59.2 a	17.2 a	9.7 a	3.9 a	4.5 a	3.1 a
ACA 1937	44.8 a	16.7 a	6.8 a	5.0 a	5.8 a	3.8 a
ACA 1964	45.5 a	14.8 a	7.3 a	4.7 a	3.8 a	3.7 a
ACA 2634	43.8 a	19.0 a	8.0 a	13.7 a	5.3 a	3.5 a
ACA 2667	36.9 a	14.2 a	5.3 a	3.6 a	3.0 a	2.2 a
Control	44.3 a	17.2 a	5.3 a	3.4 a	3.2 a	2.3 a

Table 6. Water drop penetration test results from cores taken on July 16, 2007.

	<b>Depth of Water Droplet on Soil Core</b>					
<b>Treatment</b>	<b>0 cm</b>	<b>1 cm</b>	<b>2 cm</b>	<b>3 cm</b>	<b>4 cm</b>	<b>5 cm</b>
	Time until water drop penetration - seconds					
ACA 1820	4.3 b	4.8 b	1.3 b	2.8 b	4.8 b	3.5 b
ACA 1936	7.6 b	6.8 b	1.6 b	3.0 b	3.7 b	3.7 b
ACA 1937	6.0 b	4.6 b	1.7 b	3.2 b	4.2 b	3.9 b
ACA 1964	12.6 b	4.1 b	3.1 b	3.3 b	5.5 b	5.7 b
ACA 2634	6.4 b	24.3 b	7.7 b	6.3 b	8.6 b	7.7 b
ACA 2667	9.3 b	13.0 b	2.3 b	4.3 b	8.8 b	19.3 b
Control	102 a	562 a	554 a	589 a	600 a	600 a

Table 7. Water drop penetration test results from cores taken on August 13, 2007.

	<b>Depth of Water Droplet on Soil Core</b>					
<b>Treatment</b>	<b>0 cm</b>	<b>1 cm</b>	<b>2 cm</b>	<b>3 cm</b>	<b>4 cm</b>	<b>5 cm</b>
	Time until water drop penetration - seconds					
ACA 1820	6.8 a	2.8 b	1.3 b	2.1 a	3.4 a	1.6 b
ACA 1936	10.4 a	11.8 b	3.3 b	1.8 a	1.5 a	1.6 b
ACA 1937	7.3 a	3.1 b	1.9 b	1.8 a	1.6 a	1.3 b
ACA 1964	12.0 a	8.1 b	2.2 b	1.2 a	1.5 a	1.2 b
ACA 2634	8.2 a	7.8 b	2.5 b	1.7 a	1.4 a	1.3 b
ACA 2667	12.4 a	9.6 b	2.1 b	1.7 a	2.3 a	1.8 b
Control	17.8 a	39.9 a	16.0 a	33 a	29 a	15.6 a

Table 8. Water drop penetration test results from cores taken on October 11, 2007.

	<b>Depth of Water Droplet on Soil Core</b>					
<b>Treatment</b>	<b>0 cm</b>	<b>1 cm</b>	<b>2 cm</b>	<b>3 cm</b>	<b>4 cm</b>	<b>5 cm</b>
	Time until water drop penetration - seconds					
ACA 1820	20.9 ab	12.5 a	2.7 a	2.7 a	3.9 a	1.8 a
ACA 1936	22.6 ab	13.8 a	3.5 a	2.4 a	1.9 a	2.3 a
ACA 1937	16.8 b	8.3 a	4.6 a	3.4 a	2.5 a	2.3 a
ACA 1964	30.5 a	17.1 a	4.1 a	2.8 a	2.4 a	1.7 a
ACA 2634	26.8 ab	19.7 a	3.9 a	2.1 a	1.8 a	1.5 a
ACA 2667	29.3 a	18.8 a	5.7 a	2.9 a	2.7 a	1.8 a
Control	22.5 ab	14.3 a	16.8 a	85 a	103 a	102 a



# **Performance of Floratine Products Group Liquid Slow-release Fertilizers**

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## **INTRODUCTION**

The Floratine Products Group uses liquid organic sources of nitrogen in some of its products. Because there is little research on the effectiveness of any liquid organic N sources, let alone comparison among liquid organic sources of N, the objective of this study was to evaluate four liquid organic sources of N to determine the suitability of each for use in the golf turf market.

## **MATERIALS AND METHODS**

This research was conducted at the O.J. Noer Turfgrass Research and Education Center in Madison, WI during the 2007 growing season. Treatments were applied to an existing silt loam soil push-up putting green seeded with 'L-97' creeping bentgrass in 2002. A split-plot design with 4 replications was utilized. The treatments consisted of four experimental liquid organic nitrogen fertilizer products at rates of either 0.1 or 0.2 lbs N/M every two weeks. Primo Maxx (Trinexapac-ethyl) was also applied at 0.125 oz/M every three weeks to half of the plots. Individual plots were six feet by six feet. Visual turfgrass quality (1-9, 9 = best) ratings were taken every two weeks during the growing season. Clippings were collected at the same interval, dried and weighed to determine biomass production. A Spectrum CM-1000 was used every two weeks to assess the "greenness" of the plots via a color index. Initial treatments were made using a CO<sub>2</sub>-powered backpack sprayer in late May and continued into early October 2007. Two-inch plugs were taken in May and November and tillers were counted to determine if any of the fertilizer/primo combinations affected turfgrass density.

## **RESULTS AND DISCUSSION**

### **Effect of FPG Fertilizers on Turfgrass Quality**

Table 1 shows the turfgrass quality seasonal means for each of the products tested. FPG-6007 and 4009 at the 0.2 lbs N/M bi-weekly rate resulted in significantly higher turfgrass quality than any other treatments. Interestingly, a doubling of the N application rate for FPG-6016 and 6005 did not result in a significant increase in turfgrass quality over the course of the growing season. However, the low rate (0.1 lbs N/M) of 4009 and 6007 were not significantly better than any other treatments suggesting that 0.2 lbs N/M should be applied to maximize product efficacy.

Table 1. Effect of various liquid organic fertilizers at two rates on turfgrass quality. Turfgrass quality judged on a 1 – 9 scale where 9 is best possible quality.

Treatment	June 20	July 13	July 19	Aug 3	Aug 17	Aug 30	Sept 26	Oct 11	Average
<b>0.1 lb N/M/2wk</b>									
FPG-4009	6.50 b	5.88 b	6.88 bc	7.31 c	6.00 b	5.56 ab	6.38 bc	6.38 b	6.36 b
FPG-6005	6.81 ab	4.94 cd	6.25 d	7.06 c	6.19 b	5.75 ab	6.19 c	6.44 b	6.20 b
FPG-6007	6.88 ab	5.31 c	6.50 cd	7.13 c	6.44 b	5.94 a	6.38 bc	6.50 ab	6.38 b
FPG-6016	6.81 ab	5.25 c	6.75 c	7.13 c	6.19 b	5.81 ab	6.25 bc	6.44 b	6.32 b
<b>0.2 lb N/M/2wk</b>									
FPG-4009	6.69 ab	6.50 a	7.94 a	7.81 ab	6.50 ab	5.31 b	6.50 ab	6.50 ab	6.72 a
FPG-6005	6.88 ab	4.75 d	6.63 cd	7.31 c	6.13 b	5.75 ab	6.38 bc	6.50 ab	6.29 b
FPG-6007	7.19 a	5.94 b	7.31 b	7.94 a	7.06 a	5.94 a	6.69 a	6.63 a	6.84 a
FPG-6016	6.88 ab	4.81 d	6.63 cd	7.44 bc	6.19 b	5.75 ab	6.44 abc	6.44 b	6.33 b

### Effect of FPG Fertilizers on Clipping Production

Table 2 shows the average clippings removed from each plot in grams per day. Similar to the quality data, FPG-4009 and 6007 at the 0.2 lb N/M rate had the greatest clipping production suggesting that these products supplied the more plant available N than FPG-6016 and 6005. Doubling the amount of 6016 and 6005 did not result in a significant increase in clipping production. This suggests that these products are not providing a significant amount of plant-available N. In contrast, 4009 and 6007 showed increases in clipping production and quality with increasing N rate.

Table 2. Effect of various liquid organic fertilizers at two rates on clipping production of bentgrass (grams/plot/day).

Treatment	June 20	July 5	July 18	Aug 3	Aug 17	Aug 30	Average
<b>0.1 lb N/M/2wk</b>							
FPG-4009	1.72 ab	2.31 b	2.69 bc	2.87 b	3.96 ab	5.16 abc	2.89 ab
FPG-6005	1.59 b	2.39 b	2.27 d	2.40 c	3.39 b	5.17 abc	2.67 b
FPG-6007	1.68 ab	2.34 b	2.52 cd	2.46 c	3.91 ab	5.01 abc	2.81 ab
FPG-6016	1.60 b	2.41 ab	2.46 cd	2.48 c	3.47 b	5.20 abc	2.67 b
<b>0.2 lb N/M/2wk</b>							
FPG-4009	1.91 a	2.80 a	3.31 a	3.24 a	4.03 ab	5.50 ab	3.22 a
FPG-6005	1.72 ab	2.25 b	2.52 cd	2.54 c	3.22 b	3.66 c	2.54 b
FPG-6007	1.84 ab	2.64 ab	3.03 ab	3.07 ab	4.33 a	6.31 a	3.22 a
FPG-6016	1.80 ab	2.56 ab	2.51 cd	2.52 c	3.51 ab	4.36 bc	2.68 b

## Effect of FPG Fertilizers on Turf Color Index

Color index readings followed very similar trends to the quality and clipping production data, however, more significant differences were detected. This is likely because the instrument was more sensitive than visual ratings or clipping production. The high rate of FGP-6007 and 4009 gave significantly higher color index than 6016 and 6005 at both rates. FPG-6016 and 6005 were not statistically different from each other at any rate, again suggesting that the N in these products was not being taken up by the turfgrass. However, an unfertilized control plot would be needed to confirm this hypothesis and due to limitations in plot space a control was not included. A laboratory study was conducted to determine the mineralization rate of FPG-4009 and 6005 compared to Milorganite and urea (Fig. 1). We found that FPG-4009 mineralized at a rate similar to that of the industry standard Milorganite, while FPG-6005 did not produce any plant available N over the 12 day incubation period. This finding supports the field observations that little N from 6005 was being utilized by the plant.

Table 3. Effect of various liquid organic fertilizers at two rates on turfgrass chlorophyll index.

Treatment	June 20	July 13	July 19	Aug 3	Aug 17	Aug 30	Sept 26	Oct 11	Average
<b>0.1 lb N/M/2wk</b>									
FPG-4009	219.6 bc	228.6 bc	231.3 b	255.8 bc	244.5 b	232.5 ab	196.6 b	227.5 ab	229.5 bc
FPG-6005	217.0 c	204.0 ef	215.6 c	248.6 c	241.6 b	224.0 bc	194.5 b	223.8 b	221.1 de
FPG-6007	224.8 b	221.0 cd	220.3 c	257.3 bc	244.1 b	234.8 ab	199.0 b	226.8 ab	228.5 bcd
FPG-6016	221.6 bc	211.1 de	219.6 c	251.6 c	238.1 b	229.0 abc	196.5 b	225.9 ab	224.2 cde
<b>0.2 lb N/M/2wk</b>									
FPG-4009	222.1 bc	246.8 a	251.1 a	269.0 a	247.3 b	220.8 bc	202.0 ab	226.6 ab	235.7 ab
FPG-6005	219.3 bc	192.5 g	216.3 c	248.4 c	237.0 b	216.5 c	202.9 ab	229.6 ab	220.3 e
FPG-6007	234.3 a	234.8 b	237.1 b	267.3 ab	264.3 a	241.6 a	210.9 a	235.9 a	240.8 a
FPG-6016	220.0 bc	197.1 fg	215.6 c	250.8 c	241.4 b	223.6 bc	199.8 b	227.0 ab	221.9 de

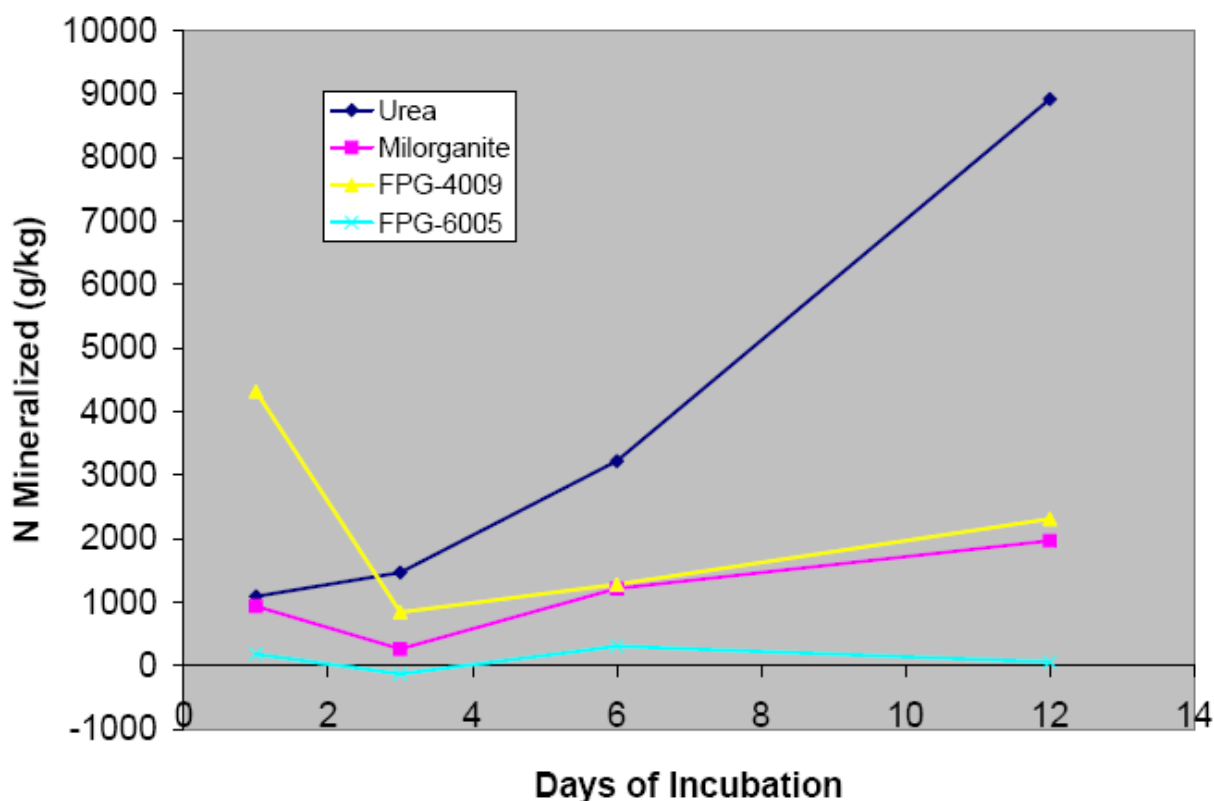


Figure 1. Mineralization rate of four organic sources of N. Equal amounts of fertilizer N were incubated at room temperature with a sand soil. Mineralization rate is a measure of how rapidly organic N is converted into plant available (mineral) forms.

### Effect of Primo on Turf Quality, Color and Clipping Production

Influence of Primo on putting green quality, color, and clipping production. It was found that Primo Maxx influenced all FPG products in the same manner; no synergistic or antagonistic effects were noted. Overall, Primo application had no significant effect on turfgrass quality over the course of the season (Table 4), although Primo decreased turf quality on July 13<sup>th</sup>, due to the incidence of slight tip burn. Primo-treated plots showed significantly greater turf quality during three individual rating dates in August. No differences in turf quality were observed in September or October, likely because the final Primo application was made in August.

Primo increased the seasonal average of color index (Table 5), and the significance on individual rating dates was nearly identical as the difference found in turfgrass quality. A negative influence of Primo on turf color index was observed on July 13<sup>th</sup>, with positive influences on all three rating dates in August, as well as an increase on October 11<sup>th</sup> despite the passage of eight weeks since the last application.

As advertised, application of Primo Maxx at labeled rates and intervals resulted in a significant reduction in turfgrass clipping production (Table 6). Over the course of the study we observed the decrease to be on the order of 30%. Individual dates decreases in clipping production ranged from 16 to 39% on all five collection dates where differences were statistically significant.

Table 4. Effect of Primo Maxx on turfgrass quality.

Treatment	June 20	July 13	July 19	Aug 3	Aug 17	Aug 30	Sept 26	Oct 11	Average
With Primo	6.84 a	4.86 b	6.75 a	7.75 a	6.58 a	6.05 a	6.42 a	6.47 a	6.46 a
Without Primo	6.81 a	5.98 a	6.97 a	7.03 b	6.09 b	5.41 b	6.38 a	6.48 a	6.39 a

Table 5. Effect of Primo Maxx on chlorophyll index.

Treatment	June 20	July 13	July 19	Aug 3	Aug 17	Aug 30	Sept 26	Oct 11	Average
With Primo	221.6 a	212.6 b	224.3 a	263.3 a	250.3 a	239.9 a	201.5 a	231.8 a	230.6 a
Without Primo	223.1 a	221.3 a	227.4 a	248.9 b	239.3 b	215.8 b	199.1 a	224.0 b	224.9 b

Table 6. Effect of Primo Maxx on clipping production.

Treatment	June 20	July 5	July 18	Aug 3	Aug 17	Aug 30	Average
With Primo	1.58 b	1.88 b	2.10 b	2.45 b	3.11 b	4.94 a	2.47 b
Without Primo	1.89 a	3.05 a	3.22 a	2.94 a	4.34 a	5.15 a	3.22 a

## CONCLUSIONS

In conclusion, a good deal of variability exists among organic N sources. Although four products were applied at equal N rate, differential effects were observed. FPG-4009 and 6007 provided increased turf quality, color, and clipping production at a rate of 0.2 lbs N/M every two weeks over FPG-6005 and 6016. Reducing the N application rate to 0.1 lbs/M every two weeks for 4009 and 6007 did not result in any significant differences from all other FPG products. Primo did not have any synergistic or antagonistic effect when used with the FPG products. Incorporating Primo Maxx into a program with the FPG products will decrease clipping production and increase turfgrass color index.

# **Evaluation of Economy and Premium Fairway Fertilizers for Innovative Hort Solutions**

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## **INTRODUCTION**

In 2007, a study was conducted at the O.J. Noer Turfgrass Research and Education Center in Madison, WI to evaluate the performance of various fertilizers on both “economy” fairways (Kentucky bluegrass/perennial ryegrass) and “premium” fairways (creeping bentgrass).

## **MATERIALS AND METHODS**

The economy fairway trial was conducted on a Batavia silt loam soil on a mixed stand of Kentucky bluegrass and perennial ryegrass mown at 1.5 inches. The premium fairway trial was conducted on a Batavia silt loam soil on a stand of creeping bentgrass mown at 0.5 inches. The treatments in both trials were arrayed in a randomized complete block design with four replications. For both economy and premium trials the fertilizers were applied to each 6 by 3 ft plot with a hand shaker at a rate of either 1 or 2 lbs N/1000 sqft on May 21, 2007. After fertilizer application, 0.15 inches of irrigation was applied to water the fertilizer into the soil. Irrigation was applied three days a week to replace 80% of evapotranspiration as estimated by a computer model. Data collected from economy and premium trials included turfgrass color (1-9 scale, 9=greenest) 1, 3, 7 days after treatment (DAT) and weekly thereafter until the end of the trial, turfgrass quality (1-9 scale, 9=best) and turfgrass injury (1-9, 9=dead) at the same frequency as turfgrass color.

## **RESULTS**

The weather during the trials was rather dry with normal temperatures. Daily data for precipitations, evapotranspiration (ET), air temperature, and soil temperature are listed in Table 9.

### **Economy Fairway Trial**

At the low rate (1 lb N/1000 sqft.) turfgrass color (Fig. 3) and quality (Fig. 1) became unacceptable (<6.0) by July 2 and July 16 respectively. The high rate afforded one more week of acceptable turfgrass color (Fig. 4) and quality (Fig 2). Ratings were collected through July 16, 2007. Turfgrass color and quality ratings of the high rate treatments tended to be greater by 0.5 to 1 rating unit than the low rate treatments. Turfgrass color and quality were highly correlated; this was as expected as turfgrass color is a major

component of turfgrass quality. No injury was noticed due to fertilization at both high and low rates.

For both high and low rates (1 and 2 lb N/1000 sqft), IHS 632416, 632414, and 632413 provided the quickest green up response. These products tended to have the highest turfgrass color and quality throughout the trial. For the low rate, 632416 fared well throughout the trial, but the response declined rapidly at the high rate. IHS 632413 and 632414 were top performers at the high fertilization rate, having a good initial response that lasted throughout the trial.

Fertilizers with a lower initial green up tended to have above-average responses later in the season. Two good examples were IHS 632418 and 632419 at both high and low rates. However, these products were very far behind the initial green up of the best performers, and only slightly higher than most others (if at all) in the late-season.

The poorest performer at the low rate was IHS 632411 with its poor initial green up and poor late-season response at both high and low rates. However, this product did fairly well at the high rate. At the high rate, IHS 632418 and 632419 were the poorest products in terms of turfgrass color and quality. At both rates IHS 632417 provided a very consistent season-long response. The initial green-up was in the middle of the pack and the late-season color and quality tended to be among the best.

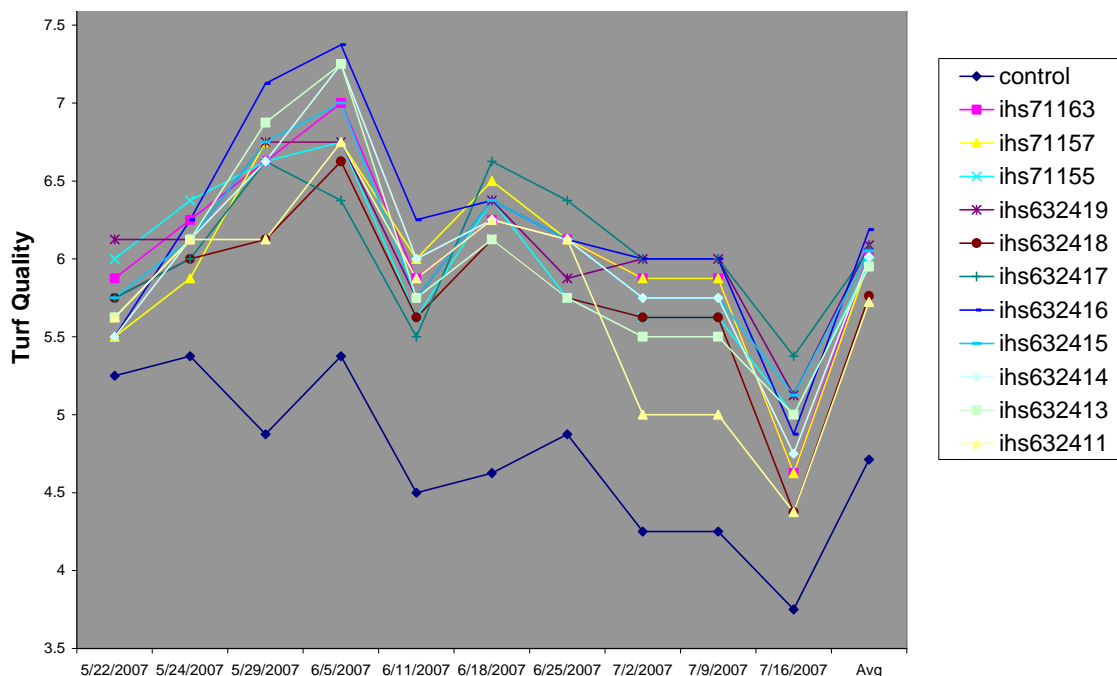


Figure 1. Turfgrass quality (1-9, 9=best) of a Kentucky bluegrass/perennial ryegrass fairway as affected by various fertilizers for 1 lb N/M applied on May 21, 2007.

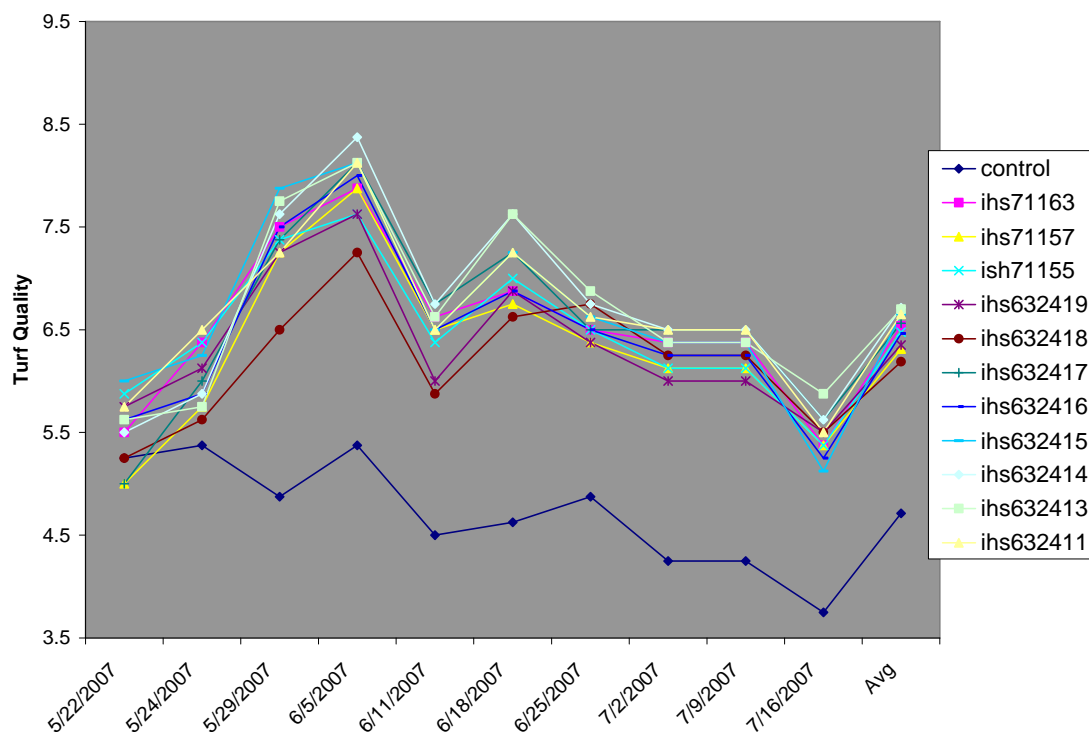


Figure 2. Turfgrass quality (1-9, 9=best) of a Kentucky bluegrass/perennial ryegrass fairway as affected by various fertilizers for 2 lb N/M applied on May 21, 2007.

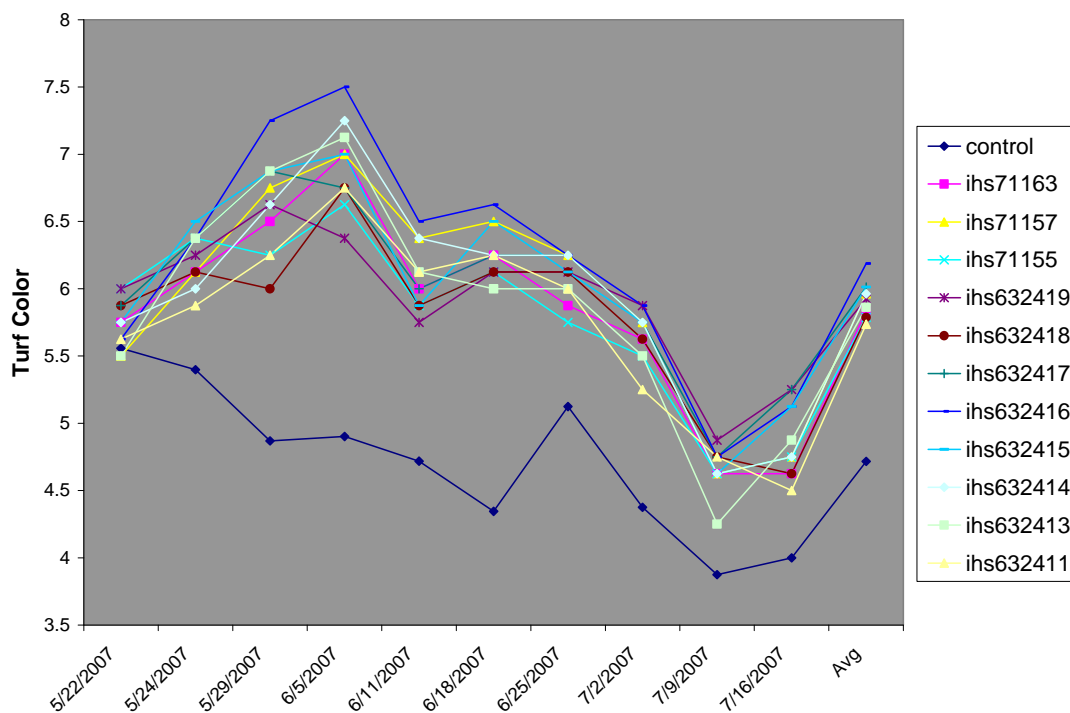


Figure 3. Turfgrass color of a Kentucky bluegrass/perennial ryegrass fairway as affected by various fertilizers (1-9, 9=greenest) for 1 lb N/M applied on May 21, 2007.



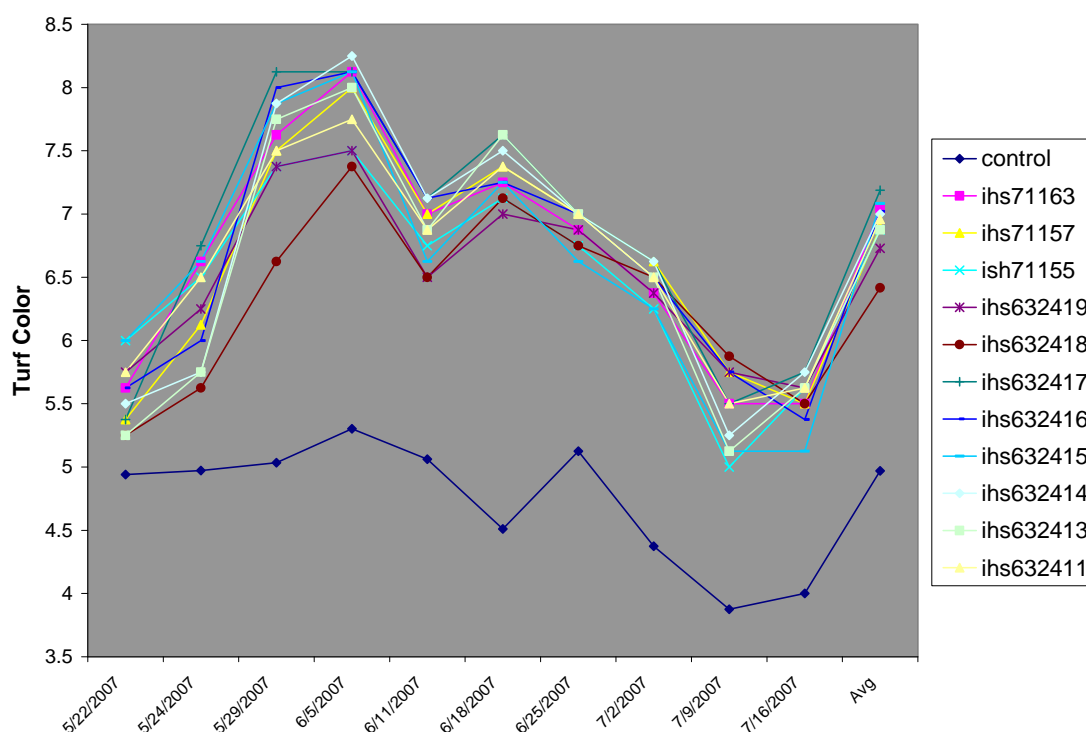


Figure 4. Turfgrass color of a Kentucky bluegrass/perennial ryegrass fairway as affected by various fertilizers (1-9, 9=greenest) for 2 lb N/M applied on May 21, 2007.

### Premium Fairway Trial

At the low rate (1 lb N/1000 sqft.) turfgrass color (Fig. 7) and quality (Fig. 5) of most treatments became unacceptable (<6.0) by July 2 and July 9 respectively. The high rate did not extend the quality (Fig. 6) or color (Fig. 8) response as occurred in the economy trial. Ratings were collected through July 9, 2007. Turfgrass color and quality ratings of the high rate treatments tended to be greater by 0.5 to 1 rating unit than the low rate treatments for most dates. Turfgrass color and quality were highly correlated; this was as expected as turfgrass color is a major component of turfgrass quality. No injury was noticed due to fertilization at both high and low rates.

At the low rate, peak green up occurred at 2 weeks for most of the treatments. Notable exceptions IHS 71153 and 71156 with a maximum green up at 3 to 4 weeks. IHS 632410 had the quickest green up and greatest average color and quality ratings at the conclusion of the trial. However, the color and quality response was limited to a 5 week period. IHS 71153 had a very good initial response and sustained acceptable color and quality throughout the trial. IHS 63248 had a mediocre green up and poor late-season response.

Trends for the high rate applications were very similar to the low rate responses, although color and quality tended to be 0.5 – 1.0 units greater. Color ratings of several treatments

peaked at 2 weeks and declined fairly rapidly, being similar to the control after 6 weeks. However, IHS 63245 displayed a rapid green up and a sustained response throughout the trial, setting it apart from the other treatments. IHS 71156 had a much delayed green up, but one of the highest late-season color and quality ratings.

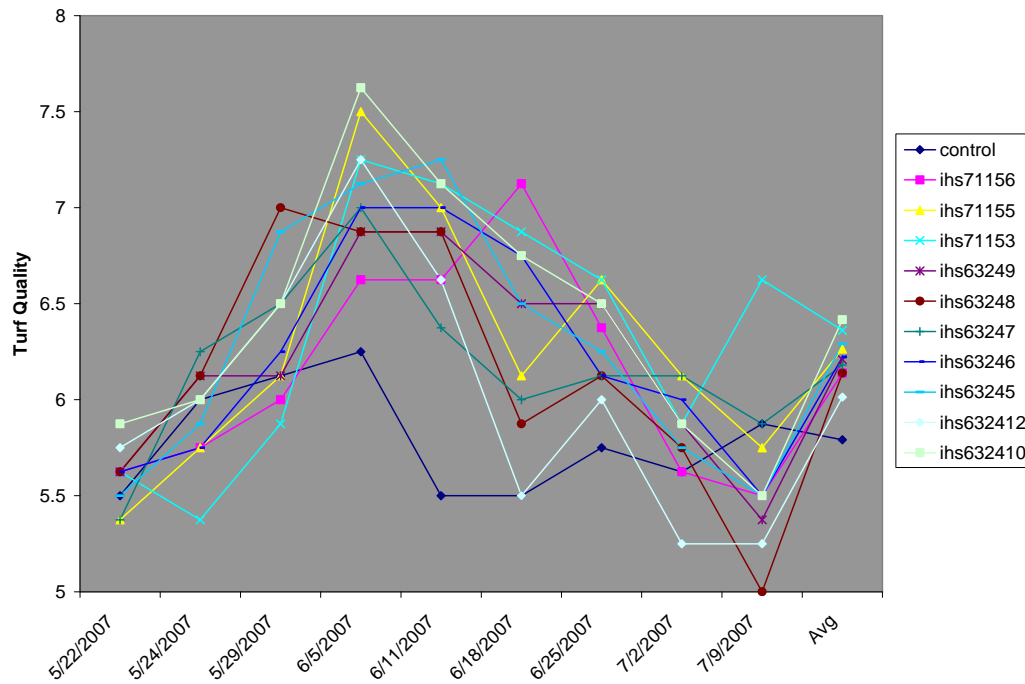


Figure 5. Turfgrass quality (1-9, 9=best) of a bentgrass fairway as affected by various fertilizers for 1 lb N/M applied on May 21, 2007.

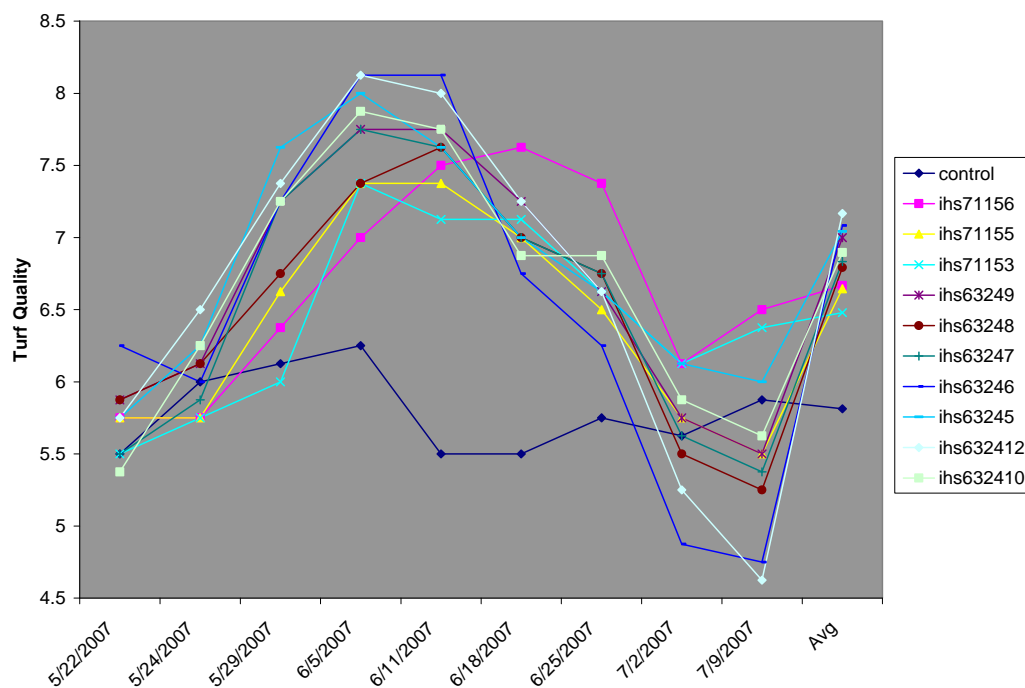


Figure 6. Turfgrass quality (1-9, 9=best) of a bentgrass fairway as affected by various fertilizers for 2 lb N/M applied on May 21, 2007.

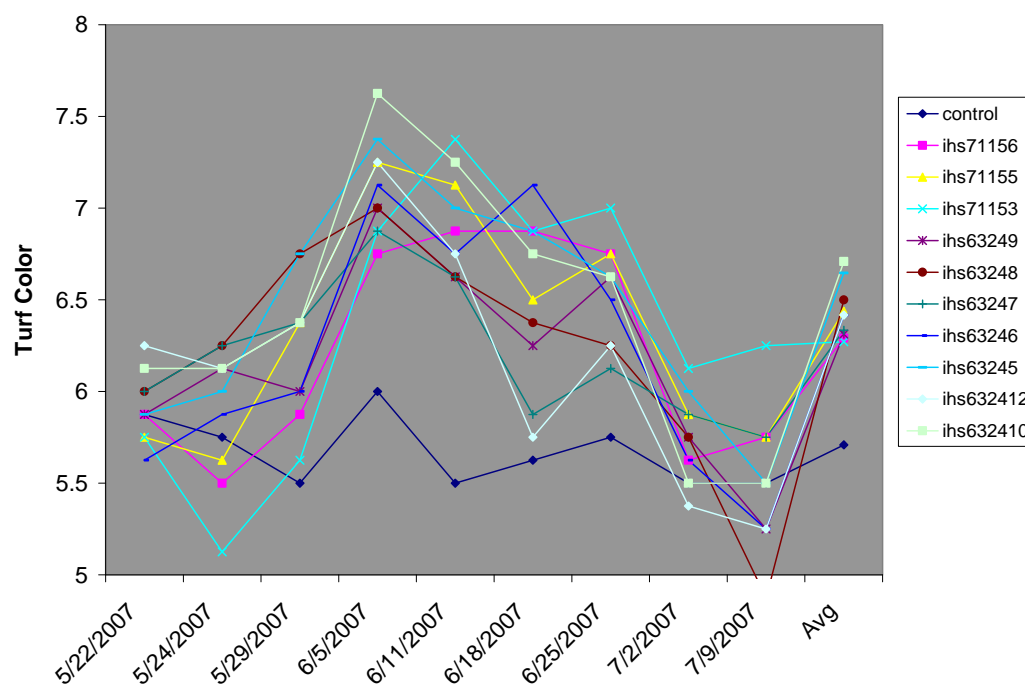


Figure 7. Turfgrass color of a bentgrass fairway as affected by various fertilizers (1-9, 9=greenest) for 1 lb N/M applied on May 21, 2007.

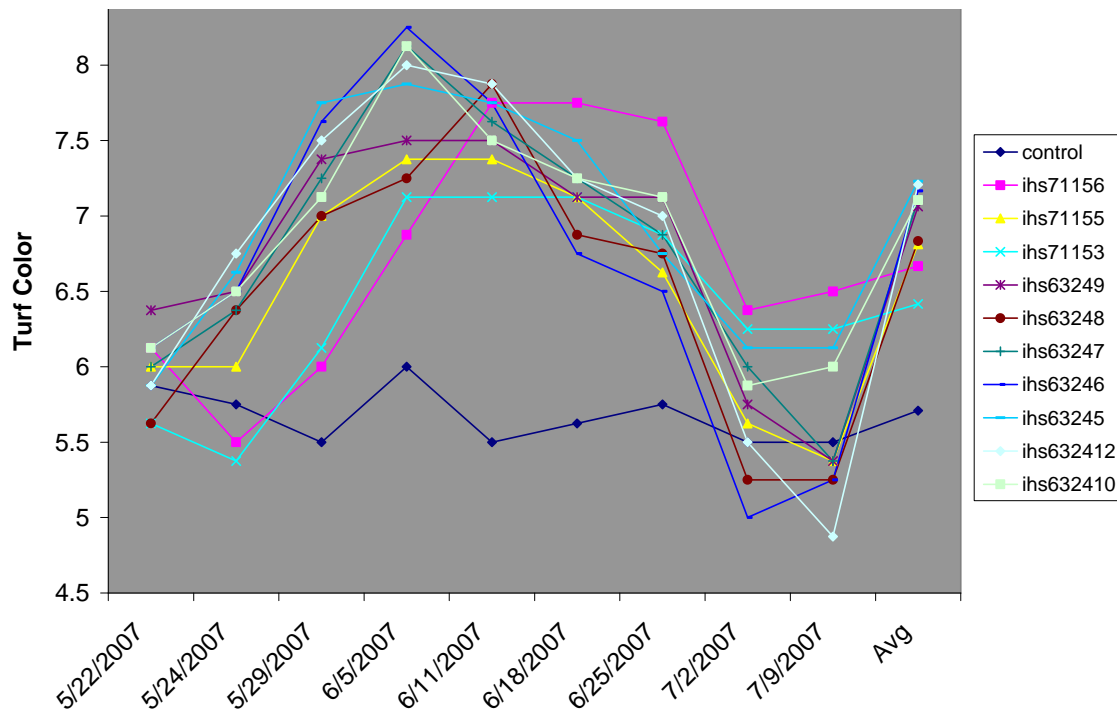


Figure 8. Turfgrass color of a bentgrass fairway as affected by various fertilizers (1-9, 9=greenest) for 1 lb N/M applied on May 21, 2007.

Table 9. 2007 weather data from the O.J. Noer Turfgrass Research and Education Center in Madison, WI.

Date	Precip	ET	Clear Sky Ratio	Air Temp			Soil Temp					
				Maximum	Minimum	Average	5cm	15 cm	5cm	15 cm	5cm	15 cm
				Maximum Minimum Average								
	inches	inches	1 = full sun	°F								
5/20/2007	0.00	0.07	0.29	60.7	43.9	50.7	60.5	60.3	56.4	56.9	58.0	58.0
5/21/2007	0.00	0.20	0.76	81.4	42.7	62.8	66.4	62.2	54.3	55.4	60.3	58.7
5/22/2007	0.00	0.18	0.66	83.3	46.2	68.0	65.3	62.2	56.5	57.7	61.4	60.1
5/23/2007	0.00	0.20	0.68	84.6	66.7	75.0	67.5	63.9	60.4	59.9	63.6	61.8
5/24/2007	0.43	0.14	0.49	83.3	48.8	68.3	67.1	63.9	61.2	61.1	64.0	62.5
5/25/2007	0.00	0.21	0.86	70.8	39.9	55.9	69.5	65.0	56.7	58.5	62.9	61.7
5/26/2007	0.06	0.07	0.25	65.2	52.4	59.0	62.9	62.2	60.1	60.4	61.5	61.0
5/27/2007	0.00	0.21	0.84	70.6	44.0	57.9	67.7	63.9	57.9	58.9	62.4	61.3
5/28/2007	0.00	0.14	0.52	75.6	40.9	62.4	65.7	62.7	56.7	58.3	61.4	60.6
5/29/2007	0.00	0.20	0.65	85.1	58.2	71.3	70.8	66.2	60.4	60.4	65.4	63.3
5/30/2007	0.00	0.17	0.55	81.8	56.0	71.1	70.3	66.3	61.6	61.9	66.1	64.3
5/31/2007	0.00	0.15	0.49	80.1	59.1	69.1	71.4	67.6	64.3	63.7	67.2	65.4
6/1/2007	0.64	0.14	0.46	77.6	52.9	65.1	70.5	67.0	62.3	62.9	66.0	64.9
6/2/2007	0.41	0.14	0.44	75.8	54.6	64.4	70.2	67.0	62.3	62.7	65.8	64.6
6/3/2007	0.40	0.18	0.60	73.2	56.6	63.1	72.5	68.6	63.9	63.9	67.5	66.1
6/4/2007	0.54	0.09	0.32	71.1	57.3	62.2	66.4	66.2	63.9	64.0	65.1	64.7
6/5/2007	0.00	0.16	0.64	65.5	44.2	55.9	66.8	64.9	61.7	62.5	64.1	63.6
6/6/2007	0.08	0.13	0.47	70.2	46.0	58.7	64.1	63.0	59.5	60.7	62.0	62.0
6/7/2007	0.03	0.17	0.50	82.2	66.7	74.2	68.3	66.1	62.1	61.9	65.5	63.9
6/8/2007	0.00	0.19	0.73	69.4	43.2	61.6	69.4	66.5	62.8	63.8	66.1	65.1
6/9/2007	0.00	0.22	0.83	76.0	40.7	60.6	71.9	67.7	59.5	61.1	65.6	64.4
6/10/2007	0.00	0.22	0.77	79.3	47.2	65.1	71.8	68.1	61.8	62.8	66.7	65.5
6/11/2007	0.00	0.24	0.80	83.5	52.6	70.1	72.7	69.1	63.1	63.8	67.9	66.5
6/12/2007	0.00	0.24	0.80	84.0	52.8	69.6	75.3	70.6	63.6	64.5	69.2	67.5
6/13/2007	0.00	0.22	0.73	86.6	51.1	71.0	75.7	71.2	63.7	64.8	69.7	68.0
6/14/2007	0.00	0.23	0.73	89.7	52.9	74.1	77.4	72.6	65.1	66.0	71.3	69.4
6/15/2007	0.00	0.22	0.68	90.9	58.0	74.4	79.1	73.9	66.9	67.5	72.8	70.7
6/16/2007	0.00	0.19	0.58	84.9	61.2	73.8	75.9	72.7	68.7	69.0	72.5	71.0
6/17/2007	0.00	0.19	0.54	87.2	60.2	74.6	76.8	72.8	67.9	68.4	72.1	70.5

Date	Precip	ET	Clear Sky Ratio	Air Temp			Soil Temp					
				Maximum	Minimum	Average	5cm	15 cm	5cm	15 cm	5cm	15 cm
				Maximum	Minimum	Average	Maximum	Maximum	Minimum	Minimum	Average	Average
	inches	inches	1 = full sun	-----°F-----								
6/18/2007	0.41	0.17	0.50	83.4	63.8	72.6	75.7	72.0	68.8	69.0	71.9	70.6
6/19/2007	0.01	0.24	0.83	74.7	50.5	65.4	75.3	71.9	67.0	68.1	70.8	69.9
6/20/2007	0.00	0.23	0.80	83.2	47.0	69.1	74.9	71.5	63.6	65.3	69.5	68.5
6/21/2007	1.15	0.11	0.35	77.4	55.7	67.9	73.0	70.6	67.3	67.5	69.7	69.0
6/22/2007	0.00	0.09	0.33	69.4	54.1	63.0	69.0	68.5	66.0	66.5	67.5	67.4
6/23/2007	0.00	0.19	0.62	74.4	56.5	65.1	72.7	70.0	64.7	65.3	68.5	67.5
6/24/2007	0.00	0.19	0.61	79.6	53.3	66.7	74.5	71.5	65.4	66.1	70.0	68.8
6/25/2007	0.00	0.21	0.63	83.2	56.2	71.2	76.2	72.9	67.2	67.7	71.7	70.3
6/26/2007	0.00	0.24	0.67	88.9	61.9	76.8	78.8	75.1	69.0	69.2	74.0	72.2
6/27/2007	0.00	0.20	0.60	82.3	63.5	74.5	77.4	74.4	71.4	71.8	74.2	73.0
6/28/2007	0.00	0.15	0.54	71.4	50.8	64.1	72.3	72.2	66.9	68.5	70.0	70.1
6/29/2007	0.00	0.21	0.81	75.7	45.8	60.9	73.0	70.3	63.8	65.7	68.2	68.0
6/30/2007	0.00	0.23	0.82	79.4	45.1	65.2	75.8	71.9	63.2	65.2	69.4	68.5
7/1/2007	0.00	0.22	0.78	76.1	56.0	65.5	75.3	71.5	65.0	66.3	69.7	68.9
7/2/2007	0.00	0.20	0.68	79.8	49.3	66.5	76.9	72.2	64.8	66.3	70.3	69.2
7/3/2007	0.49	0.11	0.33	80.6	62.4	70.0	74.7	71.4	67.5	67.9	70.5	69.6
7/4/2007	0.00	0.24	0.72	83.7	64.0	72.9	79.0	75.1	69.2	69.0	73.6	71.8
7/5/2007	0.00	0.26	0.80	83.3	64.0	74.3	79.7	75.9	70.5	70.7	74.8	73.3
7/6/2007	0.00	0.25	0.82	84.8	59.0	71.9	81.1	76.9	69.5	70.3	75.0	73.5
7/7/2007	0.00	0.27	0.79	88.2	57.7	75.8	81.1	76.9	70.1	70.9	75.5	74.0
7/8/2007	0.00	0.28	0.78	90.7	71.8	80.7	82.2	78.0	72.6	72.7	77.1	75.3
7/9/2007	0.00	0.23	0.68	83.4	65.2	76.0	79.9	76.8	73.7	73.7	76.6	75.3

# **Turfgrass Response and Tolerance to Honeywell Experimental Fertilizers**

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Department of Soil Science

## **INTRODUCTION**

In 2007, two studies were conducted at the O.J. Noer Turfgrass Research and Education Center in Madison, WI. The objective of the first study was to determine the tolerance of turfgrass to various experimental ammonium sulfate fertilizers compared to industry standards on a creeping bentgrass fairway. The objective of the second study was to determine the agronomic response to fall applications of experimental fertilizers compared to industry standards.

## **MATERIALS AND METHODS**

### **Study #1: Bentgrass Tolerance to Experimental Fertilizers**

This experiment was conducted on a creeping bentgrass stand maintained under fairway conditions on a Batavia silt loam soil. The fairway was mowed at a height of 0.5 inches with clippings removed. Irrigation was applied three times per week based at 80% of estimated ET. The turf was on a preventive fungicide application schedule to minimize the chance of disease occurrence. Fertilizer treatments are listed in Tables 1-3 and were applied at both 1 and 2 lbs N/M. Plots were 3 x 7 ft. with 1 ft. borders between all plots. The twenty-four treatments were replicated three times and arrayed in a randomized complete block design. Fertilizers were applied at by hand using shaker jars in the early morning of August 30, 2007 while the grass was still wet. The fertilizer was allowed to remain on the turf leaf tissue for 48 hours after application, at which time irrigation was applied to wash the fertilizer into the soil. No rainfall occurred during the 48 hour period when the fertilizer was on the turf leaf tissue. Data collected from this study included the percent injury of each plot at 0, 1, 3, 5, 7, 10, 14, 21, and 28 days after treatment (DAT). Turf color ratings (1-9 scale, 1=brown 9=greenest) were taken 0, 1, 5, 7 DAT and weekly thereafter. Turf quality ratings (1-9 scale, 9=highest quality) were also taken according to the same schedule as turf color. Turf density (as percent cover) was evaluated at the beginning and end of the study period.

### **Study #2 – Agronomic response to fall application of Honeywell experimental fertilizers**

This experiment was conducted on a Kentucky bluegrass stand maintained as a high quality lawn on a Batavia silt loam. The turf was mowed at 2 inches weekly and irrigated with an automated irrigation system on an as needed basis. The experimental plots were replicated three times and treatments arrayed in a randomized complete block design. The study was initiated on September 26, 2007 at which time the fertilizer treatments (listed in Tables 4-6) were applied at a rate of 2 lbs N/M using a hand shaker jar to plots measuring 8 by 3 ft. Immediately following the fertilizer application, 0.15 inches of irrigation was applied to water the fertilizer into the soil. Data collected from this study included the percent injury of each plot at 0, 1, 3, and 7 days after treatment (DAT). Turf color ratings (1-9 scale, 1=brown 9=greenest) were taken 0, 3, and 7 DAT and weekly thereafter. Turf quality ratings (1-9 scale, 9=highest quality) were also taken

according to the same schedule as turf color. Turf density (as percent cover) was evaluated at the beginning and end of the study period. Clippings were collected weekly (or biweekly when growth rate was slow). Clippings were oven dried at 60° C and weighed.

## RESULTS

### **Weather**

The weather during both of these in late August through September was fairly normative for Madison, WI despite the unusual weather experienced from June through mid-August (which was very dry, followed by very heavy and prolonged rainfall). Complete daily weather data are tabulated at the end of this report (Table 7).

### **Study #1: Bentgrass Tolerance to Experimental Fertilizers**

Greatest turfgrass injury was evident at 1 DAT with 70% “burn” on the uncoated ammonium sulfate product (HON AS) at the 2 lb application rate (Table 1). Although the burn was quite severe, it was also fairly short-lived in nature. The burn was primarily relegated to shoot tissue and the lack of crown damage resulted in minimal lasting damage less. By 21 DAT, no burn was evident on HON AS at 1 lb N/M and less than 10% for the 2 lb rate of HON AS. The fertilizers that exhibited insignificant amounts or no burn at all included HON PC AS (no burn at 4 lbs N/M either), Nutralene, and the sulfur-coated urea. The Mesa 30 and Mini Mesa 34 had intermediate levels of burn at both rates, approximately 13% at 1 lb N/M and 25% at 2 lbs N/M. The Honeywell products with the lowest burn potential were HON 72061, 72081 and 72041, while HON 72051 had the greatest injury ratings at both rates. By 7 DAT, the 72051 at the 1 lb N/M rate had injury of 5%, not statistically different from the unfertilized plot. However, at the 2 lb rate, 72051 had 17% injury at 7 DAT and 0% by 21 DAT, similar to Mesa 30.

Turfgrass quality (Table 2) and color ratings (Table 3) were obviously related to the injury ratings described above. The uncoated HON AS had the lowest turf quality following 1 and 2 lb N/M applications. Of the experimental fertilizers 72051 had the lowest turf quality ratings, while 72061 and 72081 had the highest turf quality ratings. In nearly all cases, the experimental fertilizers had statistically similar quality as the Mesa and Mini Mesa products. Density at the beginning of the study was 100% and by the conclusion, all plots had 100% density.



Table 1. Turfgrass injury ratings (% of plot affected) following application of various fertilizers at two rates on August 30, 2007.

Treatment	Aug 31	Sept 2	Sept 4	Sept 6	Sept 20	Sept 27
<b>1 lb N/M</b>	-----Percent Injury-----					
<i>Experimental Fertilizers</i>						
HON AS	60.00 b	46.67 b	30.00 b	15.00 b	0.00 b	0.00 b
HON PC AS	0.00 j	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
HON 72041	13.33 gh	3.33 fgh	5.00 f	1.67 d	0.00 b	0.00 b
HON 72051	16.67 fg	13.33 de	5.00 f	1.67 d	0.00 b	0.00 b
HON 72052	13.33 gh	13.33 de	1.67 f	0.00 d	0.00 b	0.00 b
HON 72061	8.33 hi	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
HON 72081	8.33 hi	1.67 gh	0.00 f	1.67 d	0.00 b	0.00 b
<i>Industry Standards</i>						
Mesa 30	13.33 gh	8.33 efg	8.33 def	5.00 d	0.00 b	0.00 b
Mini Mesa 34	13.33 gh	3.33 fgh	1.67 f	3.33 d	0.00 b	0.00 b
Nutralene	1.67 ij	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
Sulfur-coated urea	0.00 j	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
<b>2 lb N/M</b>						
<i>Experimental Fertilizers</i>						
HON AS	70.00 a	58.33 a	53.33 a	38.33 a	8.33 a	2.67 a
HON PC AS	0.00 j	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
HON PC AS (4 lb N/M)	0.00 j	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
HON 72041	36.67 d	20.00 cd	8.33 def	1.67 d	0.00 b	0.00 b
HON 72051	50.00 c	43.33 b	25.00 bc	16.67 b	0.00 b	0.00 b
HON 72052	36.67 d	23.33 c	15.00 de	5.00 d	0.00 b	0.00 b
HON 72061	25.00 e	18.33 cd	8.33 def	0.00 d	0.00 b	0.00 b
HON 72081	16.67 fg	10.00 ef	8.33 def	5.00 d	0.00 b	0.00 b
<i>Industry Standards</i>						
Mesa 30	26.67 e	18.33 cd	16.67 cd	13.33 bc	0.00 b	0.00 b
Mini Mesa 34	23.33 ef	18.33 cd	8.33 def	6.67 cd	0.00 b	0.00 b
Nutralene	0.00 j	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b
Sulfur-coated urea	0.00 j	5.00 fgh	6.67 ef	5.00 d	0.00 b	0.00 b
Unfertilized control	0.00 j	0.00 h	0.00 f	0.00 d	0.00 b	0.00 b

Table 2. Turfgrass quality ratings (1-9, 9=best) following application of various fertilizers at two rates on August 30, 2007.

Treatment	Aug 31	Sept 4	Sept 6	Sept 20	Sept 27
<b>1 lb N/M</b>	-----Turfgrass Quality-----				
<i>Experimental Fertilizers</i>					
HON AS	6.33 b	3.67 i	5.83 fg	7.50 abcde	7.83 ab
HON PC AS	7.00 a	7.67 a	8.00 a	6.83 cde	7.00 bcd
HON 72041	7.00 a	6.33 cde	6.50 cdefg	7.00 bcde	7.17 abc
HON 72051	7.00 a	5.33 fg	7.17 abcd	6.67 de	7.00 bcd
HON 72052	7.00 a	5.50 efg	7.33 abcd	7.33 abcde	7.17 abc
HON 72061	7.00 a	7.17 abc	7.67 ab	8.17 a	7.83 ab
HON 72081	7.00 a	7.17 abc	7.50 abc	7.33 abcde	6.67 cd
<i>Industry Standards</i>					
Mesa 30	7.00 a	6.33 cde	6.83 bcdef	6.50 e	7.33 abc
Mini Mesa 34	7.00 a	6.67 bcd	7.17 abcd	6.83 cde	7.50 abc
Nutralene	7.00 a	8.00 a	7.67 ab	7.33 abcde	7.50 abc
Sulfur-coated urea	7.00 a	8.00 a	7.50 abc	7.67 abcd	7.33 abc
<b>2 lb N/M</b>					
<i>Experimental Fertilizers</i>					
HON AS	5.83 c	2.67 j	3.67 h	5.33 f	6.17 d
HON PC AS	7.00 a	7.50 ab	7.00 abcde	7.67 abcd	7.67 ab
HON PC AS (4 lb N/M)	7.00 a	7.67 a	7.33 abcd	7.50 abcde	7.67 ab
HON 72041	7.00 a	4.83 g	6.83 bcdef	8.00 ab	8.00 a
HON 72051	7.00 a	3.83 hi	5.50 g	7.50 abcde	7.67 ab
HON 72052	7.00 a	4.67 gh	7.17 abcd	7.67 abcd	7.83 ab
HON 72061	7.00 a	5.00 g	7.33 abcd	7.83 abc	7.67 ab
HON 72081	7.00 a	6.00 def	6.33 defg	7.33 abcde	7.33 abc
<i>Industry Standards</i>					
Mesa 30	7.00 a	4.83 g	6.00 efg	6.83 cde	7.00 bcd
Mini Mesa 34	7.00 a	4.67 gh	7.00 abcde	7.67 abcd	7.33 abc
Nutralene	7.00 a	8.00 a	7.67 ab	7.50 abcde	7.67 ab
Sulfur-coated urea	7.00 a	6.50 cd	6.50 cdefg	7.17 abcde	7.17 abc
Unfertilized control	7.00 a	7.83 a	7.50 abc	7.00 bcde	7.33 abc

Table 3. Turfgrass color ratings (1-9 scale, 9=greenest) following application of various fertilizers at two rates on August 30, 2007.

Treatment	Aug 31	Sept 4	Sept 6	Sept 20	Sept 27
<b>1 lb N/M</b>	-----Turfgrass Color-----				
<i>Experimental Fertilizers</i>					
HON AS	3.67 j	5.83 gh	7.67 abc	8.00 abc	6.29 ijk
HON PC AS	7.67 ab	7.83 a	6.67 c	7.17 d	7.38 abcdef
HON 72041	6.33 def	7.33abcd	7.17 abc	7.17 d	7.00 defgh
HON 72051	5.50 fgh	7.50 abcd	6.83 bc	7.50 bcd	6.83 fghi
HON 72052	6.17 ef	7.33 abcd	6.67 c	7.50 bcd	6.92 efgh
HON 72061	7.17 abcd	7.83 ab	8.17 a	8.17 ab	7.83 a
HON 72081	7.33 abc	7.50 abcd	7.33 abc	7.33 cd	7.38 abcdef
<i>Industry Standards</i>					
Mesa 30	6.83 bcde	6.83 cdef	7.00 bc	7.50 bcd	7.04 defgh
Mini Mesa 34	6.67 cde	7.17 abcde	6.83 bc	7.83 abcd	7.13 bcdefgh
Nutralene	8.00 a	7.67 abc	7.50 abc	7.50 bcd	7.67 abc
Sulfur-coated urea	8.00 a	7.50 abcd	7.17 abc	7.50 bcd	7.54 abcd
<b>2 lb N/M</b>					
<i>Experimental Fertilizers</i>					
HON AS	3.00 j	3.67 i	7.83 ab	8.33 a	5.71 k
HON PC AS	7.50 abc	7.00 bcde	7.50 abc	8.00 abc	7.50 abcde
HON PC AS (4 lb N/M)	7.67 ab	7.33 abcd	7.83 ab	8.17 ab	7.75 a
HON 72041	4.67 hi	6.83 cdef	8.17 a	8.17 ab	6.96 defgh
HON 72051	3.83 ij	5.50 h	7.67 abc	7.83 abcd	6.21 jk
HON 72052	5.00 h	7.50 abcd	7.67 abc	8.17 ab	7.08 cdefgh
HON 72061	5.17 gh	7.17 abcde	7.83 ab	8.00 abc	7.04 defgh
HON 72081	6.00 efg	6.33 efgh	7.50 abc	7.67 abcd	6.88 fghi
<i>Industry Standards</i>					
Mesa 30	5.00 h	6.00 fgh	7.67 abc	7.50 bcd	6.54 hij
Mini Mesa 34	4.67 hi	7.33 abcd	7.50 abc	7.50 bcd	6.75 ghij
Nutralene	8.00 a	7.67 abc	7.33 abc	7.83 abcd	7.71 ab
Sulfur-coated urea	6.67 cde	6.67 defg	7.33 abc	7.50 bcd	7.04 defgh
Unfertilized control	7.83 a	7.50 abcd	6.67 c	7.33 cd	7.33 abcdefg

## Study #2: Agronomic response to fall application of Honeywell experimental fertilizers

Somewhat surprisingly, no injury was observed on any of the plots, despite the 2 lbs N/M application rate. It is likely that the cool temperatures, application to dry turf, and the watering in of the fertilizer were responsible for the lack of visual injury. Very few differences among fertilized plots were observed. Generally, all fertilizers improved turfgrass color (Table 4) and quality (Table 5) compared to the unfertilized control treatment. Clipping weights were also similar among fertilizers, which all produced significantly more clippings than the unfertilized control over the three collection dates (Table 6). This study will continue into the Spring of 2008. We look forward to determining if any differences in spring green up will be evident among the fertilized treatments.

## CONCLUSIONS

1. Coating ammonium sulfate significantly reduced the injury and duration of injury from fertilizer burn.
2. In Study #1, experimental Honeywell fertilizers performed similar to or better than Mesa 30 and Mini Mesa 34 in terms of safety (or conversely burn potential).
3. Burn from ammonium sulfate fertilizers although initially severe in some cases, was rather short-lived with minimal if any lasting damage.
4. Nutralene, sulfur-coated urea, and Honeywell PC AS have a very low burn potential, as no burn was evident at the 2 lb N/M rate on a creeping bentgrass fairway.
5. In Study #2, few agronomic differences were observed among the fertilizers tested and all fertilizers improved color, quality, and clipping production over unfertilized plots.

Table 4. Color ratings (1-9, 9=greenest) from Kentucky bluegrass plots fertilized with various fertilizers at two rates on Sept 26, 2007.

Treatment	Sept 29	Oct 3	Oct 5	Oct 11	Oct 19	Oct 26	Nov 2
	-----Turfgrass Color-----						
<i>Experimental Fertilizers</i>							
HON AS	7.13 ab	7.63 ab	8.00 a	7.50 abc	7.75 a	7.63 a	6.75 abc
HON 72041	7.50 a	7.75 a	7.88 a	7.38 abc	7.38 a	7.25 a	6.75 abc
HON 72051	7.00 ab	7.75 a	8.00 a	8.00 a	7.50 a	7.13 a	6.75 abc
HON 72052	7.38 ab	7.88 a	7.88 a	7.25 abcd	7.75 a	7.13 a	6.50 abc
HON 72052 (5/8)	7.13 ab	7.50 ab	8.00 a	7.00 cd	7.25 a	7.38 a	6.63 abc
HON 72061	6.75 b	7.75 a	7.88 a	6.88 cd	7.38 a	7.00 a	6.13 bc
HON 72081	7.13 ab	7.50 ab	7.75 a	7.13 bcd	7.38 a	7.13 a	6.88 ab
HON 72081 (5/8)	7.13 ab	7.50 ab	8.00 a	7.38 abc	7.50 a	7.63 a	7.00 ab
<i>Industry Standards</i>							
Mesa 30	7.13 ab	7.25 b	7.88 a	7.50 abc	7.63 a	7.25 a	6.88 ab
Sulfur-coated urea	7.00 ab	7.50 ab	7.88 a	7.38 abc	8.00 a	7.63 a	7.13 ab
SCU/urea blend	7.13 ab	7.75 a	8.00 a	7.88 ab	8.00 a	7.75 a	7.38 a
Unfertilized control	7.25 ab	7.50 ab	7.25 b	6.50 d	6.00 b	5.88 b	5.63 c

Table 5. Quality ratings (1-9, 9=best) from Kentucky bluegrass plots fertilized with various fertilizers at two rates on Sept 26, 2007.

Treatment	Sept 29	Oct 3	Oct 5	Oct 11	Oct 19	Oct 26	Nov 2
	-----Turfgrass Quality-----						
<i>Experimental Fertilizers</i>							
HON AS	7.13 ab	7.63 ab	8.00 a	7.50 ab	7.75 a	7.63 a	6.75 abc
HON 72041	7.50 a	7.75 a	7.88 a	7.38 abc	7.38 a	7.25 a	6.75 abc
HON 72051	7.00 ab	7.75 a	8.00 a	8.00 a	7.50 a	7.13 a	6.75 abc
HON 72052	7.38 ab	7.88 a	7.88 a	7.25 abcd	7.75 a	7.13 a	6.50 abc
HON 72052 (5/8)	7.25 ab	7.50 ab	8.00 a	7.00 cd	7.25 a	7.38 a	6.63 abc
HON 72061	6.75 b	7.75 a	7.88 a	6.88 cd	7.38 a	7.00 a	6.13 bc
HON 72081	7.13 ab	7.50 ab	7.75 a	7.13 bcd	7.38 a	7.13 a	6.88 ab
HON 72081 (5/8)	7.13 ab	7.50 ab	8.00 a	7.38 abc	7.50 a	7.63 a	7.00 ab
<i>Industry Standards</i>							
Mesa 30	7.13 ab	7.25 b	7.88 a	7.50 abc	7.63 a	7.25 a	6.88 ab
Sulfur-coated urea	7.00 ab	7.50 ab	7.88 a	7.38 abc	8.00 a	7.63 a	7.13 ab
SCU/urea blend	7.13 ab	7.75 a	8.00 a	7.88 ab	8.00 a	7.75 a	7.38 a
Unfertilized control	7.25 ab	7.50 ab	7.25 b	6.50 d	6.00 b	5.88 b	5.63 c

Table 6. Clipping weights from Kentucky bluegrass plots fertilized with various fertilizers at two rates on Sept 26, 2007.

Treatment	Oct 11	Oct 19	Nov 2	Total
	-----g/plot-----			
<i>Experimental Fertilizers</i>				
HON AS	43.0 a	25.7 bc	56.4 ab	125.1 ab
HON 72041	40.7 a	25.3 bc	57.6 ab	123.6 ab
HON 72051	43.6 a	26.9 bc	52.8 b	123.2 ab
HON 72052	46.7 a	23.9 c	55.5 ab	126.0 ab
HON 72052 (5/8)	43.3 a	25.1 bc	55.1 ab	123.5 ab
HON 72061	43.0 a	24.9 bc	53.5 b	121.4 b
HON 72081	41.0 a	26.6 bc	60.0 ab	127.6 ab
HON 72081 (5/8)	47.1 a	27.0 bc	61.3 ab	135.3 ab
<i>Industry Standards</i>				
Mesa 30	45.7 a	30.2 ab	61.6 ab	137.4 ab
Sulfur-coated urea	45.4 a	27.4 bc	62.7 ab	135.6 ab
SCU/urea blend	40.7 a	33.9 a	66.4 a	141.0 a
Unfertilized control	31.4 b	14.6 d	40.7 c	86.8 c

Table 7. 2007 Weather data for the O.J Noer Turfgrass Research and Education Center in Madison, WI.

Date	Precip	ET	Clear Sky Ratio	Air Temp			Soil Temp					
				Maximum	Minimum	Average	5cm	15 cm	5cm	15 cm	5cm	15 cm
				Maximum Maximum Minimum Minimum Average Average								
	inches	inches	1 = full sun	°F								
8/30	0	0.17		74.4	52.4	63.6	75.1	73.0	67.8	69.5	71.2	71.3
8/31	0	0.18	0.83	79.7	47.9	63.4	76.1	73.2	65.8	68.0	70.7	70.6
9/1	0	0.18	0.81	77.9	51.4	64.7	76.5	73.5	66.9	68.6	71.3	71.0
9/2	0	0.18	0.83	81.8	51.2	67.6	76.4	73.4	66.6	68.5	71.3	71.0
9/3	0	0.19	0.77	86.4	56.2	72.6	79.1	75.3	68.6	69.9	73.5	72.5
9/4	0	0.19	0.79	87.3	55.1	71.5	79.0	75.6	69.3	70.7	73.9	73.1
9/5	0	0.18	0.74	87.1	60.3	74.3	79.0	75.8	70.6	71.5	74.5	73.7
9/6	0.44	0.10	0.42	80.4	66.2	71.3	76.7	74.6	71.8	72.4	73.9	73.5
9/7	0.13	0.12	0.51	79.1	54.7	70.2	76.2	74.4	70.8	72.4	73.6	73.3
9/8	0.01	0.17	0.83	79.3	49.7	64.3	76.9	74.0	67.2	69.2	71.7	71.7
9/9	0	0.14	0.71	71.7	51.3	63.0	73.1	72.3	67.7	69.4	70.4	70.8
9/10	0.91	0.01	0.07	62.4	46.1	53.4	69.8	70.6	63.1	65.2	66.0	67.8
9/11	0	0.13	0.81	64.5	44.3	53.8	66.9	66.3	61.7	63.8	63.8	64.9
9/12	0	0.12	0.84	64.3	38.1	50.1	67.7	66.0	59.0	61.8	62.9	63.8
9/13	0	0.14	0.81	75.5	41.7	59.8	67.1	65.6	59.7	61.8	63.2	63.7
9/14	0.01	0.09	0.63	57.9	35.5	48.5	64.2	64.9	57.9	60.9	61.5	63.0
9/15	0	0.11	0.86	59.6	29.6	43.8	63.4	62.2	54.4	57.9	58.6	60.0
9/16	0	0.07	0.48	67.0	34.8	51.6	63.2	62.2	56.9	59.0	59.6	60.3
9/17	0	0.10	0.57	81.6	43.9	65.2	65.8	64.0	57.9	59.5	61.6	61.4
9/18	0	0.15	0.73	83.4	62.7	71.7	69.5	67.0	62.6	63.0	65.7	64.7
9/19	0	0.12	0.65	73.1	50.4	64.9	69.2	67.3	64.0	65.0	66.4	66.0
9/20	0	0.14	0.80	78.2	48.4	64.2	69.3	67.0	61.3	62.9	65.1	65.0
9/21	0.45	0.13	0.69	83.7	59.2	70.1	69.7	67.7	63.7	64.4	66.5	66.0
9/22	0	0.12	0.85	73.1	43.1	57.6	68.9	66.9	61.1	63.2	64.9	65.2
9/23	0	0.13	0.83	80.2	42.3	62.9	68.3	66.2	59.5	61.8	63.9	64.1
9/24	0	0.12	0.62	85.4	64.2	74.2	70.8	68.5	64.4	64.6	67.3	66.3
9/25	0.24	0.03	0.14	73.6	52.0	66.1	69.0	67.9	65.1	66.4	67.7	67.4
9/26	0	0.05	0.42	61.8	42.0	50.4	65.1	66.4	60.7	62.8	63.0	64.1
9/27	0.03	0.10	0.73	70.7	43.1	55.7	65.4	64.2	59.4	61.0	61.9	62.5
9/28	0	0.11	0.84	71.3	43.2	55.3	65.4	63.8	57.5	59.8	61.1	61.7
9/29	0	0.07	0.49	75.0	43.9	60.7	63.5	62.5	57.2	59.3	60.4	60.9
9/30	0.2	0.09	0.65	79.2	54.2	66.8	65.0	63.5	59.1	60.3	62.0	61.9

Date	Precip	ET	Clear Sky Ratio	Air Temp			Soil Temp					
				Maximum	Minimum	Average	5cm	15 cm	5cm	15 cm	5cm	15 cm
				Maximum	Minimum	Average	Maximum	Maximum	Minimum	Minimum	Average	Average
	inches	inches	1 = full sun	°F								
10/1	0.2	0.08	0.48	73.7	56.9	63.6	66.5	65.0	62.4	62.7	64.1	63.6
10/2	0.06	0.06	0.36	71.1	53.1	62.2	65.0	64.5	61.8	62.6	63.7	63.6
10/3	0.18	0.10	0.85	71.6	46.1	58.1	65.9	64.4	60.4	61.9	62.9	63.2
10/4	0.1	0.11	0.82	78.5	41.8	60.2	65.6	63.9	57.8	59.9	61.7	62.0
10/5	0.09	0.10	0.59	82.2	54.6	69.7	68.1	66.0	61.0	61.8	64.5	63.8
10/6	0.02	0.13	0.75	85.8	63.0	72.4	70.9	68.2	63.9	64.3	67.2	66.1
10/7	0	0.10	0.56	84.1	62.2	72.4	71.2	68.8	65.1	65.5	68.0	67.2
10/8	0.07	0.08	0.57	80.0	48.1	66.3	70.3	68.4	64.7	66.2	67.6	67.3
10/9	0	0.08	0.82	68.6	45.6	54.1	64.7	66.2	59.5	61.8	62.5	63.8
10/10	0	0.04	0.44	51.3	41.6	45.9	59.6	61.8	55.4	57.6	57.0	59.2
10/11	0	0.02	0.30	48.3	34.1	44.3	55.9	57.6	53.5	55.6	54.8	56.6
10/12	0	0.02	0.28	51.0	35.4	42.6	55.9	56.2	52.7	54.6	54.0	55.3
10/13	0	0.03	0.38	58.9	39.5	49.6	58.3	57.5	53.1	54.7	55.5	55.9
10/14	0.24	0.01	0.10	53.2	49.8	51.7	57.1	57.2	56.0	56.6	56.5	56.9
10/15	0.05	0.04	0.37	63.0	50.5	55.6	59.6	58.6	55.5	56.4	57.4	57.4
10/16	0.23	0.03	0.29	63.1	51.3	56.8	60.8	59.8	57.9	58.1	59.0	58.8
10/17	0.05	0.06	0.58	66.4	46.8	57.3	60.5	59.6	56.8	57.8	58.7	58.8
10/18	0.17	0.04	0.36	68.6	55.9	62.6	62.0	61.1	59.4	59.3	60.7	60.3
10/19	0.02	0.02	0.17	56.2	49.2	52.5	59.6	60.1	56.3	57.6	57.9	58.8
10/20	0.01	0.07	0.83	71.0	40.8	56.1	58.8	58.0	53.2	55.4	56.1	56.9
10/21	0.01	0.07	0.72	74.6	55.0	64.5	60.5	59.3	55.3	56.3	57.8	57.7
10/22	0.01	0.01	0.17	63.2	44.2	48.7	59.5	59.3	54.1	55.9	56.3	57.4
10/23	0	0.05	0.86	57.3	32.1	47.0	55.5	55.9	50.9	53.5	53.2	54.6
10/24	0.01	0.05	0.87	50.8	32.3	43.1	52.8	54.1	48.7	51.3	50.8	52.6
10/25	0.01	0.05	0.86	55.3	30.1	44.0	52.1	51.9	47.1	49.5	49.2	50.7
10/26	0.01	0.01	0.19	53.0	43.8	48.1	53.0	52.7	49.0	50.6	51.2	51.6
10/27	0.04	0.04	0.75	53.8	27.6	45.5	52.4	52.7	47.4	50.2	51.1	52.2
10/28	0.23	0.04	0.85	55.8	23.7	38.4	51.0	50.6	44.5	47.5	47.4	49.1
10/29	0	0.04	0.81	62.1	30.2	46.8	50.9	50.3	44.8	47.1	47.5	48.7
10/30	0	0.04	0.75	67.7	37.3	52.3	52.3	51.3	45.9	47.8	49.0	49.5
10/31	0	0.03	0.64	57.8	38.4	50.6	52.0	51.7	47.1	49.5	50.2	50.9
11/1	0	0.03	0.86	53.2	25.5	39.1	48.9	49.5	44.0	46.8	46.2	47.9
11/2	0	0.03	0.66	55.6	25.3	39.7	46.9	47.0	41.9	44.7	44.2	45.9

Date	Precip	ET	Clear Sky Ratio	Air Temp			Soil Temp					
				Maximum	Minimum	Average	5cm	15 cm	5cm	15 cm	5cm	15 cm
							Maximum	Maximum	Minimum	Minimum	Average	Average
	inches	inches	1 = full sun	°F								
11/3	0	0.03	0.81	49.9	28.1	41.0	46.5	46.5	41.9	44.2	44.0	45.4
11/4	0	0.03	0.76	52.7	29.6	41.6	47.2	46.9	43.0	45.0	44.9	45.9
11/5	0.01	0.02	0.47	48.5	32.9	42.2	45.6	46.1	42.4	44.7	44.5	45.7
11/6	0	0.01	0.46	39.9	28.4	35.6	43.1	44.7	40.9	43.2	42.0	43.7
11/7	0	0.02	0.73	39.6	16.2	30.9	42.6	43.2	37.6	40.7	40.4	42.1
11/8	0	0.02	0.69	46.6	23.5	37.7	44.6	44.2	39.5	41.7	41.9	42.9
11/9	0	0.02	0.72	44.3	22.4	34.0	43.3	43.4	39.3	41.5	41.2	42.6
11/10	0	0.01	0.48	44.1	18.2	33.3	42.0	42.3	36.9	39.8	39.7	41.2
11/11	0	0.01	0.21	53.3	41.8	47.0	46.0	45.5	41.1	42.1	43.5	43.5
11/12	0	0.03	0.73	58.0	28.0	51.5	48.5	47.6	44.4	45.5	46.9	46.6
11/13	0	0.02	0.69	54.5	20.5	39.5	44.9	46.1	39.7	42.5	42.8	44.2
11/14	0	0.02	0.57	48.6	35.3	42.8	44.2	44.6	41.9	43.5	43.0	44.0
11/15	0	0.01	0.62	37.6	17.3	31.6	42.0	43.5	37.9	40.7	40.6	42.3



# Evaluation of Five Nitrogen Sources for Putting Green Fertilization

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## INTRODUCTION

There are several potential benefits associated with the application of ammonium-dominated fertilizers.

1. Uptake of ammonium acidifies the rhizosphere (Barber, 1995) potentially increasing nutrient availability in soils with pH > 7.0.
2. When nitrate is taken up by plants, it is reduced to ammonium by an energy intensive process (Bloom et al., 1992). If ammonium is supplied as the primary N source, a significant savings in energy may occur, resulting in increased root growth and/or stress tolerance.
3. Efficiency of ammonium fertilizer applications could be increased compared to nitrate applications because ammonium is less prone to leaching losses. Furthermore, nitrate is susceptible to denitrification under wet conditions leading to greater losses of applied N. Increasing efficiency by using ammonium-based fertilizers could result in monetary savings and while protecting the environment.

Previous research on a sand-based putting green at the O.J. Noer center found that nearly all the N found in drainage water was in the nitrate form even though only ammonium or urea fertilizers were used (Soldat, 2003). These results suggest the applied ammonium and urea was rapidly converted to nitrate by microorganisms. Duisber and Buehrer (1954) found over 50% of applied ammonium was converted to nitrate in less than one week on a sandy loam soil. It is likely that the nitrification process is even more rapid in sand-based root zones.

Thus, inhibiting the nitrification process should result in measurable benefits to turfgrass grown on a sand based root zone. UMAXX® is a urea-based fertilizer containing the chemical nitrification inhibitor dicyandiamide (DD). It is hypothesized that fertilization with UMAXX® will result in increased ammonium levels in the soil, better turfgrass color, visual quality, and increased root mass due to increased N use efficiency and a higher proportion of ammonium uptake. To evaluate this hypothesis, the following field research was conducted.

## METHODS

The experiment was conducted on a predominantly 'L-93' creeping bentgrass sand-based putting green at the O.J. Noer Turfgrass Research and Education Center in Madison, WI. The putting green was mowed six days per week at a height of 0.120 inches and irrigated to replace 70% estimated evapotranspiration.

The treatments included UMAXX®, urea, ammonium sulfate, ammonium nitrate, calcium nitrate and an unfertilized control. These treatments were selected to generate a wide range of

ammonium to nitrate ratios. The treatments were arrayed in a randomized complete block design with four replications. On May 25<sup>th</sup> 0.4 lbs of N/M of each fertilizer was applied as a liquid (1 gal/M) and 0.2 lbs N/M were applied every two weeks until September 27<sup>th</sup>. A final granular application of 0.75 lbs N/M was made on October 17<sup>th</sup>. The total N applied over the course of the study was 3.05 lbs N/M. Potassium and phosphorus were not applied during the study, as soil tests indicated they were not required.

During the study clippings were collected every two weeks from all plots following visual color and quality ratings and a reading of chlorophyll index using a CM-1000 chlorophyll meter (Spectrum Technologies Inc., Plainfield, IL). Clippings were oven-dried, weighed, and stored for mineral analysis three times during the season. Ten soil cores were taken to a depth of four inches with a half-inch soil probe. These were mixed well, dried and sent to the UW Soil and Plant Analysis Laboratory where ammonium and nitrate were extracted with 2 M KCl and quantified. Root samples were also obtained in July and October from four soil cores taken using a one inch soil probe to a depth of six inches. Roots were carefully separated from the soil and root dry matter was calculated by weight loss on ignition at 500°C for three hours. All data were analyzed with the JMP statistical software package (Cary, NC). Means were separated using Student's T-test.

## RESULTS

Averaged over the entire season, turfgrass treated with UMAXX® and urea had significantly greater turfgrass quality than ammonium nitrate, ammonium sulfate, calcium nitrate and unfertilized turf. The chlorophyll indices (CI) followed the same trend with UMAXX® and urea having the highest CI (higher CI = darker green) than the other treatments which had significantly greater CI than the unfertilized control. There were no significant differences in clipping weights among the fertilized plots, however all fertilized plots had significantly more clippings than the unfertilized plots.

Figures 1, 2 and 3 show seasonal trends in CI, turfgrass quality and clipping weights, respectively. For CI, all treatments followed the same general trend of highest CI in late June and late August with a low CI value in late July (Fig. 1). This is likely due to an outbreak of localized dry spot on many of the plots during mid-July. In general the UMAXX® and urea treatments had the greatest CI. Turfgrass quality trends mimicked those seen in CI, with peaks in late June and August and low ratings in late July and late fall (Fig. 2). Again, greatest turfgrass quality was associated with UMAXX® and urea treated plots. Very few differences in clipping weights were detected among the fertilized treatments, but it is clear that fertilization increased clipping weights compared to the unfertilized control particularly during August and September (Fig. 3). This result may be attributed to the residual fertilizer applications from last season or soil organic matter being utilized in the earlier parts of the summer, which could have led to the smaller differences in clipping weights between fertilized and unfertilized plots during that time. After those sources became exhausted, greater differences in clipping weights would be expected.

Soil was sampled and analyzed for ammonium (NH<sub>4</sub>) and nitrate (NO<sub>3</sub>) three times in early summer and three times in fall. The results from fall were not available at press time. In early

summer, no significant differences in soil  $\text{NH}_4$  level were observed four and seven days after 0.4 lbs N/M application. However, 17 days after the application UMAXX® had significantly greater levels of  $\text{NH}_4$  in the soil than the unfertilized control and ammonium nitrate (Table 2). No significant differences in soil nitrate levels were observed four, seven or 17 days after the fertilizer application (Table 3). Seventeen days after application, UMAXX® had the highest level of total extractable soil N ( $\text{NH}_4 + \text{NO}_3$ ), significantly greater than the urea and unfertilized treatments (Table 4). To put these numbers in perspective, an application of 1 lb N/M of ammonium nitrate to a root zone should provide roughly 10 mg/kg  $\text{NO}_3$  and 10 mg/kg  $\text{NH}_4$ , assuming no transformations or losses (including uptake) take place. Root mass did not significantly differ among the treatments in summer or in late fall (Table 5).

Table 1. Season averages of chlorophyll index, turfgrass quality and clipping weights for various fertilizer treatments in 2007. Column means followed with similar letters are not significantly different from each other (Student's T-test).

Nitrogen Source	Chlorophyll Index -----CI units-----	Turfgrass Quality -----1-9-----	Clippings Weights -----g/plot-----
Ammonium Nitrate	237 AB	6.3 B	3.49 A
Ammonium Sulfate	236 AB	6.2 B	3.91 A
Calcium Nitrate	228 B	6.1 B	3.50 A
UMAXX®	247 A	6.8 A	3.68 A
Urea	249 A	6.8 A	3.76 A
No Fertilizer	205 C	4.8 C	2.53 B

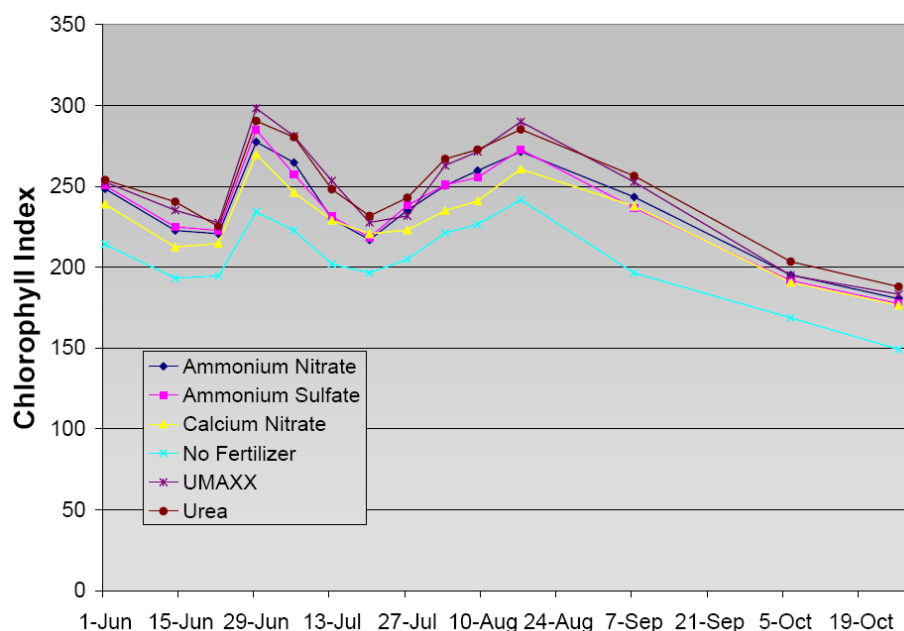


Figure 1. Chlorophyll index (CI) ratings during the season for the five fertilizers and unfertilized control. Urea and UMAXX® tended to have the greatest CI values throughout the season.

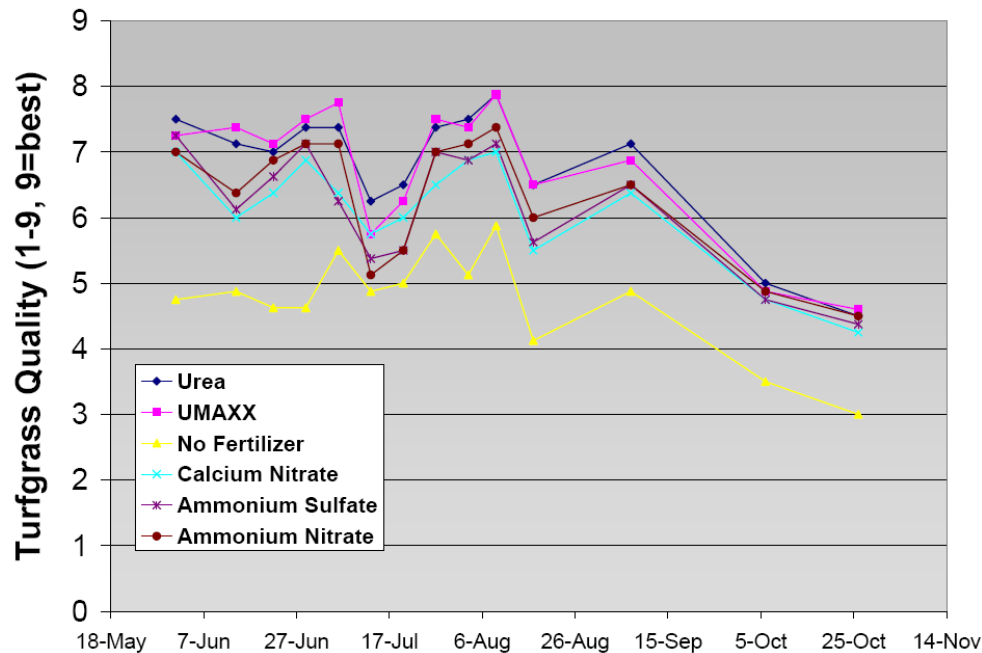


Figure 2. Seasonal trends in turfgrass quality for the five fertilizer treatments and unfertilized control. During the spring and summer, plots fertilized with UMAXX® and urea had significantly greater turfgrass quality than the other fertilizer sources and unfertilized control.

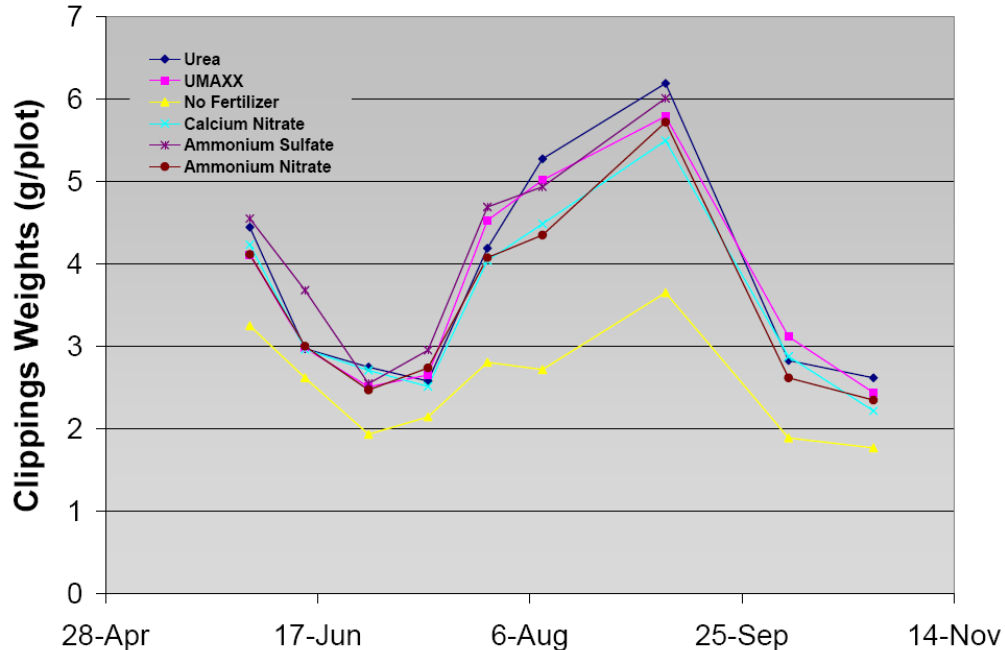


Figure 3. Clipping weights from the five fertilizer treatments and unfertilized control. No clear trends in clippings weights existed among the various fertilizers. All fertilized plots produced significantly more clippings than the unfertilized control.

Table 2. Extractable ammonium levels in soil (via 2 M KCl) 4, 7, and 17 days after a liquid fertilizer application of 0.4 lbs N/M in late spring. Column means followed with similar letters are not significantly different from each other (Student's T-test).

Nitrogen Source	May 29	June 1	June 11
	Ammonium-N concentration in soil – mg/kg		
Ammonium Nitrate	5.03 A	4.13 A	5.40 C
Ammonium Sulfate	5.15 A	4.06 A	6.09 A
Calcium Nitrate	5.43 A	3.79 A	5.83 AB
UMAXX®	5.45 A	4.30 A	6.05 A
Urea	5.60 A	4.26 A	5.71 AB
No Fertilizer	5.04 A	4.34 A	5.04 C

Table 3. Extractable nitrate levels in soil (via 2 M KCl) 4, 7, and 17 days after a liquid fertilizer application of 0.4 lbs N/M in late spring. Column means followed with similar letters are not significantly different from each other (Student's T-test).

Nitrogen Source	May 29	June 1	June 11
	Nitrate-N concentration in soil – mg/kg		
Ammonium Nitrate	0.39 A	2.28 A	2.10 A
Ammonium Sulfate	0.67 A	2.19 A	2.07 A
Calcium Nitrate	0.81 A	1.95 A	1.89 A
UMAXX®	0.78 A	2.14 A	2.26 A
Urea	0.80 A	2.62 A	1.70 A
No Fertilizer	0.90 A	2.26 A	2.12 A

Table 4. Extractable total mineral N levels in soil (via 2 M KCl) 4, 7, and 17 days after a liquid fertilizer application of 0.4 lbs N/M in late spring. Column means followed with similar letters are not significantly different from each other (Student's T-test).

Nitrogen Source	May 29	June 1	June 11
	Nitrate-N concentration in soil – mg/kg		
Ammonium Nitrate	5.42 B	6.41 A	7.50 ABC
Ammonium Sulfate	5.82 AB	6.25 A	8.16 AB
Calcium Nitrate	6.25 AB	5.75 A	7.71 ABC
UMAXX®	6.23 AB	6.44 A	8.30 A
Urea	6.40 A	6.52 A	7.41 BC
No Fertilizer	5.94 AB	6.60 A	7.16 C

Table 5. Root mass measurements from mid summer and late fall. Four samples were taken from each plot to a depth of six inches with a one inch diameter soil probe. Column means followed with similar letters are not significantly different from each other (Student's T-test).

Nitrogen Source	July 11	Nov. 8	Average
	Root mass (LOI) – g/ft <sup>3</sup>		
Ammonium Nitrate	36.1 A	16.8 A	26.5 A
Ammonium Sulfate	31.4 A	13.4 A	22.4 A
Calcium Nitrate	30.0 A	14.5 A	22.3 A
UMAXX®	32.5 A	15.0 A	23.8 A
Urea	32.0 A	20.1 A	26.0 A
No Fertilizer	29.4 A	15.5 A	22.4 A

## CONCLUSIONS

After one season of study, the two primary finding were:

1. Use of urea and UMAXX® results in improved turfgrass color and quality compared to other N sources.
2. Clipping weights and root mass were unaffected by the various N treatments.
3. Seventeen days after a 0.4 lbs N/M application, UMAXX® had the highest level of total extractable soil mineral N, significantly greater than that of urea.

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# Surfactant Application Strategies for Localized Dry Spot Management

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## INTRODUCTION

Hydrophobic conditions in sand root zones of golf course putting greens are common in Wisconsin and the Upper Midwest. Hydrophobic zones in the upper soil profile can lead to droughty conditions creating patches of moisture-stressed turfgrass, known as localized dry spot (LDS). These stressed areas are difficult to manage because hydrophobic soils are difficult to re-wet even with intensive irrigation and/or rainfall. In the Upper Midwest, surfactants are widely used on sand-based putting greens to correct or prevent the occurrence of LDS. However, little information exists with which to compare different products and application strategies such as preventive or curative. The objective of this study was to evaluate the efficacy of four surfactants for prevention and correction of hydrophobic conditions on a newly-constructed sand putting green.

## METHODS

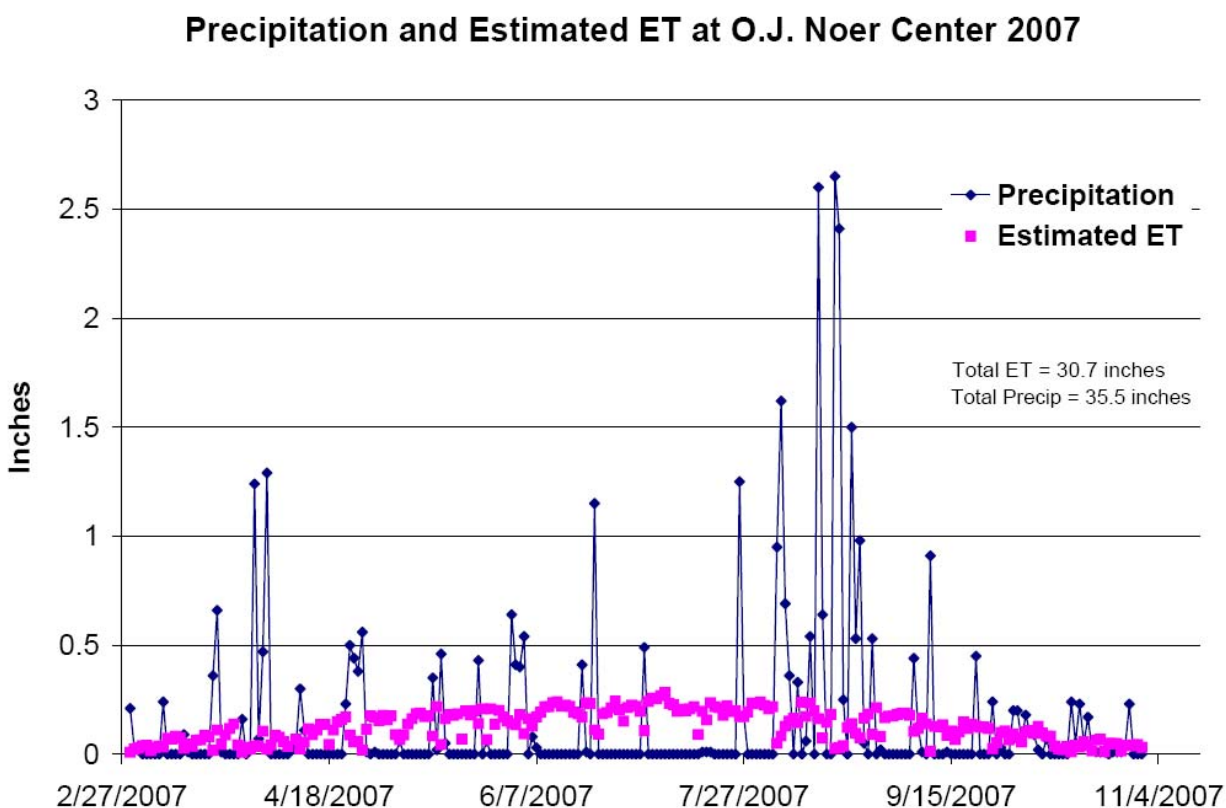
A USGA-specification sand putting green was constructed at the O.J. Noer Research Facility in May 2006 and seeded to 'Pennncross' creeping bentgrass. The plots were 6 ft. by 6 ft. and were arrayed in a completely randomized design with four replications. The treatments consisted of four different surfactants applied at either preventive or curative schedules. Preventive plots received surfactants continually through the summer, while preventive plots received surfactants only after symptoms of LDS developed. Applications were stopped when symptoms were no longer evident. Both preventive and curative applications were made following the labeled rates for the various products which included Aqueduct, Primer, Respond-2L and Revolution. Two control plots were employed. The first control was referred to as "control dry", the second control plot was watered heavily by hand every day to prevent formation of LDS and was referred to as "control wet". Preventive treatments were applied on 29 May 2007. The first symptoms of LDS appeared on 15 June 2007 at which time curative treatments were applied. Curative treatments were applied again on 17 July 2007 because LDS symptoms were still evident.

The putting green was mowed at 0.120 inches six days per week. Irrigation was applied at 50% of estimated ET during the month of June, and at 30% of estimated ET from July through the end of the season. Turfgrass color and quality were evaluated weekly along with twenty five volumetric soil moisture measurements which were made on a five by five grid pattern. The percentage of LDS in each plot was also estimated on a weekly basis. Surface temperatures were measured weekly using an infrared thermometer. The water drop penetration test was conducted on soil cores at the beginning and end of the study. This test is used to quantify the degree of water repellency of the soil. To conduct the test, small drops of water were placed at 1 cm

intervals down to a depth of 5 cm of an air dried soil core. A stopwatch was used to record the amount of time required for each drop to fully penetrate the soil core.

## RESULTS

Two-thousand seven was a year of weather extremes for most of the state of Wisconsin. At the O.J. Noer Center, we experienced fairly normal spring conditions where rainfall exceeded ET. However, our normal spring was followed by a minor drought in the early summer (Fig. 1). The drought conditions were relieved at the beginning of August, but the relief just kept coming and seventeen inches of rain were recorded in as many days. September and October brought some normalcy back to the region, and growing conditions remained good for the remainder of the season. The weather provided a unique opportunity to collect data on the effect of surfactants in both very dry and very wet conditions.



**Figure 1.** Precipitation and estimated ET for 2007 at the O.J. Noer Turfgrass Research and Education Center in Madison, WI. Conditions were very dry in early summer, and very wet in late summer.

Localized dry spots first appeared on the untreated curative plots on June 15<sup>th</sup> about two weeks after the irrigation regime of 50% estimated ET was implemented. Symptoms of LDS also



appeared on June 15<sup>th</sup> in the plots treated preventively, but were much less severe than the curative plots (Table 1). Maximum LDS symptoms appeared on July 17<sup>th</sup> for both the preventive and curative plots. The dry control plots had LDS symptoms on 50% of the plot space, while no LDS symptoms were evident in the well-watered control plots (Control Wet). This result was expected because LDS occurs only during extreme drying of the soil, and the well-watered control plots were never allowed to dry down severely as they were watered daily at or above estimated ET.

Preventive applications decreased the incidence of LDS compared to curative applications. Preventively treated plots rarely had more than 10% of the plot affected by LDS, while curative applications resulted in roughly double the LDS symptoms. Primer was the most effective product when applied curatively as LDS symptoms dropped from 17.5 to 5% in one week (Table 1). However, symptoms of LDS ranged from 10 – 20% for most products from June 15<sup>th</sup> to July 31<sup>st</sup>, demonstrating that LDS symptoms are difficult to correct even with the use of most wetting agents curatively. However, it should be noted that the irrigation schedule was not conducive to recovery from LDS, as it was maintained at 50% of estimated ET in June and 30% of estimated ET in July. Increasing the amount of irrigation applied may have resulted in quicker recovery from LDS.

During the season, four applications were made to the preventive treatments (June, July, August, September), while only two applications were made to the curative treatments (June, July). The last two preventive applications were unnecessary as conditions for LDS were unfavorable due to the long period of wet weather. However, waiting until LDS symptoms appeared before using wetting agents resulted in unacceptable declines in turfgrass quality.

Chlorophyll index (CI) measurements are a quantitative measurement of turfgrass color; a higher number represents a darker green plot. Over the course of the study, dry control plots consistently had the lowest CI while well-watered control plots consistently had the greatest CI (Table 2). Chlorophyll indices of surfactant treated plots fell between the two controls, and were not generally significantly different from each other. Turfgrass quality measurements follow the same trend as the CI measurements (Table 3).

Soil moisture measurements revealed that the lowest water content could be found on the dry control plots, and the greatest water content could be found on the well-watered plots. The surfactant treated plots generally fell between the two extremes (Table 4). However, the numbers can be misleading. A dry control plot will have hydrophobic regions with very low soil moisture levels, but also regions with very high moisture content. This is a phenomenon that results when the hydrophobic spots repel water into the hydrophilic regions. For example, if 50% of a plot is hydrophobic and we apply 0.25 inches of water, virtually none of the water will enter the hydrophobic regions, instead it will runoff or infiltrate the 50% of the plot that remains hydrophilic. So the 0.25 inch application was more like a 0.50 inch application to the hydrophilic region of the plot (see Figure 2). So while the soil moisture measurements can be useful, a perhaps more useful measure is the standard deviation of the soil moisture measurements (Table 5). Standard deviation is a measure of the amount of variation in a group, and lower values indicate less variability. Table 5 shows that the two control plots had the greatest amount of variability in moisture content. All surfactants had significantly lower standard deviations than

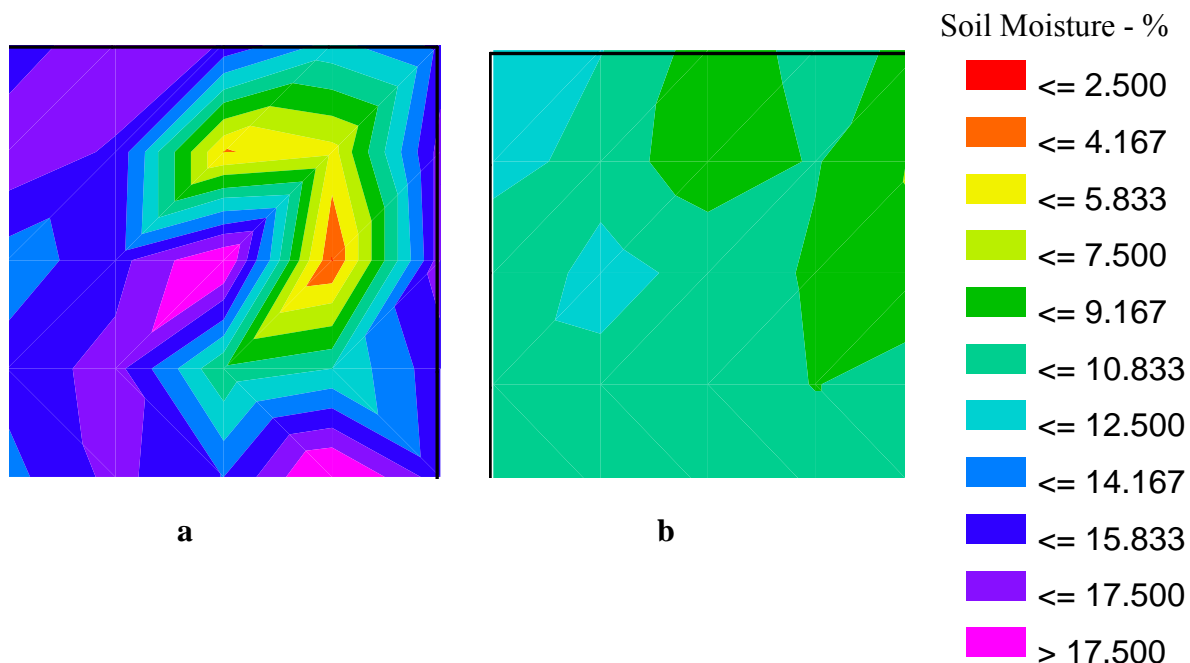
the dry control, and no statistical differences existed among the surfactants or applications strategies.

There were no significant differences in water drop penetration time before the application of the treatments (Table 6). However, at the end of the study, differences were evident (Table 6). Hydrophobicity was greater near the surface of the soil than at deeper layers. Revolution applied preventively resulted in the lowest time for water drop penetration at the air/thatch interface. However, all other treatments were statistically similar except for Primer applied curatively which had the greatest water drop penetration time. At deeper depths, no statistical differences were evident among the surfactants. However, surfactants generally reduced water drop penetration time compared to the dry control. It is interesting to note that the well-watered control was never statistically different than the surfactant treated plots.

## CONCLUSIONS

The major conclusions of this research are:

1. It is important to make applications of wetting agents before symptoms of LDS appear. Most products were unable to reduce LDS symptoms in less than a month, an unacceptable period of time. However, it is likely that the recovery time could be reduced to 10 to 14 days when wetting agents are coupled with an aggressive watering schedule. Curative treatments of Primer were the most effective, and symptoms were eliminated in 7 days but more data are required to determine if this is a “real” phenomenon or just a statistical anomaly.
2. Wetting agents are not necessary when soil moisture levels are adequate. The well-watered control plots had virtually no LDS during the season. Also, after the rains began in August, LDS symptoms never again appeared even though the irrigation regime remained at 30% of estimated ET.
3. Irrigation can be dramatically reduced through the use of wetting agents and irrigation based on ET estimates during dry periods. In this study, we found very similar turf quality between the well-watered control and surfactant-treated plots irrigated at 30-50% of estimated ET. This led to a 50-70% reduction in irrigation during the season. Without wetting agents, this irrigation regime led to unacceptable turf quality.



**Figure 2.** Soil moisture levels of (a) a dry control plot exhibiting symptoms of LDS and (b) a surfactant-treated plot with no symptoms of LDS. Note the large range of soil moisture levels in the control plot compared with the relatively constant moisture levels found in the surfactant-treated plot. Notice the relatively high soil moisture levels in the hydrophilic regions of (a) and the relatively low moisture levels in the hydrophobic regions. Compare this too the almost constant, but middle range of soil moisture levels found in (b). Both plots are 6 by 6 feet.

Table 1. Percentage of plots affected by Localized Dry Spot.

Treatment	June 5	June 15	July 17	July 24	July 31	Aug 8	Aug 14	Aug 21	Aug 28	Sept 12	Sept 20	Sept 26	Oct 3
	-----LDS Incidence - % -----												
<b>Preventive</b>													
Aqueduct	0.0 a	2.5 b	11.3 bc	7.5 b	13.8 ab	8.8 bc	3.8 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Primer	0.0 a	0.0 b	5.0 bc	2.5 b	3.8 b	5.0 bc	1.3 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Respond 2L	0.0 a	1.3 b	1.3 bc	0.0 b	0.0 b	1.3 c	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Revolution	0.0 a	3.8 b	12.5 bc	7.5 b	5.0 b	5.0 bc	1.3 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Control Wet	0.0 a	0.0 b	0.0 c	0.0 b	0.0 b	0.0 c	1.3 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
<b>Curative</b>													
Aqueduct	0.0 a	16.3 ab	12.5 bc	11.3 b	18.8 ab	7.5 bc	2.5 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Primer	0.0 a	17.5 ab	5.0 bc	2.5 b	3.8 b	2.5 c	1.3 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Respond 2L	0.0 a	22.5 a	21.3 b	16.3 b	27.5 a	16.3 ab	8.8 ab	6.3 ab	5.0 a	2.5 b	2.5 ab	1.3 b	0.0 b
Revolution	0.0 a	11.3 ab	18.8 bc	7.5 b	20.0 ab	6.3 bc	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Control Dry	0.0 a	12.5 ab	47.5 a	42.5 a	35.0 a	23.8 a	13.8 a	10.0 a	6.3 a	7.5 a	5.0 a	3.8 a	2.5 a

Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Student's T test.

Table 2. Chlorophyll index (CI) readings taken with Spectrum Technologies CM1000 meter. Larger numbers represent darker green color.

Treatment	June 19	June 26	July 10	July 17	July 24	July 31	Aug 8	Aug 14	Aug 21	Aug 28	Sept 12	Sept 20	Oct 3	Avg
	-----Chlorophyll Index-----													
<b>Preventive</b>														
Aqueduct	205 a	248 a	186 b	169 bc	199 b	185 abc	193 b	191 abc	216 ab	252 ab	161 ab	164 a	216 a	198 abc
Primer	205 a	243 ab	182 b	169 bc	207 ab	200 a	197 ab	191 abc	219 a	243 ab	165 ab	166 a	234 a	202 ab
Respond 2L	207 a	244 ab	193 ab	179 ab	214 ab	208 a	202 ab	199 ab	221 a	231 bc	164 ab	166 a	241 a	204 ab
Revolution	198 a	233 ab	177 b	169 bc	201 ab	189 abc	195 b	182 bc	215 ab	255 ab	158 b	164 a	229 a	196 abc
Control Wet	195 a	245 ab	208 a	190 a	221 a	209 a	211 a	202 a	227 a	252 ab	170 a	167 a	217 a	206 a
<b>Curative</b>														
Aqueduct	196 a	232 b	181 b	167 bc	203 ab	193 ab	204 ab	189 abc	227 a	269 a	170 a	169 a	224 a	200 abc
Primer	203 a	244 ab	186 b	175 bc	212 ab	203 a	196 ab	184 abc	223 a	260 ab	167 ab	168 a	228 a	203 ab
Respond 2L	194 a	234 ab	173 b	169 ab	196 b	173 bc	190 bc	180 cd	216 ab	203 c	167 ab	166 a	226 a	193 bc
Revolution	197 a	234 ab	189 ab	164 bc	196 b	189 abc	193 b	181 bcd	214 ab	260 ab	169 ab	165 a	223 a	198 abc
Control Dry	198 a	233 ab	177 b	157 c	165 c	167 c	177 c	163 d	202 b	248 ab	160 ab	163 a	229 a	189 c

Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Student's T test.

Table 3. Turf quality ratings on a 1-9 scale where 9 represents the highest quality turfgrass possible, 6 represents minimally acceptable turf quality.

Treatment	June 12	June 20	June 29	July 10	July 24	July 31	Aug 8	Aug 14	Aug 21	Aug 28	Sept 12	Sept 20	Oct 3	Avg
	-----Turf Quality-----													
<b>Preventive</b>														
Aqueduct	5.3 ab	5.0 a	5.5 a	3.0 bc	4.6 b	4.3 bc	4.3 bc	4.9 abc	5.4 ab	4.8 bcd	5.3 ab	4.6 bc	5.4 a	4.8 bc
Primer	5.5 a	4.8 a	5.4 ab	3.3 b	4.8 b	4.5 ab	5.0 ab	5.4 ab	5.4 ab	5.0 abc	5.4 a	4.8 ab	6.0 a	5.1 ab
Respond 2L	5.0 ab	5.0 a	5.5 a	3.1 b	4.5 bc	4.8 ab	5.0 ab	5.3 ab	5.5 ab	4.9 abcd	5.3 ab	4.6 bc	5.8 a	5.0 ab
Revolution	4.8 b	4.6 a	5.1 abc	2.9 bc	4.4 bc	4.0 bc	4.6 b	4.6 bc	5.3 ab	4.8 bcd	5.3 ab	4.5 bc	5.9 a	4.7 bc
Control Wet	4.9 ab	4.8 a	5.5 a	5.4 a	5.6 a	5.4 a	5.8 a	6.1 a	5.9 a	5.6 a	6.0 a	5.1 a	5.6 a	5.5 a
<b>Curative</b>														
Aqueduct	5.0 ab	4.4 a	5.1 abc	3.3 b	4.4 bc	3.8 bcd	4.1 bc	4.8 bc	5.3 ab	5.1 ab	5.4 a	4.9 ab	5.6 a	4.8 bc
Primer	5.3 ab	4.5 ab	5.3 abc	3.4 b	4.9 b	4.8 ab	4.8 ab	5.4 ab	5.5 ab	5.0 abc	5.3 ab	4.8 ab	5.5 a	5.0 ab
Respond 2L	4.9 ab	4 b	5.0 abc	2.1 c	3.9 cd	3.4 cd	3.4 cd	3.8 c	4.8 bc	4.1 d	4.5 b	4.6 bc	5.9 a	4.3 cd
Revolution	5.3 ab	4.3 ab	4.9 bc	3.2 b	4.4 bc	3.9 bc	4.0 bc	4.9 abc	5.3 ab	5.0 abc	5.5 a	4.9 ab	5.5 a	4.7 bc
Control Dry	4.9 ab	4.3 ab	4.8 c	2.9 bc	3.4 d	2.8 d	2.9 d	3.6 c	4.0 c	4.3 cd	4.5 b	4.3 c	5.3 a	4.1 d

Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Student's T test.

Table 4. Volumetric soil moisture readings. Column means are averages of 100 readings.

Treatment	June 5	June 12	June 19	June 26	July 10	July 17	July 24	Aug 8	Aug 14	Aug 21	Sept 26	Average
	----- Volumetric Soil Moisture Content - % -----											
<b>Preventive</b>												
Aqueduct	14.1 a	5.8 a	13.9 ab	13.3 ab	4.3 b	15.0 ab	11.9 abcd	12.9 abcd	15.4 a	15.4 abc	15.7 a	12.5 abcd
Primer	13.9 a	5.9 a	13.3 abc	13.0 ab	4.3 b	14.6 ab	12.8 abcd	12.8 bcd	14.8 abc	15.0 abc	15.3 a	12.3 abcd
Respond 2L	14.8 a	5.9 a	14.6 a	14.3 a	4.4 b	16.4 a	14.6 a	13.8 ab	15.6 a	15.9 ab	15.0 a	13.3 ab
Revolution	13.0 a	5.5 a	13.1 abc	12.7 ab	4.5 b	14.7 ab	11.3 bcd	12.0 cd	13.5 bc	14.2 bc	14.5 a	11.7 cd
Control Wet	13.7 a	5.7 a	14.1 ab	14.5 a	9.7 a	16.5 a	14.5 a	14.6 a	16.4 a	16.6 a	15.9 a	13.9 a
<b>Curative</b>												
Aqueduct	13.9 a	5.3 a	12.7 bc	12.9 ab	4.4 b	15.4 ab	12.0 abcd	12.5 bcd	14.7 abc	14.7 bc	14.9 a	12.1 bcd
Primer	14.8 a	6.1 a	13.0 abc	13.8 ab	4.3 b	15.1 ab	14.2 ab	13.3 abc	15.4 ab	15.1 abc	15.4 a	12.3 abcd
Respond 2L	14.0 a	5.3 a	12.6 bc	12.2 b	3.8 b	14.0 bc	11.2 cd	12.7 bcd	15.2 abc	14.6 bc	15.0 a	13.3 ab
Revolution	14.4 a	6.0 a	13.8 ab	13.4 ab	4.6 b	14.6 ab	13.6 abc	12.8 abcd	15.2 abc	14.9 abc	15.5 a	12.6 abcd
Control Dry	14.2 a	5.6 a	11.8 c	12.2 b	3.9 b	11.8 c	10.2 d	11.5 d	13.3 c	13.9 c	15.0 a	11.2 d

Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Student's T test.

Table 5. Seasonal standard deviations of soil moisture content. Lower standard deviations indicate more soil moisture uniformity. Twenty-five soil moisture measurements were taken from each plot from which standard deviations were calculated.

<b>Treatment</b>	<b>Standard Deviation of Soil Moisture Content</b>
<b><i>Preventive</i></b>	
Aqueduct	1.51 bc
Primer	1.34 c
Respond 2L	1.58 bc
Revolution	1.44 bc
Control Wet	1.86 ab
<b><i>Curative</i></b>	
Aqueduct	1.43 bc
Primer	1.53 bc
Respond 2L	1.65 bc
Revolution	1.55 bc
Control Dry	2.21 a

Table 6. Water drop penetration test results following the end of the trial. Cores were taken on October 13<sup>th</sup>, 2007.

	<b>Depth</b>					
<b>Treatment</b>	<b>0 cm</b>	<b>1 cm</b>	<b>2 cm</b>	<b>3 cm</b>	<b>4 cm</b>	<b>5 cm</b>
<b><i>Preventive</i></b>	Time until water drop penetration - seconds					
Aqueduct	36 abc	12 b	3 b	3 b	3 a	3 ab
Primer	31 bc	20 ab	5 b	4 b	3 a	3 ab
Respond 2L	44 abc	15 b	5 b	4 b	3 a	2 b
Revolution	14 c	6 b	2 b	2 b	2 a	2 b
Control Wet	39 abc	17 b	5 b	3 b	4 a	2 b
<b><i>Curative</i></b>						
Aqueduct	36 abc	20 ab	5 b	3 b	2 a	2 b
Primer	72 a	18 b	6 b	3 b	3 a	3 ab
Respond 2L	37 abc	16 b	6 b	5 b	3 a	3 ab
Revolution	41 abc	18 b	4 b	2 b	3 a	2 b
Control Dry	58 ab	39 a	45 a	65 a	20 a	8 a

# Fungicide Trials

# Fungicides for the Preventative Control of Anthracnose

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## OBJECTIVE

To determine the efficacy of standard fungicides for preventing anthracnose caused by the fungus *Colletotrichum cereale*.

## MATERIALS AND METHODS

The study was conducted on an annual bluegrass (*Poa annua*) and creeping bentgrass (*Agrostis stolonifera* 'Penncross') putting green maintained at a mowing height of 0.100 inches at the OJ Noer Turfgrass Research and Education Facility in Verona, WI as well as a creeping bentgrass and annual bluegrass fairway maintained at 0.5 inches at Blackhawk Country Club in Madison, WI. The individual plots measured 3 X 10 feet 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. Treatments were initiated on June 15<sup>th</sup> at the OJ Noer center and June 19<sup>th</sup> at Blackhawk CC and subsequent applications were made at 14 day intervals until the final application was made on August 16<sup>th</sup> at Blackhawk CC and August 24<sup>th</sup> at the OJ Noer center. A traffic simulator was applied to the plots at the OJ Noer center three times per week to simulate average traffic conditions on a typical golf course putting green. Visual ratings of percent anthracnose and quality were recorded and the data was subjected to an analysis of variance to determine statistical differences between treatments.

## RESULTS AND DISCUSSION

Anthracnose was slow to develop at Blackhawk CC this year, but moderate symptoms did develop after a very warm and stressful period in early August. All 14 treatments included in the study reduced anthracnose compared to the untreated control. The most severe anthracnose disease symptoms were observed on the August 16<sup>th</sup> rating date, and those treatments that contained a contact fungicide and a penetrant fungicide performed the best. Treatments 4 and 5 were the only ones to completely control all anthracnose symptoms, but 3, 7, 13, and 14 were statistically very similar. Tank mixes of propiconazole and chlorothalonil (trts 5 and 14) provided the highest quality turfgrass at Blackhawk CC on the August 16<sup>th</sup> rating date. No anthracnose symptoms developed over the course of the season at the OJ Noer Turfgrass Research and Education Facility, though significant differences in turfgrass quality were observed on both the August rating dates shown in table 2. Here treatments 4, 8, 9, and 10 provided the highest quality turfgrass under very stressful conditions throughout the entire season.



**Table 1. Percent Anthracnose from the OJ Noer Turfgrass Research Facility in Verona, WI and Blackhawk Country Club in Madison, WI in 2007.**

Treatment					Percent Anthracnose Rating Date*			
					OJ Noer		Blackhawk	
					Aug 6	Aug 20	Aug 2	Aug 16
1	Non-treated control				0	0	35a	50a
2	Insignia	0.9	OZ/M	14 days	0	0	2.5bc	26.3b
3	Trinity	1	FL OZ/M	14 days	0	0	0.5c	2.5e
4	Insignia Trinity	0.5 1	OZ/M FL OZ/M	14 days	0	0	0c	0e
5	Spectator Ultra Manicure Ultra	2 5	FL OZ/M OZ/M	14 days	0	0	0c	0e
6	Disarm Spectator Ultra	0.18 1	FL OZ/M FL OZ/M	14 days	0	0	0.8c	8.8cde
7	Disarm Manicure Ultra	0.18 3.25	FL OZ/M OZ/M	14 days	0	0	1.3bc	3e
8	Twosome	4	FL OZ/M	14 days	0	0	5bc	17.5bcd
9	Chipco 26GT	4	FL OZ/M	14 days	0	0	2bc	10cde
10	QP Ipro Plus	4	FL OZ/M	14 days	0	0	3.8bc	6.3de
11	QP Propiconazole	0.2	FL OZ/M	14 days	0	0	2.5bc	10cde
12	QP TM Flowable	0.2	FL OZ/M	14 days	0	0	7.5b	18.8bc
13	QP Propiconazole QP TM Flowable	0.2 0.2	FL OZ/M FL OZ/M	14 days	0	0	0c	1.3e
14	Banner MAXX Daconil Ultrex	1 3.5	FL OZ/M OZ/M	14 days	0	0	0c	1.3e
LSD					NS	NS	4.22	7.96
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)								

**Table 2. Quality ratings from the OJ Noer Turfgrass Research Facility in Verona, WI and Blackhawk Country Club in Madison, WI in 2007.**

Treatment					Quality Rating Date*			
					OJ Noer		Blackhawk	
					Aug 6	Aug 20	Aug 2	Aug 16
1	Non-treated control				4d	2f	4c	3.5h
2	Insignia	0.9	OZ/M	14 days	5.8bc	3.5e	6.5b	4.3gh
3	Trinity	1	FL OZ/M	14 days	6.3b	4.5d	7ab	6.5bcd
4	Insignia Trinity	0.5 1	OZ/M FL OZ/M	14 days	6b	7a	7.5ab	7b
5	Spectator Ultra Manicure Ultra	2 5	FL OZ/M OZ/M	14 days	5.3c	6b	8a	8a
6	Disarm Spectator Ultra	0.18 1	FL OZ/M FL OZ/M	14 days	5.8bc	6b	7ab	5.8c-f
7	Disarm Manicure Ultra	0.18 3.25	FL OZ/M OZ/M	14 days	6.5ab	5.3c	6.8b	6.5bcd
8	Twosome	4	FL OZ/M	14 days	7a	7a	6.5b	5.3ef
9	Chipco 26GT	4	FL OZ/M	14 days	7a	7a	6.5b	5.8c-f
10	QP Ipro Plus	4	FL OZ/M	14 days	7a	7a	6.8b	6.3b-e
11	QP Propiconazole	0.2	FL OZ/M	14 days	5.8bc	6b	7.3ab	5.5def
12	QP TM Flowable	0.2	FL OZ/M	14 days	4d	2.3f	6.5b	4.8fg
13	QP Propiconazole QP TM Flowable	0.2 0.2	FL OZ/M FL OZ/M	14 days	6b	4.8d	7ab	6.8bc
14	Banner MAXX Daconil Ultrex	1 3.5	FL OZ/M OZ/M	14 days	6b	6b	8a	7.3ab
LSD					0.48	0.44	0.66	0.81
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)								

## Control of Rhizoctonia Brown Patch

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### OBJECTIVE

To determine the efficacy of fungicides for the control of Rhizoctonia blight (brown patch) caused by the fungus *Rhizoctonia solani*.

### MATERIALS AND METHODS

The study was conducted at the O. J. Noer Turfgrass Research and Education Facility on a mixed stand of colonial bentgrass (*Agrostis capillaries* 'SR7150') and annual bluegrass (*Poa annua*) 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. All treatments were initiated on June 14<sup>th</sup> and subsequent applications were made at 7, 14, 21, or 28 day intervals until the final application was made on August 16<sup>th</sup>. Plots were not inoculated with *R. solani*, however, plots received increased irrigation (200% of estimated evapotranspiration) and biweekly applications of 0.5 lb N/1000 ft<sup>2</sup> when conditions were conducive for disease development. Percent brown patch per plot and quality (1-9, 9 being excellent and 6 acceptable) were visually assessed and the data was subjected to an analysis of variance to determine statistical differences between treatments.

### RESULTS AND DISCUSSION

Brown patch disease pressure was slow to develop this year in southern Wisconsin due to mild temperatures, virtually no rainfall, and low relative humidities. But disease pressure increased markedly in August with arrival of adequate rainfall, increased relative humidities, and warmer temperatures. The rating on August 24<sup>th</sup> immediately followed a 10 day period of moderately higher disease pressure, and best differentiated between those products that best control brown and those that do not. On this date, all treatments significantly reduced brown patch compared to the untreated control. Treatments containing only chlorothalonil at 14 day intervals performed statistically worse than the other treatments. Only treatments 3, 14, 16, 19, and 20 completely controlled brown patch on August 24<sup>th</sup>. Quality ratings mirrored percent brown patch ratings for the most part, with treatments 11 and 12 having significantly poorer quality than all other treatments.

**Table 1. Percent Brown Patch and Quality Ratings from the O. J. Noer Turfgrass Research and Education Facility in Verona, WI in 2007.**

	Treatment	Rate		Interval	Percent Brown Patch*			Quality*
					Jul 10	Aug 13	Aug 24	Aug 24
1	Non-treated control				30a	60a	61.3a	3.3d
2	Insignia	0.9	OZ/M	28 Days	2.5c	1.3d	2.5c	7ab
3	Insignia	0.5	OZ/M	21 Days	0c	3.8d	0c	7ab
4	Trinity	1	FL OZ/M	14 Days	1.3c	1.3d	2.5c	6.8ab
5	Disarm	0.18	FL OZ/M	21 Days	2.5c	3.8d	5c	6.5ab
6	Heritage	0.20	OZ/M	21 Days	1.3c	9.5cd	5c	6.5ab
7	Compass	0.10	OZ/M	21 Days	1.3c	18.8bcd	5.8c	6.5ab
8	Eagle	1.2	FL OZ/M	14 Days	11.3bc	9.3cd	2.3c	7ab
9	HM-0701	1.2	FL OZ/M	14 Days	8.8bc	2.5d	5c	6.5ab
10	Spectator Ultra	2	FL OZ/M	21 Days	17.5b	8.8cd	11.3c	5.8b
11	Manicure Ultra	3.25	OZ/M	14 Days	5c	21.3bc	40b	4.3cd
12	Manicure 6FL	3.6	FL OZ/M	14 Days	1.3c	30b	47.5b	4.3cd
13	Spectator Ultra Manicure Ultra	2 3.25	FL OZ/M OZ/M	14 Days	1.3c	10cd	18.8c	5.5bc
14	Spectator Ultra Manicure Ultra	1 1.82	FL OZ/M OZ/M	7 days	3.8c	1.3d	0c	8a
15	Disarm Spectator Ultra	0.18 1	FL OZ/M FL OZ/M	14 Days	3.8c	1.3d	4.5c	7ab
16	Disarm Manicure Ultra	0.18 1.82	FL OZ/M OZ/M	14 Days	1.3c	0d	0c	7.3ab
17	QP Iprodione	4	FL OZ/M		2.5c	1.3d	1.3c	7ab
18	Concert	5.4	FL OZ/M	21 Days	2.5c	3.8d	7.5c	6.8ab
19	Headway	1.5	FL OZ/M	21 Days	0c	2.5d	0c	7.8a
20	Tartan	2	FL OZ/M	21 Days	5c	6.3cd	0c	7.8a
<b>LSD</b>					<b>7.91</b>	<b>10.45</b>	<b>13.28</b>	<b>1.12</b>
*Means followed by same letter do not significantly differ (P=,05, Student-Newman-Keuls)								

## **Control of Sclerotinia Dollar Spot (Fairway)**

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### **OBJECTIVE**

To determine the efficacy of standard and experimental fungicides for controlling dollar spot caused by the fungus *Sclerotinia homoeocarpa*.

### **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* 'Penneagle') maintained at 0.5 inches. The individual plots measured 3 feet by 5 feet 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. All treatments were initiated May 30<sup>th</sup>, and subsequent applications were made at either 14, 21, or 28 day intervals until the final application was made on August 21<sup>st</sup>. The number of dollar spot infection centers per plot and quality (1-9, 9 being excellent and 6 acceptable) were visually assessed and the data was subjected to an analysis of variance to determine statistical differences between treatments.

### **RESULTS AND DISCUSSION**

Dollar spot disease pressure was slow to develop this year in southern Wisconsin due to mild temperatures, virtually no rainfall, and low relative humidities. But disease pressure increased markedly in August with arrival of adequate rainfall, increased relative humidities, and warmer temperatures. The rating on August 20<sup>th</sup> immediately followed a 10 day period of extremely high disease pressure, and best differentiated between those products that best control dollar spot and those that do not. On this date, all treatments with the exceptions of 4-7, 10, 15, 16, 19, 23, and 52 significantly reduced dollar spot compared to the untreated control. Treatments 2, 11, 12, 13, 14, 22, 28, and 29 displayed the most effective control of dollar spot, limiting symptom development to an average of less than ten dollar spot infection centers per plot. Treatment 29 was the only treatment on August 20<sup>th</sup> to completely control all dollar spot development. Quality ratings mirrored the dollar spot ratings, and the same treatments that limited dollar spot treatments provided acceptable turfgrass quality with the exception of treatment 22.

**Table 1. Mean number of dollar spots per treatment on a creeping bentgrass fairway plot at the OJ Noer Turfgrass Research and Education Facility in Verona, WI in 2007.**

Treatment	Rate	Interval	Rating Date*			
			July 10	July 23	Aug 6	Aug 20
1 Non-treated control			41.3b	44.3b	50.3b	84a
2 Emerald	0.13 OZ/M	21 Days	1.8d	0.5d	0.3d	6.5e-h
3 Emerald	0.18 OZ/M	28 Days	0.5d	1d	0.3d	15.5d-h
4 Trinity	1 FL OZ/M	14 Days	11.5d	12.8d	29bcd	48.3a-g
5 Trinity	1.5 FL OZ/M	21 Days	13d	7.3d	12cd	45.8a-h
6 Tartan	1.5 FL OZ/M	21 Days	18.5cd	1.3d	6.8cd	43a-h
7 Tartan	2 FL OZ/M	21 Days	15.5cd	2.8d	1.3d	50.3a-f
8 Headway	1.5 FL OZ/M	21 Days	2.5d	2.3d	2cd	17.8d-h
9 26/36	4 FL OZ/M	21 Days	10.5d	0.5d	0.3d	35.5b-h
10 3336 Plus	4 FL OZ/M	21 Days	63.8a	91.8a	82.3a	84.8a
11 3336 Plus CLEX-8	4 FL OZ/M 4 OZ/M	21 days	0.3d	0d	0d	4fgh
12 3336 Plus CLEX-8	4 FL OZ/M 2 OZ/M	21 Days	1d	0.3d	0.5d	1.3h
13 CLEX-8	4 OZ/M	21 Days	2.3d	0.5d	0d	3.5gh
14 CLEX-8	2 OZ/M	21 Days	2.3d	0d	0d	3.5gh
15 CLEX-9	1.2 OZ/M	21 Days	16cd	3d	14cd	83.3a
16 Eagle	1 FL OZ/M	14 Days	31.5bc	39.3bc	35.8bc	65abc
17 Eagle Daconil Ultrex	0.5 FL OZ/M 1.8 OZ/M	14 Days	8.5d	3d	13.5cd	20d-h
18 Eagle Daconil Ultrex	1 FL OZ/M 1.8 OZ/M	14 Days	1.5d	2d	8.3cd	26.8b-h
19 Eagle Daconil Ultrex	1 FL OZ/M 1.8 OZ/M	21 Days	44.5b	14.3d	9cd	56.3a-d
20 HM-0701	1 FL OZ/M	14 Days	13.3d	19.5d	18.8cd	31.5b-h
21 HM-0701 Daconil Ultrex	0.5 FL OZ/M 1.8 OZ/M	14 Days	2.3d	6.5d	6.5cd	31b-h
22 HM-0701 Daconil Ultrex	1 FL OZ/M 1.8 OZ/M	14 Days	1.8d	0.8d	1.5d	8.8e-h
23 HM-0701 Daconil Ultrex	1 FL OZ/M 1.8 OZ/M	21 Days	14.8cd	1.8d	4.8cd	70.8ab
24 Spectator Ultra	1 FL OZ/M	14 Days	1.3d	0.8d	1.8d	14.8d-h
25 Spectator Ultra	2 FL OZ/M	21 Days	11.8d	3.5d	1d	52a-e
26 Manicure Ultra	3.25 OZ/M	14 Days	12d	4d	22.5cd	32.8b-h
27 Manicure 6FL	3.6 FL OZ/M	14 Days	2.5d	1.5d	5cd	19.3c-h
28 Spectator Ultra Manicure Ultra	2 FL OZ/M 3.25 OZ/M	14 Days	0d	0.5d	0d	0h
29 QP Iprodione Plus	4 FL OZ/M	14 Days	0d	1.3d	0d	1h
30 Instrata	2.75 FL OZ/M	21 Days	7.5d	2.3d	4d	41.3b-h
31 Instrata	4 FL OZ/M	21 Days	3d	1.8d	0.8d	27.5b-h
32 Concert	5.4 FL OZ/M	21 Days	10.8d	0.5d	1.3d	19.3c-h
33 Banner MAXX	1.5 FL OZ/M	21 Days	4d	3.5d	4.8cd	27.8b-h
LSD			11.84	16.24	17.78	25.3
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)						

**Table 2. Quality ratings per treatment on a creeping bentgrass fairway taken from the OJ Noer Turfgrass Research and Education Facility in Verona, WI in 2007.**

Treatment		Rate		Interval	Rating Date*			
					June 29	July 10	July 23	Aug 20
1	Non-treated control				7a	5def	4.3ef	3gh
2	Emerald	0.13	OZ/M	21 Days	7a	7.5abc	7ab	6.8bc
3	Emerald	0.18	OZ/M	28 Days	7a	7.8ab	7ab	5.8cd
4	Trinity	1	FL OZ/M	14 Days	7a	5.5c-f	5.5cd	3.8e-h
5	Trinity	1.5	FL OZ/M	21 Days	7a	5.3def	6.3bc	3.5fgh
6	Tartan	1.5	FL OZ/M	21 Days	7a	5.3def	6.8abc	4.3d-g
7	Tartan	2	FL OZ/M	21 Days	7a	5def	6.8abc	4.3d-g
8	Headway	1.5	FL OZ/M	21 Days	7a	7.5abc	6.5abc	5def
9	26/36	4	FL OZ/M	21 Days	7a	6a-e	7ab	4.5d-g
10	3336 Plus	4	FL OZ/M	21 Days	5.5b	4.3ef	3.3g	3gh
11	3336 Plus	4	FL OZ/M	21 days	7a	7.3abc	7ab	7.8b
	CLEX-8	4	OZ/M					
12	3336 Plus	4	FL OZ/M	21 Days	7a	7.5abc	6.8abc	7.5b
	CLEX-8	2	OZ/M					
13	CLEX-8	4	OZ/M	21 Days	7a	7.5abc	7ab	7.3b
14	CLEX-8	2	OZ/M	21 Days	7a	7.5abc	7ab	6.8bc
15	CLEX-9	1.2	OZ/M	21 Days	7a	6a-e	6.8abc	3gh
16	Eagle	1	FL OZ/M	14 Days	7a	4.8def	3.5fg	3.5fgh
17	Eagle	0.5	FL OZ/M	14 Days	7a	6.8a-d	6.3bc	5.8cd
	Daconil Ultrex	1.8	OZ/M					
18	Eagle	1	FL OZ/M	14 Days	7a	7.5abc	6.3bc	5def
	Daconil Ultrex	1.8	OZ/M					
19	Eagle	1	FL OZ/M	21 Days	7a	4.3ef	4.8de	2.3h
	Daconil Ultrex	1.8	OZ/M					
20	HM-0701	1	FL OZ/M	14 Days	7a	5.8b-f	6.3bc	4.3d-g
21	HM-0701	0.5	FL OZ/M	14 Days	7a	6.8a-d	6.3bc	4.8d-g
	Daconil Ultrex	1.8	OZ/M					
22	HM-0701	1	FL OZ/M	14 Days	7a	7.5abc	6.8abc	5.5cde
	Daconil Ultrex	1.8	OZ/M					
23	HM-0701	1	FL OZ/M	21 Days	7a	5.8b-f	6.5abc	3.5fgh
	Daconil Ultrex	1.8	OZ/M					
24	Spectator Ultra	1	FL OZ/M	14 Days	7a	7.8ab	6.5abc	5.5cde
25	Spectator Ultra	2	FL OZ/M	21 Days	7a	6a-e	6.5abc	4d-g
26	Manicure Ultra	3.25	OZ/M	14 Days	7a	6.3a-d	6.8abc	4.3d-g
27	Manicure 6FL	3.6	FL OZ/M	14 Days	7a	7.5abc	7ab	5def
28	Spectator Ultra	2	FL OZ/M	14 Days	7a	8a	7.8a	9a
	Manicure Ultra	3.25	OZ/M					
29	QP Iprodione Plus	4	FL OZ/M	14 Days	7a	8a	7ab	7.8b
30	Instrata	2.75	FL OZ/M	21 Days	7a	6.3a-d	7ab	4.5d-g
31	Instrata	4	FL OZ/M	21 Days	7a	6.5a-d	7.3ab	4.5d-g
32	Concert	5.4	FL OZ/M	21 Days	7a	6.5a-d	7ab	4.8d-g
33	Banner MAXX	1.5	FL OZ/M	21 Days	7a	7.3abc	7ab	4d-g
LSD					0.31	1.12	0.79	0.7
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)								

## **Control of Sclerotinia Dollar Spot (Putting Green)**

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Department of Plant Pathology

### **OBJECTIVE**

To determine the efficacy of standard and experimental fungicides for controlling dollar spot caused by the fungus *Sclerotinia homoeocarpa*.

### **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* 'Penncross') maintained at 0.140 inches. The individual plots measured 3 feet by 5 feet 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. All treatments were initiated June 6<sup>th</sup>, and subsequent applications were made at 7, 14 or 21 day intervals until the final application was made on August 28<sup>th</sup>. The number of dollar spot infection centers per plot was visually assessed and quality rated on a 1-9 scale (9 being excellent, 6 being acceptable) and the data was subjected to an analysis of variance to determine statistical differences between treatments.

### **RESULTS AND DISCUSSION**

Dollar spot disease pressure was slow to develop this year in southern Wisconsin due to mild temperatures, virtually no rainfall, and low relative humidities. But disease pressure increased markedly in August with arrival of adequate rainfall, increased relative humidities, and warmer temperatures. The rating date on August 20<sup>th</sup> immediately follows a 10 day period of extremely high disease pressure, and best differentiates between those products that best control dollar spot and those that do not. On this date, all treatments except the two Heritage TL treatments provided statistically significant control when compared to the untreated control. Treatments 2, 3 19, 22, and 23 limited dollar spot to an average of less than five dollar spot infection centers per plot. Both Emerald treatments were the only treatment on August 20<sup>th</sup> to completely control all dollar spot development, though their quality ratings were decreased slightly by the onset of brown patch (*Rhizoctonia solani*) symptoms. Quality ratings mirrored the dollar spot ratings, and the same treatments that limited dollar spot to under five infection centers per plot provided acceptable turfgrass quality.



**Table 1. Mean number of dollar spots per treatment on a creeping bentgrass putting green plot at the OJ Noer Turfgrass Research and Education Facility in Verona, WI in 2007.**

Treatment		Rate		Interval	Rating Date*			
					July 10	July 23	Aug 6	Aug 20
1	Non-treated control				7.5ab	11.5a	20.8bc	57.5ab
2	Emerald	0.13	OZ/M	14 days	0d	1bc	0d	0h
3	Emerald	0.18	OZ/M	14 days	0d	0.3c	1.3cd	0h
4	Trinity	1	FL OZ/M	14 days	0.3d	2.3bc	11cd	48bc
5	Trinity	1.5	FL OZ/M	14 days	1d	0c	3.5cd	21.3d-h
6	Heritage TL	1	FL OZ/M	14 days	8.8a	4.8bc	24.8b	61.5ab
7	Heritage TL	2	FL OZ/M	28 days	5a-d	4.5bc	34.5ab	76a
8	Tartan	1	FL OZ/M	14 days	0d	1.5bc	3.5cd	31c-g
9	Tartan Chipco Signature	1 4	FL OZ/M OZ/M	14 days	0d	0.3c	2.5cd	26.3c-h
10	Eagle	1	FL OZ/M	14 days	0d	1.3bc	5.3cd	43.8bcd
11	Eagle Daconil Ultrex	0.5 1.8	FL OZ/M OZ/M	14 days	3bcd	5.3b	41a	52bc
12	Eagle Daconil Ultrex	1 1.8	FL OZ/M OZ/M	14 days	0.5d	0c	4.5cd	14.8e-h
13	Eagle Daconil Ultrex	1 1.8	FL OZ/M OZ/M	21 days	6.5abc	2.8bc	31.3ab	41.3b-e
14	HM-0701	1	FL OZ/M	14 days	1.5cd	0.8bc	4.8cd	31.3c-g
15	HM-0701 Daconil Ultrex	0.5 1.8	FL OZ/M OZ/M	14 days	1.3cd	0.5c	8.3cd	18.5d-h
16	HM-0701 Daconil Ultrex	1 1.8	FL OZ/M OZ/M	14 days	1.3cd	0.3c	3.8cd	18.8d-h
17	HM-0701 Daconil Ultrex	1 1.8	FL OZ/M OZ/M	21 days	0.3d	2.8bc	8.8cd	6.3gh
18	Spectator Ultra	1	FL OZ/M	14 days	0d	0c	2cd	9.3gh
19	Spectator Ultra	2	FL OZ/M	21 days	0.3d	0.5c	2.3cd	2.3h
20	Manicure Ultra	3.25	OZ/M	14 days	0.3d	2bc	4.3cd	16.8d-h
21	Manicure 6FL	3.6	FL OZ/M	14 days	0d	0.3c	4.8cd	13fgh
22	Spectator Ultra Manicure Ultra	2 3.25	FL OZ/M OZ/M	14 days	0d	0.8bc	2.8cd	1h
23	Instrata	4	FL OZ/M	14 days	0d	0c	1.8cd	2h
24	Concert	3.2	FL OZ/M	14 days	0d	0.5c	6.3cd	11.8fgh
25	Headway	1.5	FL OZ/M	14 days	0d	0c	4.5cd	13fgh
26	Disarm	0.18	FL OZ/M	14 days	4a-d	2.5bc	4.8cd	38.8b-f
LSD					3.47	2.64	10.77	16.59
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)								

**Table 2. Quality ratings per treatment on a creeping bentgrass putting green plot taken from the OJ Noer Turfgrass Research and Education Facility in Verona, WI.**

Treatment		Rate		Interval	Rating Date*			
					July 10	July 23	Aug 6	Aug 20
1	Non-treated control				7b	7abc	6.5bc	3.5gh
2	Emerald	0.13	OZ/M	14 days	7b	7abc	7b	6.8a
3	Emerald	0.18	OZ/M	14 days	7b	6.8bc	7b	6.5ab
4	Trinity	1	FL OZ/M	14 days	7b	7abc	7b	3.8fgh
5	Trinity	1.5	FL OZ/M	14 days	7b	7abc	7b	4.8c-g
6	Heritage TL	1	FL OZ/M	14 days	7b	7abc	7b	3.8fgh
7	Heritage TL	2	FL OZ/M	28 days	7b	7abc	7b	3h
8	Tartan	1	FL OZ/M	14 days	7b	7.5ab	7b	4.5d-g
9	Tartan Chipco Signature	1 4	FL OZ/M OZ/M	14 days	8a	7.8a	8a	5b-g
10	Eagle	1	FL OZ/M	14 days	7b	6.8bc	6c	3.8fgh
11	Eagle Daconil Ultrex	0.5 1.8	FL OZ/M OZ/M	14 days	7b	7abc	6c	3.8fgh
12	Eagle Daconil Ultrex	1 1.8	FL OZ/M OZ/M	14 days	7b	7abc	6.3bc	5.3a-f
13	Eagle Daconil Ultrex	1 1.8	FL OZ/M OZ/M	21 days	7b	7abc	6.3bc	4.3e-h
14	HM-0701	1	FL OZ/M	14 days	7b	6.5c	6c	4.3e-h
15	HM-0701 Daconil Ultrex	0.5 1.8	FL OZ/M OZ/M	14 days	7b	6.8bc	6.5bc	5b-g
16	HM-0701 Daconil Ultrex	1 1.8	FL OZ/M OZ/M	14 days	7b	6.8bc	6c	5b-g
17	HM-0701 Daconil Ultrex	1 1.8	FL OZ/M OZ/M	21 days	7b	6.8bc	6.5bc	6.3abc
18	Spectator Ultra	1	FL OZ/M	14 days	7b	6.8bc	6.5bc	5.8a-e
19	Spectator Ultra	2	FL OZ/M	21 days	7b	6.5c	6.8bc	6a-d
20	Manicure Ultra	3.25	OZ/M	14 days	7b	7.3abc	7b	5.5a-e
21	Manicure 6FL	3.6	FL OZ/M	14 days		7abc	6.5bc	5.8a-e
22	Spectator Ultra Manicure Ultra	2 3.25	FL OZ/M OZ/M	14 days	7b	6.8bc	6c	6.5ab
23	Instrata	4	FL OZ/M	14 days	7b	6.8bc	6.3bc	6.3abc
24	Concert	3.2	FL OZ/M	14 days	7b	7abc	6.5bc	5.5a-e
25	Headway	1.5	FL OZ/M	14 days	7b	7abc	7b	5.8a-e
26	Disarm	0.18	FL OZ/M	14 days	7b	7abc	7b	4fgh
LSD					NS	0.5	0.47	0.9
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)								

# Curative Fungicide Applications for Dollar Spot Control

Paul Koch, John Kalmi, Brittany Seabloom, Tom Huncosky  
Department of Plant Pathology

## INTRODUCTION

Dollar spot, caused by the fungus *Sclerotinia homoeocarpa*, is an important disease of intensively managed cool-season turfgrass. Fungicides are necessary to provide complete control of the disease throughout the growing season, but decreasing budgets can make it impossible to spray all susceptible turfgrass preventatively. Therefore, it is important to know which fungicides and which fungicide combinations provide the best curative control of dollar spot. The objective of this study was to determine the efficacy of fungicide combinations to curatively control dollar spot caused by the fungus *Sclerotinia homeocarpa*.

## MATERIALS AND METHODS

The field trials were conducted at the OJ Noer Turfgrass Research and Education Facility in Verona, WI on a 'Crenshaw' creeping bentgrass plot maintained at 0.5 inches. Individual plots measured 3 x 5 ft, and were arranged in a randomized complete block design with four replications. Individual treatments were applied at a nozzle pressure of 40 psi using a CO<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were shaken by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. The rating of dollar spot severity was measured by counting dollar spot infection centers (DSIC's; approximate 2-inch diameter) per each plot. A total of 26 fungicide treatments (either single or mixtures of two) were evaluated for their curative efficacy of dollar spot control. Each treatment was applied twice to the plots. The first treatment was initiated on June 27<sup>th</sup> when there was greater than an average of 15 DSIC's per plot. The second application was made two weeks later, on July 11<sup>th</sup>. Ratings were made before the first application, after the first application, and the final rating was made two weeks following the second fungicide application. All ratings were subjected to an analysis of variance to determine statistically significant differences between the treatments.

## RESULTS AND DISCUSSION

All treatments except treatment 9 significantly reduced dollar spot when compared to the untreated control. Treatment 9 contains thiophanate-methyl, and resistance to this active ingredient is well documented at the OJ Noer research facility. All treatments not containing thiophanate-methyl provided a similar amount of curative control of dollar spot, but higher rates of single active ingredients and tank mixes of two active ingredients provided the most effective curative control.

**Table 1. Mean number of dollar spots per plot in response to curative fungicide applications at the OJ Noer Turfgrass Research Facility in Verona, WI.**

Treatment		Rate	Rating Date*		
			6/27/2007	7/10/2007	7/23/2007
1	Non-treated control		28a	44.5a	85.3b
2	Chipco 26GT	4 FL OZ/M	15a	5.5b	4c
3	Chipco 26GT	2 FL OZ/M	21a	2b	1c
4	Emerald	0.13 OZ/M	19.5a	8.5b	4.5c
5	Concert	5.4 FL OZ/M	27a	4.3b	1.5c
6	Banner MAXX	2 FL OZ/M	5.5a	3.5b	1c
7	Banner MAXX	0.5 FL OZ/M	21.8a	6.3b	4.3c
8	Instrata	4 FL OZ/M	13a	2.8b	0.3c
9	3336F	4 FL OZ/M	18.8a	18.3b	115.8a
10	Curalan EG	1 OZ/M	18.3a	5b	1c
11	3336 Plus Protect	4 FL OZ/M 8 OZ/M	15.3a	47.5a	42.3c
12	3336 Plus Spotrete	4 FL OZ/M 7 FL OZ/M	22.8a	9b	23.5c
13	Daconil Ultrex	5 OZ/M	23a	23ab	2c
14	Daconil Ultrex	1.8 OZ/M	13a	9.5b	10.5c
15	Eagle	2.4 FL OZ/M	26a	5.8b	0.5c
16	Lynx	1 FL OZ/M	16.8a	1.5b	0.3c
17	Bayleton	1 OZ/M	20a	2.3b	0.8c
18	Bayleton	0.25 OZ/M	19.8a	22.5ab	8c
19	Banner MAXX	2 FL OZ/M	19.3a	1.8b	2.3c
	Chipco 26GT	4 FL OZ/M			
20	Banner MAXX	0.5 FL OZ/M	27.8a	1.5b	1c
	Chipco 26GT	2 FL OZ/M			
21	Banner MAXX	2 FL OZ/M	16.5a	1.5b	2c
	Curalan EG	1 OZ/M			
22	Banner MAXX	0.5 FL OZ/M	8.8a	2b	1.8c
	Curalan EG	1 OZ/M			
23	Banner MAXX	2 FL OZ/M	10.5a	4.3b	0c
	Daconil Ultrex	5 OZ/M			
24	Banner MAXX	0.5 FL OZ/M	21.5a	3.5b	0.8c
	Daconil Ultrex	1.8 OZ/M			
25	Banner MAXX	2 FL OZ/M	26a	2.5b	5c
	Bayleton	1 OZ/M			
26	Banner MAXX	0.5 FL OZ/M	12.8a	1.3b	0c
	Bayleton	0.25 OZ/M			
LSD			NS	19.54	25.2
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)					

# Early Season Preventative Fungicide Applications for the Delay of Dollar Spot Symptom Development

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<sup>2</sup>Milwaukee Country Club, River Hills, WI

## OBJECTIVE

To determine length and degree of efficacy of different fungicides and fungicide combinations in preventing dollar spot caused by the fungus *Sclerotinia homoeocarpa*.

## MATERIALS AND METHODS

This study was performed at Milwaukee Country Club located in River Hills, WI on a creeping bentgrass nursery maintained at 0.5 inches. The individual plots measured 3 x 5 ft and were arranged in a randomized complete block design with four replications. Treatments 2-25 were applied once on May 2nd, 2007. Treatment 26 simulates a “traditional” dollar spot control program, and was initiated on May 31<sup>st</sup> after conditions became optimum for dollar spot infection and applied every 21 days until the final application was made August 2<sup>nd</sup>. Fungicide treatments were applied at a rate of 2 gallons per 1000 ft<sup>2</sup> using a CO<sub>2</sub> pressurized boom sprayer (40 psi) equipped with XR Teejet 8005 VS nozzles. The percent dollar spot per plot and turfgrass quality (1-9, 9 being excellent and 6 acceptable) were visually assessed and the data subjected to an analysis of variance to determine statistical differences between treatments. The results of the percent dollar spot ratings were then analyzed for their statistical significance via analysis of variance and included in table 1.

## RESULTS AND DISCUSSION

Dollar spot disease pressure was slow to develop in southern Wisconsin this season, though pressure did increase significantly near the end of July and beginning of August. Though the data was not statistically significant on the July 27<sup>th</sup> rating date, several treatments did provide a level of dollar spot control similar to the level of the “traditional” fungicide program nearly two months after the initial applications were made. As expected, contact fungicides and low rates of penetrant fungicides provided the shortest length of dollar spot control. No significant differences in quality were recorded.

**Table 1: Efficacy of fungicides and tank mixtures for delaying the onset of dollar spot symptoms at Milwaukee Country Club in River Hills, WI in 2007.**

	Treatment		Rate	Disease Rating (mean percent diseased area per plot)*					
				June 21	Jul 6	July 17	July 27	Aug 8	Aug 16
1	Non-treated control			6.5ab	9.3abc	10bc	11.3b	20bc	15b
2	Chipco 26GT	4	FL OZ/M	0.5b	3.3bc	2.8bc	6.8b	10.5bc	13.8b
3	Chipco 26GT	2	FL OZ/M	0.5b	5.5bc	6.3bc	8.8b	17.5bc	22.5ab
4	Emerald	0.18	OZ/M	0.5b	3bc	3.8bc	5b	16.3bc	20ab
5	Banner Maxx	2	FL OZ/M	0b	0c	2.3bc	3.5b	8.3bc	10b
6	Banner Maxx	0.5	FL OZ/M	0.5b	3.3bc	5bc	6.5b	15.5bc	13.8b
7	Spotrete	5	OZ/M	9.5a	15.8a	23.8a	31.3a	56.3a	48.8a
8	3336 Plus	4	FL OZ/M	1.8b	5bc	6.3bc	8.8b	21.3bc	30ab
9	Curalan EG	1	OZ/M	0.3b	3bc	6.3bc	12.5b	22.5bc	31.3ab
10	Tartan	2	FL OZ/M	0b	3bc	4.5bc	5.5b	16.3bc	28.8ab
11	Daconil Ultrex	5	OZ/M	2b	6.3bc	10bc	10b	27.5bc	25ab
12	Daconil Ultrex	1.8	OZ/M	1.8b	10ab	12.5b	15b	32.5b	15b
13	Rubigan AS	1.5	FL OZ/M	0.8b	6.3bc	7.5bc	10b	18.8bc	26.3ab
14	Eagle	2.4	FL OZ/M	0.3b	0.5c	1.3bc	3.5b	4.8bc	12.5b
15	Lynx	2	FL OZ/M	0b	0c	0.3c	2.5b	7.5bc	7.5b
16	Bayleton	1	OZ/M	0b	0.8c	1bc	4.3b	8bc	8.8b
17	Bayleton	0.25	OZ/M	0.5b	4.5bc	5.5bc	8.8b	17.5bc	17.5b
18	Banner MAXX	2	FL OZ/M						
	Chipco 26GT	4	FL OZ/M	0.3b	0c	0.5c	3b	5bc	8.8b
19	Banner MAXX	0.5	FL OZ/M						
	Chipco 26GT	2	FL OZ/M	0.3b	2.5bc	5bc	5.5b	11.8bc	22.5ab
20	Banner MAXX	2	FL OZ/M						
	Curalan EG	1	OZ/M	0b	1.3bc	2.3bc	3.3b	7.5bc	20ab
21	Banner MAXX	0.5	FL OZ/M						
	Curalan EG	1	OZ/M	0.3b	1.5bc	3.5bc	5b	8.3bc	11.3b
22	Banner MAXX	2	FL OZ/M						
	Daconil Ultrex	5	OZ/M	0b	1.8bc	1.8bc	5.5b	10bc	13.8b
23	Banner MAXX	0.5	FL OZ/M						
	Daconil Ultrex	1.8	OZ/M	3.8b	10ab	10bc	12.5b	21.3bc	25.8ab
24	Banner MAXX	2	FL OZ/M						
	Bayleton	1	OZ/M	0.3b	0.5c	0.5c	2.8b	6.3bc	10b
25	Banner MAXX	0.5	FL OZ/M						
	Bayleton	0.25	OZ/M	1.8b	4bc	3.5bc	5.5b	11.3bc	11.3b
26	Banner MAXX	0.5	FL OZ/M						
	Daconil Ultrex	1.8	OZ/M	0.3b	0.5c	0c	0b	0c	0b
<b>LSD</b>				<b>4.08</b>	<b>5.03</b>	<b>NS</b>	<b>NS</b>	<b>16.89</b>	<b>18.08</b>
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)									

## **Fungicides for the Preventative Control of Pythium Blight**

Paul Koch, John Kalmi, Brittany Seabloom, Tom Huncosky  
Department of Plant Pathology  
University of Wisconsin

### **OBJECTIVE**

To determine the efficacy of standard and experimental fungicides for preventing Pythium blight caused by *Pythium* spp.

### **MATERIALS AND METHODS**

The study was conducted at the O.J. Noer Turfgrass Research and Education Facility in Verona, WI on a stand of perennial ryegrass (*Lolium perenne*) seeded on July 11<sup>th</sup> and maintained at a one inch cutting height. The individual plots measured 3 feet by 5 feet and were arranged in a randomized complete block design with four replications. Individual treatments were applied on August 5<sup>th</sup> at a nozzle pressure of 40 p.s.i. using a CO<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. On August 6<sup>th</sup>, the trial was covered with an Evergreen® growth blanket to increase the turfgrass canopy temperature and humidity and make the environment more conducive for Pythium blight infection. The plots were visually rated for percent Pythium blight on August 7<sup>th</sup>, 9<sup>th</sup>, and 13<sup>th</sup>. The data was subjected to an analysis of variance to determine statistically significant differences between individual treatments.

### **RESULTS AND DISCUSSION**

Conditions conducive for the development of Pythium blight did not occur until the middle of August in southern Wisconsin. All treatments significantly reduced Pythium blight in comparison to the untreated control on the August 13<sup>th</sup> rating date. The two higher rates of Cyazofamid, QP Mefenoxam, and a Subdue MAXX/Heritage tank mix significantly reduced Pythium blight symptoms compared to the other treatments. No treatment completely controlled Pythium blight on the August 13<sup>th</sup> rating date.

**Table 1. Fungicide treatments and rates for the preventative control of Pythium blight at the OJ Noer Turfgrass Research and Education Facility in Verona, WI in 2007.**

Treatment		Rate		Rating Date*		
				8/7/2007	8/9/2007	8/13/2007
1	Non-treated control			5.3a	14.3a	62.5a
2	Cyazofamid	0.45	FL OZ/M	0.8a	0.5b	7.5bc
3	Cyazofamid	0.6	FL OZ/M	0.8a	1b	5.8bc
4	Cyazofamid	0.75	FL OZ/M	1.5a	2.5b	4.5c
5	Cyazofamid	0.9	FL OZ/M	0a	1.3b	2.5c
6	Subdue MAXX	1	FL OZ/M	2.8a	2.8b	8.8bc
7	Insignia	0.9	OZ/M	1.3a	3.3b	14.3b
8	Banol	2	FL OZ/M	1.3a	2.3b	11.8bc
9	Chipco Signature	4	OZ/M	2a	2.8b	8.8bc
10	QP Mefenoxam	1	FL OZ/M	0a	0.5b	2.8c
11	Subdue MAXX Heritage TL	0.5	FL OZ/M	2a	4b	7.5bc
		1	FL OZ/M			
12	Subdue MAXX Heritage TL	0.5	FL OZ/M	1.3a	1.3b	3.3c
		0.5	FL OZ/M			
13	Subdue MAXX Chipco Signature	0.5	FL OZ/M	0a	0b	5bc
		2	OZ/M			
14	Disarm	0.18	FL OZ/M	2.5a	4.3b	11.3bc
<b>LSD</b>				3.02	3.58	5.87
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)						



## **Fairy Ring Control**

Paul Koch, John Kalmi, Brittany Seabloom, Tom Huncosky  
Department of Plant Pathology  
University of Wisconsin

### **OBJECTIVE**

To determine the efficacy of standard fungicides for preventing fairy ring caused by many different species of basidiomycete fungi.

### **MATERIALS AND METHODS**

The study was conducted on an annual bluegrass (*Poa annua*) and creeping bentgrass (*Agrostis stolonifera* 'Penncross') fairway maintained at a mowing height of 0.5 inches at Maple Bluff CC in Madison, WI as well as a Kentucky bluegrass (*Poa pratensis*) fairway maintained at 0.5 inches at Lake Breeze GC in Winneconne, WI. The individual plots measured 3 X 10 feet 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. Treatments were initiated on May 7<sup>th</sup> at Maple Bluff CC and May 10<sup>th</sup> at Lake Breeze GC, and subsequent applications were made based on the interval code in table 1. The letter "A" represents the initial application, and "B" and "C" represent the second and if made the third application, respectively. Visual ratings of percent fairy ring and quality were recorded and the data was subjected to an analysis of variance to determine statistical differences between treatments.

### **RESULTS AND DISCUSSION**

Despite past history of fairy ring development at these locations, no fairy ring was observed within the trial sites at either golf course during 2007. Differences in quality at the Maple Bluff trial site were observed beginning in July, with reductions in quality primarily due to development of anthracnose. No quality differences were observed at Lake Breeze golf club.

**Table 1. Quality ratings from Maple Bluff Country Club in Madison, WI and Lake Breeze Golf Club in Winneconne, WI in 2007.**

Treatment						Quality Rating Date*							
						Rate		Interval	Interval Code	Maple Bluff CC		Lake Breeze GC	
										Jul 24	Aug 9	Jul 17	Aug 2
1	Non-treated control					5.5bc	4.3a	7a	7a				
2	Bayleton SC Revolution	1.5 6	FL OZ/M FL OZ/M	21 Days	AB AB	7.3ab	6a	7a	7a				
3	Bayleton SC Revolution	1.5 6	FL OZ/M FL OZ/M	28 Days	AB AB	7.5ab	6a	7a	7a				
4	Bayleton SC Revolution	1.5 6	FL OZ/M FL OZ/M	28 Days	ABC ABC	7.3ab	6a	7a	7a				
5	Lynx Revolution	1.5 6	FL OZ/M FL OZ/M	21 days	AB AB	8a	6a	7a	7a				
6	Lynx Revolution	1.5 6	FL OZ/M FL OZ/M	28 Days	AB AB	7.3ab	6a	7a	7a				
7	Tartan Revolution	2 6	FL OZ/M FL OZ/M	21 Days	AB AB	6.8ab	6a	7a	7a				
8	Bayleton SC Revolution Prostar	2 6 2.2	FL OZ/M FL OZ/M OZ/M	21 Days	A AB B	5.8abc	6a	7a	7a				
9	Prostar Revolution	2.2 6	OZ/M FL OZ/M	21 Days	AB AB	5.5bc	5.5a	7a	7a				
10	Headway	4	FL OZ/M	21 Days	AB AB	4.5c	4.3a	7a	7a				
11	Banner MAXX	0.2	FL OZ/M	21 Days	AB AB	6.5abc	6a	7a	7a				
12	Banner MAXX	0.2	FL OZ/M	21 Days	AB AB	7.3ab	6a	7a	7a				
13	Disarm	0.36	FL OZ/M	21 Days	AB AB	3d	2.5b	7a	7a				
14	Disarm ARY-0534001	0.1 0.83	FL OZ/M FL OZ/M	21 Days	AB AB	6.3abc	5.3a	7a	7a				
LSD						1.36	1.33	NS	NS				
*Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)													

# **APPENDIX A: SNOW MOLD TRIALS**

## **SNOW MOLD FIELD DAY SUPPORTERS THANK YOU**

**The Andersons  
Arysta LifeScience  
BASF Corporation  
Bayer Environmental Science  
Chemtura Corporation  
Cleary Chemical Corporation  
LESCO  
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Syngenta Professional Products  
Northern Great Lakes Golf Course Superintendents Association  
Wisconsin Golf Course Superintendents Association  
Gateway GC - Todd Renk Superintendent  
Lake Wisconsin Country Club – Kendall Marquadt Superintendent  
The Legend at Giants Ridge - Jared Finch Superintendent  
Sentryworld - Gary Tanko Superintendent**

# **FIELD DAY IS SPONSORED BY:**

**Turfgrass Diagnostic Lab  
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## **2006-2007 Snow Mold Control Evaluation Lake Wisconsin Country Club – Prairie du Sac, WI.**

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University of Wisconsin-Madison

### **OBJECTIVE**

To evaluate fungicides for the control of Typhula blight (caused by *Typhula incarnata*) and pink snow mold (caused by *Microdochium nivale*).

### **MATERIALS AND METHODS**

This evaluation was conducted at Lake Wisconsin Country Club in Prairie du Sac, WI on a creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) fairway maintained at 0.5-inch cutting height. Individual plots measured 3 ft x 10 ft (30 ft<sup>2</sup>), and were arranged in a randomized complete block design with three replications. Individual treatments were applied at a nozzle pressure of 40 p.s.i using a CO<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000ft<sup>2</sup> except treatment 8 was applied in 5 gallons of water per 1000 ft<sup>2</sup>. Proper amounts of granular applications were weighed and applied using a shaker jar. Early applications were applied on October 24th, 2006 and late applications were applied on November 20th, 2006. The experimental plot area was not inoculated. There was continuous snow cover on the plots from mid January to mid March 2007, a total of approximately 60 days. The percent disease and color ratings were recorded on March 21st, 2007. Data obtained was subjected to an analysis of variance to determine significant differences between treatments. The mean percent disease area and mean color rating for each individual treatment are located in the table below.

### **RESULTS AND DISCUSSION**

Disease pressure at Lake Wisconsin CC was surprisingly very low this year with untreated checks averaging just over 3% snow mold. The only pathogen causing any damage within the research plot was *Microdochium nivale*, though significant amounts of *Typhula incarnata* were observed just outside the treated area. All treatments gave 100% control of snow mold compared with the non-treated controls. Differences in plot color were observed. The untreated area surrounding the research plot was determined to have a color rating of 7, and many of the treatments had a rating lower than 7 but still above the acceptable level of 6. The granular treatments generally had the best color, with treatment 52 having the only statistically higher rating. Treatments 36, 37, and 38 had statistically the lowest color rating.

# **Snow Mold and Color Ratings Recorded on March 21, 2007 at Lake Wisconsin CC**

Treatment	Rate	Timing <sup>a</sup>	% Snow Mold <sup>b</sup>	Color <sup>c</sup>
1 Untreated Control			3.3 a	7.3 abc
2 Instrata	5 FL OZ/M	Late	0 b	6 cde
3 Instrata	9 FL OZ/M	Late	0 b	6.3 b-e
4 Instrata	11 FL OZ/M	Late	0 b	6.3 b-e
5 Medallion	0.15 OZ/M	Late	0 b	6 cde
Daconil WeatherStik	2.5 OZ/M	Late		
Banner MAXX	1.8 FL OZ/M	Late		
6 Banner MAXX	2 FL OZ/M	Late	0 b	6 cde
Daconil WeatherStik	5.5 FL OZ/M	Late		
7 Banner MAXX	2 FL OZ/M	Late	0 b	6.7 a-e
Turficide 400	6 FL OZ/M	Late		
8 Turfcide 400	12 FL OZ/M	Late	0 b	6 cde
9 Insignia	0.7 OZ/M	Early	0 b	6.3 b-e
Manicure Ultra	5 OZ/M	Late		
Revere 4000	12 FL OZ/M	Late		
10 18 Plus	4 FL OZ/M	Late	0 b	6 cde
Manicure Ultra	5 OZ/M	Late		
Revere 4000	12 FL OZ/M	Late		
11 Spectator Ultra	4 FL OZ/M	Early	0 b	6 cde
Insignia	0.7 OZ/M	Early		
Manicure Ultra	5 OZ/M	Late		
12 Spectator Ultra	4 FL OZ/M	Early	0 b	6.3 b-e
Revere 4000	12 FL OZ/M	Late		
13 Insignia	0.7 OZ/M	Early	0 b	6 cde
18 Plus	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
14 Armada	1.2 OZ/M	Early	0 b	6 cde
Revere 4000	12 FL OZ/M	Late		
15 Tartan	2 FL OZ/M	Late	0 b	6.7 a-e
Daconil WeatherStik	5.5 FL OZ/M	Late		
16 Tartan	2 FL OZ/M	Late	0 b	6.7 a-e
Turficide 400	6 FL OZ/M	Late		
17 Tartan	2 FL OZ/M	Late	0 b	7 a-d
Chipco 26019GT	6 FL OZ/M	Late		
18 Tartan	2 FL OZ/M	Late	0 b	7 a-d
Prostar	2.2 OZ/M	Late		
19 TBZ+TFS Green	2 FL OZ/M	Late	0 b	6.7 a-e
20 TBZ+TFS Green	2 FL OZ/M	Late	0 b	6.3 b-e
Chipco 26019GT	4 FL OZ/M	Late		
21 Lynx	1 FL OZ/M	Late	0 b	6 cde
Chipco 26019GT	4 FL OZ/M	Late		
Daconil WeatherStik	5.5 FL OZ/M	Late		
22 Insignia	0.7 OZ/M	Late	0 b	6 cde
Revere 4000	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

<sup>a</sup>Early and late fungicide treatments were applied on Oct. 24, 2006 and Nov. 20, 2006, respectively

<sup>b</sup>Mean % diseased area

<sup>c</sup>Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green

**Snow Mold and Color Ratings Recorded on March 21st, 2007 at Lake Wisconsin CC**

<b>Treatment</b>	<b>Rate</b>	<b>Timing<sup>a</sup></b>	<b>% Snow Mold<sup>b</sup></b>	<b>Color<sup>c</sup></b>
23 Insignia	0.7 OZ/M	Late	0 b	6 cde
Iprodione Pro	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
24 Insignia	0.7 OZ/M	Late	0 b	6 cde
BAS 595	1 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
25 Insignia	0.7 OZ/M	Late	0 b	6.3 b-e
Revere 4000	4 FL OZ/M	Late		
Manicure Ultra	4 OZ/M	Late		
26 Spectro	4 OZ/M	Early	0 b	6 cde
26/36	4 FL OZ/M	Late		
CLEX-9	1.2 OZ/M	Late		
27 Spectro	4 OZ/M	Early	0 b	6 cde
26/36	4 FL OZ/M	Late		
Daconil Ultrex	5.5 OZ/M	Late		
28 Spectro	4 OZ/M	Early	0 b	6 cde
26/36	4 FL OZ/M	Late		
Endorse	4 OZ/M	Late		
29 26/36	4 FL OZ/M	Late	0 b	6 cde
CLEX-9	1.2 OZ/M	Late		
30 26/36	4 FL OZ/M	Late	0 b	6 cde
Daconil Ultrex	5.5 OZ/M	Late		
31 26/36	4 FL OZ/M	Late	0 b	6 cde
Endorse	4 OZ/M	Late		
32 Spectro	5.75 OZ/M	Late	0 b	6 cde
CLEX-9	1.2 OZ/M	Late		
33 Turfcide 400	12 FL OZ/M	Late	0 b	6.3 b-e
34 Turfcide 400	9 FL OZ/M	Late	0 b	6 cde
Daconil Ultrex	3.7 OZ/M	Late		
35 Instrata	7 FL OZ/M	Late	0 b	5.7 de
36 Instrata	3 FL OZ/M	Early	0 b	5.3 e
Instrata	8 FL OZ/M	Late		
37 Instrata	5.5 FL OZ/M	Early/Late	0 b	5.3 e
38 Instrata	7 FL OZ/M	Early/Late	0 b	5.3 e
47 Disarm	0.18 FL OZ/M	Early/Late	0 b	6.3 b-e
48 Disarm	0.36 FL OZ/M	Early/Late	0 b	6 cde
Banner MAXX	0.36 FL OZ/M	Early/Late		
49 Disarm	0.18 FL OZ/M	Early/Late	0 b	6 cde
Banner MAXX	2 FL OZ/M	Early/Late		
50 AND6242	6.36 lb/M	Late	0 b	7.7 ab
51 AND6243	6.36 lb/M	Late	0 b	7.7 ab
52 AND3224	6.36 lb/M	Late	0 b	8 a
53 AND6244	6.36 lb/M	Late	0 b	7.7 ab
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)				
<sup>a</sup> Early and late fungicide treatments were applied on Oct. 24, 2006 and Nov. 20, 2006, respectively				
<sup>b</sup> Mean % diseased area				
<sup>c</sup> Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green				



**Snow Mold and Color Ratings Recorded on March 21st, 2007 at Lake Wisconsin CC**

<b>Treatment</b>	<b>Rate</b>	<b>Timing<sup>a</sup></b>	<b>% Snow Mold<sup>b</sup></b>	<b>Color<sup>c</sup></b>
54 AND6245	6.66 lb/M	Late	0 b	7 a-d
55 AND6246	6.66 lb/M	Late	0 b	7 a-d
56 AND5017	6.66 lb/M	Late	0 b	6.3 b-e
57 AND6247	6.66 lb/M	Late	0 b	6.3 b-e
58 AND6248	10 lb/M	Late	0 b	6.7 a-e
59 AND6259	10 lb/M	Late	0 b	7 a-d
60 AND6249	10 lb/M	Late	0 b	6.7 a-e
61 AND6251	10 lb/M	Late	0 b	7 a-d
62 AND6252	10 lb/M	Late	0 b	7 a-d
63 AND6254	10 lb/M	Late	0 b	7 a-d
64 AND6253	10 lb/M	Late	0 b	6.3 b-e
65 AND6255	10 lb/M	Late	0 b	7 a-d
66 Prophecy	5 lb/M	Early	0 b	7 a-d
AND6257	10 lb/M	Late		
67 Prophecy	5 lb/M	Early	0 b	6.7 a-e
AND6258	10 lb/M	Late		
68 Prophecy	5 lb/M	Early	0 b	6.7 a-e
AND6259	10 lb/M	Late		
69 Prophecy	5 lb/M	Early	0 b	6.7 a-e
AND6260	10 lb/M	Late		
70 AND6261	9 lb/M	Late	0 b	7.3 abc
71 AND6262	9 lb/M	Late	0 b	7 a-d
72 AND6263	9 lb/M	Late	0 b	7 a-d
73 AND6264	9 lb/M	Late	0 b	6.7 a-e
74 AND6265	9 lb/M	Late	0 b	6.7 a-e
75 AND6266	9 lb/M	Late	0 b	7 a-d
76 AND6267	9 lb/M	Late	0 b	6.3 b-e
77 AND6268	9 lb/M	Late	0 b	6.7 a-e
78 Prophecy	5 lb/M	Early	0 b	6.7 a-e
AND6269	9 lb/M	Late		
79 Prophecy	5 lb/M	Early	0 b	7.7 ab
AND6270	9 lb/M	Late		
80 Prophecy	5 lb/M	Early	0 b	7 a-d
AND6271	9 lb/M	Late		
81 Prophecy	5 lb/M	Early	0 b	7 a-d
AND6272	9 lb/M	Late		
82 Prophecy	5 lb/M	Early	0 b	7 a-d
AND6273	9 lb/M	Late		
83 Prophecy	5 lb/M	Early	0 b	6.7 a-e
AND6274	9 lb/M	Late		
84 Prophecy	5 lb/M	Early	0 b	6.3 b-e
AND6275	9 lb/M	Late		
85 Prophecy	5 lb/M	Early	0 b	6.7 a-e
AND6276	9 lb/M	Late		
86 Daconil WeatherStik	5.5 FL OZ/M	Late	0 b	6 cde
26GT	4 FL OZ/M	Late		
87 Daconil WeatherStik	5.5 FL OZ/M	Late	0 b	6 cde
Medallion	0.5 OZ/M	Late		
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)				
<sup>a</sup> Early and late fungicide treatments were applied on Oct. 24, 2006 and Nov. 20, 2006, respectively				
<sup>b</sup> Mean % diseased area				
<sup>c</sup> Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green				

## **2006-2007 Snow Mold Control Evaluation Sentryworld Golf Course - Stevens Point, WI.**

Paul Koch<sup>1</sup> and Jake Schneider<sup>2</sup>

<sup>1</sup>Department of Plant Pathology, <sup>2</sup>Department of Horticulture  
University of Wisconsin-Madison

### **OBJECTIVE**

To evaluate fungicides for the control of Typhula blight (caused by *Typhula ishikariensis* and *T. incarnata*) and pink snow mold (caused by *Microdochium nivale*).

### **MATERIALS AND METHODS**

This evaluation was conducted at Sentryworld Golf Course in Stevens Point, WI on a Penneagle creeping bentgrass (*Agrostis stolonifera*) fairway nursery maintained at 0.5-inch cutting height. Individual plots measured 3 ft x 10 ft (30 ft<sup>2</sup>), and were arranged in a randomized complete block design with three replications. Individual treatments were applied at a nozzle pressure of 40 p.s.i using a CO<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup> except treatment 8 was applied in 5 gallons of water per 1000 ft<sup>2</sup>. Granular applications were applied using a shaker jar. Early applications were applied on October 17th, 2006 and late applications were applied on November 9th, 2006. The experimental plot area was not inoculated. There was continuous snow cover on the plots from mid-January to mid-March 2006, a total of approximately 60 days. The percent cover of snow mold and color were recorded on March 28th, 2007 and another color rating was done on April 25<sup>th</sup>, 2007. Data obtained was subjected to an analysis of variance to determine significant differences between treatments. The mean percent diseased area snow mold and mean color rating for each individual treatment are located in the table below.

### **RESULTS AND DISCUSSION**

Disease pressure was low at this site this year with untreated checks averaging only 10% disease. The dominant pathogens causing damage were *Typhula ishikariensis*, and to a lesser degree *Typhula incarnata*. Most treatments gave 100% control of snow mold, and all treatments gave significant reduction of snow mold compared with non-treated controls. The non-treated control was rated as having a color of 7, and differences in plot color were observed with many of the treatments. Those treatments containing PCNB caused some slight turfgrass yellowing, but had recovered within two weeks of the initial rating. Those treatments that contained Tartan were slightly greener when compared to the non-treated controls after the initial rating, but were statistically the same as the untreated controls two weeks after the initial rating. Most of the granular products also gave the plot a slightly greener color during the initial rating, but were strikingly greener in color during the second rating.

# **Snow Mold and Color Ratings Recorded on March 28th and April 25th, 2007 at Sentryworld GC**

Treatment	Rate	Timing <sup>a</sup>	% Snow Mold <sup>b</sup>	Color <sup>c</sup>	
				3/28/2007	4/25/2007
1 Untreated Control			10 a	7 abc	7 b
2 Instrata	5 FL OZ/M	Late	0 b	7 abc	7 b
3 Instrata	9 FL OZ/M	Late	0 b	6.7 a-d	7 b
4 Instrata	11 FL OZ/M	Late	0.7 b	6.7 a-d	7 b
5 Medallion	0.15 OZ/M	Late	0 b	7 abc	7 b
Daconil WeatherStik	2.5 OZ/M	Late			
Banner MAXX	1.8 FL OZ/M	Late			
6 Banner MAXX	2 FL OZ/M	Late	0 b	6.7 a-d	7 b
Daconil WeatherStik	5.5 FL OZ/M	Late			
7 Banner MAXX	2 FL OZ/M	Late	0 b	6.7 a-d	7 b
Turfcide 400	6 FL OZ/M	Late			
8 Turfcide 400	12 FL OZ/M	Late	0 b	6 bcd	7 b
9 Insignia	0.7 OZ/M	Early	0 b	6.3 a-d	7 b
Manicure Ultra	5 OZ/M	Late			
Revere 4000	12 FL OZ/M	Late			
10 18 Plus	4 FL OZ/M	Late	0 b	5.7 cd	7 b
Manicure Ultra	5 OZ/M	Late			
Revere 4000	12 FL OZ/M	Late			
11 Spectator Ultra	4 FL OZ/M	Early	0 b	7 abc	7 b
Insignia	0.7 OZ/M	Early			
Manicure Ultra	5 OZ/M	Late			
12 Spectator Ultra	4 FL OZ/M	Early	0 b	5.3 d	7 b
Revere 4000	12 FL OZ/M	Late			
13 Insignia	0.7 OZ/M	Early	0 b	7.3 ab	7 b
18 Plus	4 FL OZ/M	Late			
Manicure Ultra	5 OZ/M	Late			
14 Armada	1.2 OZ/M	Early	0 b	7 abc	7 b
Revere 4000	12 FL OZ/M	Late			
15 Tartan	2 FL OZ/M	Late	0 b	7.3 ab	7 b
Daconil WeatherStik	5.5 FL OZ/M	Late			
16 Tartan	2 FL OZ/M	Late	0 b	6.7 a-d	7 b
Turfcide 400	6 FL OZ/M	Late			
17 Tartan	2 FL OZ/M	Late	0 b	7.3 ab	7 b
Chipco 26019GT	6 FL OZ/M	Late			
18 Tartan	2 FL OZ/M	Late	0 b	7 abc	7 b
Prostar	2.2 OZ/M	Late			
19 TBZ+TFS Green	2 FL OZ/M	Late	0 b	7 abc	7 b
20 TBZ+TFS Green	2 FL OZ/M	Late	0 b	6.7 a-d	7 b
Chipco 26019GT	4 FL OZ/M	Late			
21 Lynx	1 FL OZ/M	Late	0 b	7 abc	7 b
Chipco 26019GT	4 FL OZ/M	Late			
Daconil WeatherStik	5.5 FL OZ/M	Late			
22 Insignia	0.7 OZ/M	Late	0 b	6.3 a-d	7 b
Revere 4000	4 FL OZ/M	Late			
Manicure Ultra	5 OZ/M	Late			

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

<sup>a</sup>Early and late fungicide treatments were applied on Oct. 17, 2006 and Nov. 9, 2006, respectively

<sup>b</sup>Mean percent diseased area

<sup>c</sup>Phytotoxicity was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green

**Snow Mold and Color Ratings Recorded on March 28th and April 25th, 2007 at Sentryworld GC**

Treatment	Rate	Timing <sup>a</sup>	% Snow Mold <sup>b</sup>	Color <sup>c</sup>	
				3/28/2007	4/25/2007
23 Insignia	0.7 OZ/M	Late	0 b	6.3 a-d	7 b
Iprodione Pro	4 FL OZ/M	Late			
Manicure Ultra	5 OZ/M	Late			
24 Insignia	0.7 OZ/M	Late	0 b	7 abc	7 b
BAS 595	1 FL OZ/M	Late			
Manicure Ultra	5 OZ/M	Late			
25 Insignia	0.7 OZ/M	Late	0 b	6.7 a-d	7 b
Revere 4000	4 FL OZ/M	Late			
Manicure Ultra	4 OZ/M	Late			
26 Spectro	4 OZ/M	Early	0 b	7 abc	7 b
26/36	4 FL OZ/M	Late			
CLEX-9	1.2 OZ/M	Late			
27 Spectro	4 OZ/M	Early	0 b	7 abc	7 b
26/36	4 FL OZ/M	Late			
Daconil Ultrex	5.5 OZ/M	Late			
28 Spectro	4 OZ/M	Early	0 b	7 abc	7 b
26/36	4 FL OZ/M	Late			
Endorse	4 OZ/M	Late			
29 26/36	4 FL OZ/M	Late	0 b	6.7 a-d	7 b
CLEX-9	1.2 OZ/M	Late			
30 26/36	4 FL OZ/M	Late	0 b	7 abc	7 b
Daconil Ultrex	5.5 OZ/M	Late			
31 26/36	4 FL OZ/M	Late	0 b	7 abc	7 b
Endorse	4 OZ/M	Late			
32 Spectro	5.75 OZ/M	Late	0 b	6.7 a-d	7 b
CLEX-9	1.2 OZ/M	Late			
33 Turfcide 400	12 FL OZ/M	Late	0 b	5.7 cd	7 b
34 Turfcide 400	9 FL OZ/M	Late	0 b	5.7 cd	7 b
Daconil Ultrex	3.7 OZ/M	Late			
35 Instrata	7 FL OZ/M	Late	0 b	7 abc	7 b
36 Instrata	3 FL OZ/M	Early	0 b	7 abc	7 b
Instrata	8 FL OZ/M	Late			
37 Instrata	5.5 FL OZ/M	Early/Late	0 b	6.7 a-d	7 b
38 Instrata	7 FL OZ/M	Early/Late	0 b	7 abc	7 b
47 Disarm	0.18 FL OZ/M	Early/Late	0 b	7 abc	7 b
48 Disarm	0.36 FL OZ/M	Early/Late	0 b	7 abc	7 b
Banner MAXX	0.36 FL OZ/M	Early/Late			
49 Disarm	0.18 FL OZ/M	Early/Late	0 b	7 abc	7 b
Banner MAXX	2 FL OZ/M	Early/Late			
50 AND6242	6.36 lb/M	Late	0 b	7.7 a	8.3 a
51 AND6243	6.36 lb/M	Late	0 b	7.3 ab	8 a
52 AND3224	6.36 lb/M	Late	0 b	7 abc	8 a
53 AND6244	6.36 lb/M	Late	0 b	7 abc	8 a

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

<sup>a</sup>Early and late fungicide treatments were applied on Oct. 17, 2006 and Nov. 9, 2006, respectively

<sup>b</sup>Mean percent diseased area

<sup>c</sup>Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green

**Snow Mold and Color Ratings Recorded on March 28th and April 25th, 2007 at Sentryworld GC**

Treatment	Rate	Timing <sup>a</sup>	% Snow Mold <sup>b</sup>	Color <sup>c</sup>	
				3/28/2007	4/25/2007
54 AND6245	6.66 lb/M	Late	0 b	7 abc	8 a
55 AND6246	6.66 lb/M	Late	0 b	7 abc	8 a
56 AND5017	6.66 lb/M	Late	0 b	6.3 a-d	7 b
57 AND6247	6.66 lb/M	Late	0 b	7 abc	7 b
58 AND6248	10 lb/M	Late	0 b	7 abc	8 a
59 AND6259	10 lb/M	Late	0 b	7.7 a	8 a
60 AND6249	10 lb/M	Late	0 b	7.3 ab	8 a
61 AND6251	10 lb/M	Late	1.7 b	7.3 ab	8 a
62 AND6252	10 lb/M	Late	0 b	7.7 a	8 a
63 AND6254	10 lb/M	Late	0 b	7 abc	8 a
64 AND6253	10 lb/M	Late	0 b	7 abc	8 a
65 AND6255	10 lb/M	Late	0 b	7.3 ab	8 a
66 Prophecy	5 lb/M	Early	0 b	7 abc	8 a
AND6257	10 lb/M	Late			
67 Prophecy	5 lb/M	Early	0 b	7.3 ab	8 a
AND6258	10 lb/M	Late			
68 Prophecy	5 lb/M	Early	0 b	7 abc	8 a
AND6259	10 lb/M	Late			
69 Prophecy	5 lb/M	Early	0 b	7.3 ab	8 a
AND6260	10 lb/M	Late			
70 AND6261	9 lb/M	Late	0 b	7.3 ab	8.3 a
71 AND6262	9 lb/M	Late	0 b	7.3 ab	8.3 a
72 AND6263	9 lb/M	Late	0 b	7.3 ab	8.3 a
73 AND6264	9 lb/M	Late	0 b	7.3 ab	8.3 a
74 AND6265	9 lb/M	Late	0 b	7 abc	8 a
75 AND6266	9 lb/M	Late	0 b	7 abc	8 a
76 AND6267	9 lb/M	Late	0 b	7 abc	8 a
77 AND6268	9 lb/M	Late	0 b	7 abc	7.3 b
78 Prophecy	5 lb/M	Early	0 b	7.3 ab	8 a
AND6269	9 lb/M	Late			
79 Prophecy	5 lb/M	Early	0 b	7 abc	8.3 a
AND6270	9 lb/M	Late			
80 Prophecy	5 lb/M	Early	0 b	7.3 ab	8.3 a
AND6271	9 lb/M	Late			
81 Prophecy	5 lb/M	Early	0 b	7.3 ab	8.3 a
AND6272	9 lb/M	Late			
82 Prophecy	5 lb/M	Early	0 b	7.3 ab	8 a
AND6273	9 lb/M	Late			
83 Prophecy	5 lb/M	Early	0 b	7.3 ab	8 a
AND6274	9 lb/M	Late			
84 Prophecy	5 lb/M	Early	0 b	7.3 ab	8.3 a
AND6275	9 lb/M	Late			
85 Prophecy	5 lb/M	Early	0 b	7 abc	8 a
AND6276	9 lb/M	Late			
86 Daconil WeatherStik	5.5 FL OZ/M	Late	0 b	7 abc	7 b
26GT	4 FL OZ/M	Late			
87 Daconil WeatherStik	5.5 FL OZ/M	Late	0 b	7 abc	7 b
Medallion	0.5 OZ/M	Late			

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

<sup>a</sup>Early and late fungicide treatments were applied on Oct. 17, 2006 and Nov. 9, 2006, respectively

<sup>b</sup>Mean percent diseased area

<sup>c</sup>Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green

## **2006-07 Snow Mold Control Evaluation Gateway Golf Club - Land O' Lakes, WI.**

Paul Koch<sup>1</sup> and Jake Schneider<sup>2</sup>

<sup>1</sup>Department of Plant Pathology, <sup>2</sup>Department of Horticulture  
University of Wisconsin-Madison

### **OBJECTIVE**

To evaluate fungicides for the control of Typhula blight (caused by *Typhula ishikariensis* and *Typhula incarnata*) and pink snow mold (caused by *Microdochium nivale*).

### **MATERIALS AND METHODS**

This evaluation was conducted at Gateway Golf Course in Land O' Lakes, WI on a creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) fairway nursery maintained at 0.5-inch cutting height. Individual plots measured 3 ft x 10 ft (30 ft<sup>2</sup>), and were arranged in a randomized complete block design with three replications. Individual treatments were applied at a nozzle pressure of 40 p.s.i using a CO<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup> except treatment 8 was applied in 5 gallons of water per 1000 ft<sup>2</sup>. Granular applications were applied using a shaker jar. Approximately 1 lb/1000 ft<sup>2</sup> of nitrogen fertilizer was applied to the experimental plot throughout the 2006 growing season. Early treatments were applied on October 16th, 2006 and late applications were applied on November 5th, 2006. The experimental plot area was not inoculated. There was continuous snow cover on the plots from November 30th 2006 to late-March 2007, a total of approximately 120 days. The percent cover of snow mold and color were recorded on March 28th, 2007. There was an even distribution of pink snow mold across the experimental plots before the first treatment application, and that was excluded from the final rating. Data obtained was subjected to an analysis of variance to determine significant differences between treatments. The mean percent diseased area snow mold and mean color rating for each individual treatment are located in the table below.

### **RESULTS AND DISCUSSION**

Disease pressure from *Typhula ishikariensis* was fairly high at Gateway GC this season, with untreated control plots averaging 92% disease damage. Despite this high pressure, many of the treatments provided excellent control of pink and gray snow mold. Most treatments limited damage caused by *T. ishikariensis* to less than 10%, while many did not allow any *T. ishikariensis* damage. The untreated controls were rated as having a color of 7, with only minor variations found within the treatments. A large degree of ice damage was observed across much of the plot, making rating for snow mold damage difficult and increasing the variation in the results. The mean percent snow mold and mean color rating for each individual treatment is presented in the table below.

# **Snow Mold and Color Ratings Recorded on March 28th, 2007 at Gateway GC**

Treatment	Rate	Timing <sup>a</sup>	% Snow Mold <sup>b</sup>	Color <sup>c</sup>
1 Untreated Control			91.7 a	7 bc
2 Instrata	5 FL OZ/M	Late	0 f	7 bc
3 Instrata	9 FL OZ/M	Late	0 f	7 bc
4 Instrata	11 FL OZ/M	Late	0 f	7 bc
5 Medallion	0.15 OZ/M	Late	0 f	7 bc
Daconil WeatherStik	2.5 OZ/M	Late		
Banner MAXX	1.8 FL OZ/M	Late		
6 Banner MAXX	2 FL OZ/M	Late	3.3 def	7 bc
Daconil WeatherStik	5.5 FL OZ/M	Late		
7 Banner MAXX	2 FL OZ/M	Late	0 f	7 bc
Turfcide 400	6 FL OZ/M	Late		
8 Turfcide 400	12 FL OZ/M	Late	5 def	7 bc
9 Insignia	0.7 OZ/M	Early	1.7 ef	7 bc
Manicure Ultra	5 OZ/M	Late		
Revere 4000	12 FL OZ/M	Late		
10 18 Plus	4 FL OZ/M	Late	0 f	6.3 c
Manicure Ultra	5 OZ/M	Late		
Revere 4000	12 FL OZ/M	Late		
11 Spectator Ultra	4 FL OZ/M	Early	1.7 ef	7 bc
Insignia	0.7 OZ/M	Early		
Manicure Ultra	5 OZ/M	Late		
12 Spectator Ultra	4 FL OZ/M	Early	0 f	7 bc
Revere 4000	12 FL OZ/M	Late		
13 Insignia	0.7 OZ/M	Early	1.7 ef	7 bc
18 Plus	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
14 Armada	1.2 OZ/M	Early	0 f	7 bc
Revere 4000	12 FL OZ/M	Late		
15 Tartan	2 FL OZ/M	Late	0 f	7.7 ab
Daconil WeatherStik	5.5 FL OZ/M	Late		
16 Tartan	2 FL OZ/M	Late	0 f	7.7 ab
Turfcide 400	6 FL OZ/M	Late		
17 Tartan	2 FL OZ/M	Late	3.3 def	7.7 ab
Chipco 26019GT	6 FL OZ/M	Late		
18 Tartan	2 FL OZ/M	Late	0 f	7.7 ab
Prostar	2.2 OZ/M	Late		
19 TBZ+TFS Green	2 FL OZ/M	Late	0 f	7.3 b
20 TBZ+TFS Green	2 FL OZ/M	Late	0 f	8 a
Chipco 26019GT	4 FL OZ/M	Late		
21 Lynx	1 FL OZ/M	Late	0 f	7.7 ab
Chipco 26019GT	4 FL OZ/M	Late		
Daconil WeatherStik	5.5 FL OZ/M	Late		
22 Insignia	0.7 OZ/M	Late	3.3 def	7 bc
Revere 4000	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

<sup>a</sup>Early and late fungicide treatments were applied on Oct. 16, 2006 and Nov. 5, 2006, respectively

<sup>b</sup>Mean percent diseased area

<sup>c</sup>Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green

**Snow Mold and Color Ratings Recorded on March 28th, 2007 at Gateway GC**

<b>Treatment</b>	<b>Rate</b>	<b>Timing<sup>a</sup></b>	<b>% Snow Mold<sup>b</sup></b>	<b>Color<sup>c</sup></b>
23 Insignia	0.7 OZ/M	Late	3.3 def	7 bc
Iprodione Pro	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
24 Insignia	0.7 OZ/M	Late	0 f	7 bc
BAS 595	1 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
25 Insignia	0.7 OZ/M	Late	5 def	7 bc
Revere 4000	4 FL OZ/M	Late		
Manicure Ultra	4 OZ/M	Late		
26 Spectro	4 OZ/M	Early	1.7 ef	7 bc
26/36	4 FL OZ/M	Late		
CLEX-9	1.2 OZ/M	Late		
27 Spectro	4 OZ/M	Early	1.7 ef	7 bc
26/36	4 FL OZ/M	Late		
Daconil Ultrex	5.5 OZ/M	Late		
28 Spectro	4 OZ/M	Early	11.7 def	7 bc
26/36	4 FL OZ/M	Late		
Endorse	4 OZ/M	Late		
29 26/36	4 FL OZ/M	Late	0 f	7 bc
CLEX-9	1.2 OZ/M	Late		
30 26/36	4 FL OZ/M	Late	5 def	7.3 b
Daconil Ultrex	5.5 OZ/M	Late		
31 26/36	4 FL OZ/M	Late	25 cd	7 bc
Endorse	4 OZ/M	Late		
32 Spectro	5.75 OZ/M	Late	3.3 def	7 bc
CLEX-9	1.2 OZ/M	Late		
33 Turfcide 400	12 FL OZ/M	Late	25 cd	7 bc
34 Turfcide 400	9 FL OZ/M	Late	5.7 def	6.3 c
Daconil Ultrex	3.7 OZ/M	Late		
35 Instrata	7 FL OZ/M	Late	5 def	7 bc
36 Instrata	3 FL OZ/M	Early	0 f	7 bc
Instrata	8 FL OZ/M	Late		
37 Instrata	5.5 FL OZ/M	Early/Late	0 f	7 bc
38 Instrata	7 FL OZ/M	Early/Late	0 f	7 bc
47 Disarm	0.18 FL OZ/M	Early/Late	53.3 b	7 bc
48 Disarm	0.36 FL OZ/M	Early/Late	8.3 def	7 bc
Banner MAXX	0.36 FL OZ/M	Early/Late		
49 Disarm	0.18 FL OZ/M	Early/Late	6.7 def	7 bc
Banner MAXX	2 FL OZ/M	Early/Late		
50 AND6242	6.36 lb/M	Late	31.7 c	7 bc
51 AND6243	6.36 lb/M	Late	22.3 c-f	7 bc
52 AND3224	6.36 lb/M	Late	5 def	7 bc
53 AND6244	6.36 lb/M	Late	1.7 ef	7 bc
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)				
<sup>a</sup> Early and late fungicide treatments were applied on Oct. 16, 2006 and Nov. 5, 2006, respectively				
<sup>b</sup> Mean percent diseased area				
<sup>c</sup> Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green				



**Snow Mold and Color Ratings Recorded on March 28th, 2007 at Gateway GC**

<b>Treatment</b>	<b>Rate</b>	<b>Timing<sup>a</sup></b>	<b>% Snow Mold<sup>b</sup></b>	<b>Color<sup>c</sup></b>
54 AND6245	6.66 lb/M	Late	5.7 def	7 bc
55 AND6246	6.66 lb/M	Late	9.3 def	7 bc
56 AND5017	6.66 lb/M	Late	1.7 ef	7 bc
57 AND6247	6.66 lb/M	Late	0 f	7 bc
58 AND6248	10 lb/M	Late	3.3 def	7 bc
59 AND6259	10 lb/M	Late	10 def	7 bc
60 AND6249	10 lb/M	Late	6.7 def	7 bc
61 AND6251	10 lb/M	Late	10 def	7 bc
62 AND6252	10 lb/M	Late	4.3 def	7 bc
63 AND6254	10 lb/M	Late	3.3 def	7 bc
64 AND6253	10 lb/M	Late	6.7 def	7 bc
65 AND6255	10 lb/M	Late	8.3 def	7 bc
66 Prophecy	5 lb/M	Early	1.7 ef	7 bc
AND6257	10 lb/M	Late		
67 Prophecy	5 lb/M	Early	3.3 def	7 bc
AND6258	10 lb/M	Late		
68 Prophecy	5 lb/M	Early	1.7 ef	7 bc
AND6259	10 lb/M	Late		
69 Prophecy	5 lb/M	Early	1.7 ef	7 bc
AND6260	10 lb/M	Late		
70 AND6261	9 lb/M	Late	8.3 def	7 bc
71 AND6262	9 lb/M	Late	2.7 def	7 bc
72 AND6263	9 lb/M	Late	6.7 def	7 bc
73 AND6264	9 lb/M	Late	18.3 c-f	7 bc
74 AND6265	9 lb/M	Late	6.7 def	7 bc
75 AND6266	9 lb/M	Late	3.3 def	7 bc
76 AND6267	9 lb/M	Late	1 ef	7 bc
77 AND6268	9 lb/M	Late	6.7 def	7 bc
78 Prophecy	5 lb/M	Early	1.7 ef	7 bc
AND6269	9 lb/M	Late		
79 Prophecy	5 lb/M	Early	1.7 ef	7 bc
AND6270	9 lb/M	Late		
80 Prophecy	5 lb/M	Early	5 def	7 bc
AND6271	9 lb/M	Late		
81 Prophecy	5 lb/M	Early	0 f	7 bc
AND6272	9 lb/M	Late		
82 Prophecy	5 lb/M	Early	1.7 ef	7 bc
AND6273	9 lb/M	Late		
83 Prophecy	5 lb/M	Early	4.3 def	7 bc
AND6274	9 lb/M	Late		
84 Prophecy	5 lb/M	Early	3.3 def	7 bc
AND6275	9 lb/M	Late		
85 Prophecy	5 lb/M	Early	3.3 def	7 bc
AND6276	9 lb/M	Late		
86 Daconil WeatherStik	5.5 FL OZ/M	Late	0.7 ef	7 bc
26GT	4 FL OZ/M	Late		
87 Daconil WeatherStik	5.5 FL OZ/M	Late	1.7 ef	7 bc
Medallion	0.5 OZ/M	Late		
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)				
<sup>a</sup> Early and late fungicide treatments were applied on Oct. 16, 2006 and Nov. 5, 2006, respectively				
<sup>b</sup> Mean percent diseased area				
<sup>c</sup> Color was rated on a scale of 1-9 where 1 = straw colored, 6 = acceptable, 9 = dark green				

## **2006-07 Snow Mold Control Evaluation**

### **Quali – Pro Auxiliary Trials: Sentryworld GC and Gateway GC.**

Paul Koch<sup>1</sup> and Jake Schneider<sup>2</sup>

<sup>1</sup>Department of Plant Pathology, <sup>2</sup>Department of Horticulture  
University of Wisconsin-Madison

#### **OBJECTIVE**

To evaluate fungicides for the control of Typhula blight (caused by *Typhula ishikariensis* and *Typhula incarnata*) and pink snow mold (caused by *Microdochium nivale*).

#### **MATERIALS AND METHODS**

This evaluation was conducted at SentryWorld Golf Course in Stevens Point, WI on a Penneagle creeping bentgrass (*Agrostis stolonifera*) fairway nursery maintained at 0.5-inch cutting height and Gateway Golf Club in Land O' Lakes, WI on a creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) fairway nursery managed at a height of 0.5 inch. Individual plots measured 3 ft x 10 ft (30 ft<sup>2</sup>), 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup>. Only one application was made at each site, on November 5<sup>th</sup>, 2006 at Gateway GC and November 9<sup>th</sup>, 2006 at Sentryworld GC. There was continuous snow cover on the plots at Gateway from November 30<sup>th</sup>, 2006 to late March 2007 (120 days) and at Sentryworld from mid-December 2006 to mid-March 2007 (90 days). Percent snow mold damage was recorded on March 28<sup>th</sup>, 2007 at Sentryworld GC and Gateway GC. Data obtained were subjected to an analysis of variance to determine significant differences between treatment means.

#### **RESULTS AND DISCUSSION**

Disease pressure at the Sentryworld GC plot was fairly high this season (75% disease on untreated control) due to a combination of *Typhula incarnata* and *Typhula ishikariensis*, while pressure was even higher at Gateway GC (96% disease on untreated control) due primarily to *T. ishikariensis*. All treatments applied at both sites significantly reduced disease when compared to the untreated controls, but none of the treatments tested completely controlled disease symptoms at Gateway GC. Treatment 2 provided excellent control of *T. incarnata*, but failed to provide the same level of control of *T. ishikariensis*. No color differences were observed with any treatments applied. The mean percent snow mold per plot for each individual treatment is presented in the tables below.

### Snow Mold Ratings Recorded on March 28th, 2007 at Sentryworld GC

Treatment	Rate	Timing <sup>a</sup>	% Snow mold <sup>b</sup>
1 Untreated Control			75 a
2 QP Iprodione Pro	8 FL OZ/M	Late	5 b
3 QP CTL 720	5.5 FL OZ/M	Late	0 b
QP Iprodione Pro	4 FL OZ/M	Late	
QP Propiconazole 14.3	3 FL OZ/M	Late	
4 QP TM/C	8 OZ/M	Late	0.8 b
QP Iprodione Pro	4 FL OZ/M	Late	
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)			
<sup>a</sup> Late fungicide treatments were applied on Nov. 9, 2006, respectively			
<sup>b</sup> Mean percent diseased area			

### Snow Mold Ratings Recorded on March 28th, 2007 at Gateway GC

Treatment	Rate	Timing <sup>a</sup>	% Snow mold <sup>b</sup>
1 Untreated Control			96.3 a
2 QP Iprodione Pro	8 FL OZ/M	Late	13.3 b
3 QP CTL 720	5.5 FL OZ/M	Late	8.3 bc
QP Iprodione Pro	4 FL OZ/M	Late	
QP Propiconazole 14.3	3 FL OZ/M	Late	
4 QP TM/C	8 OZ/M	Late	5.5 c
QP Iprodione Pro	4 FL OZ/M	Late	
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)			
<sup>a</sup> Late fungicide treatments were applied on Nov. 9, 2006, respectively			
<sup>b</sup> Mean percent diseased area			

## **2006-2007 Snow Mold Control Evaluation The Legend at Giants Ridge - Biwabik, MN.**

Paul Koch<sup>1</sup> and Jake Schneider<sup>2</sup>

<sup>1</sup>Department of Plant Pathology, <sup>2</sup>Department of Horticulture  
University of Wisconsin-Madison

Dr. Brian Horgan

Department of Horticultural Science, University of Minnesota

### **OBJECTIVE**

To evaluate fungicide efficacy for the control of Typhula blight (caused by *Typhula ishikariensis* and *Typhula incarnata*), and pink snow mold (caused by *Microdochium nivale*).

### **MATERIALS AND METHODS**

This evaluation was conducted at Giants Ridge Golf Resort, Biwabik, MN on a creeping bentgrass (*Agrostis stolonifera*) golf course fairway maintained at a height of 0.5 inch. Individual plots measured 3 ft x 10 ft (30 ft<sup>2</sup>), 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000 ft<sup>2</sup> except treatment 8 was applied in 5 gallons of water per 1000 ft<sup>2</sup>. Granular applications were applied using a shaker jar. Approximately 2.25 lb/1000 ft<sup>2</sup> of nitrogen fertilizer was applied to the experimental plot throughout the 2006 growing season. Early treatments were applied on October 16, 2006 and late treatments were applied on November 6, 2006. There was continuous snow cover on the plots from December 31<sup>st</sup> until late March, a total of approximately 90 days. Percent snow mold and color were recorded on March 29th, 2007. Data obtained were subjected to an analysis of variance to determine significant differences between treatment means.

### **RESULTS AND DISCUSSION**

The disease pressure at the experimental site was very low this year, with snow mold damage averaging 4.3% on the untreated check plots. The predominant snow mold species that caused damage was *Typhula ishikariensis*. There was no disease present on any of the treatment plots, but significant differences in color were observed and rated. The untreated check plots were given a color rating of 7, and most treatments were statistically similar in color to the untreated check plots. Treatments containing PCNB were statistically more yellow in color, but were indistinguishable from the controls approximately two weeks later. Treatments containing green pigment (trt 15-21) were noticeably greener in color compared to the untreated control, but only treatment 18 was statistically significant.

# **Snow Mold Ratings Recorded on March 29th, 2007 at The Legend at Giants Ridge**

Treatment	Rate	Timing <sup>a</sup>	% Snow mold	Color <sup>c</sup>
1 Untreated Control			4.3 a	7 b
2 Instrata	5 FL OZ/M	Late	0 b	7 b
3 Instrata	9 FL OZ/M	Late	0 b	7 b
4 Instrata	11 FL OZ/M	Late	0 b	7 b
5 Medallion	0.15 OZ/M	Late	0 b	7 b
Daconil WeatherStik	2.5 FL OZ/M	Late		
Banner MAXX	1.8 FL OZ/M	Late		
6 Banner MAXX	2 FL OZ/M	Late	0 b	7 b
Daconil Weather Stik	6 FL OZ/M	Late		
7 Banner MAXX	2 FL OZ/M	Late	0 b	6 c
Turfcide 400	6 FL OZ/M	Late		
8 Turfcide 400	12 FL OZ/M	Late	0 b	5.8 cd
9 Insignia	0.7 OZ/M	Early	0 b	5.5 cd
Manicure Ultra	5 OZ/M	Late		
Revere 4000	12 FL OZ/M	Late		
10 18 Plus	4 FL OZ/M	Late	0 b	6 c
Manicure Ultra	5 OZ/M	Late		
Revere 4000	12 FL OZ/M	Late		
11 Spectator Ultra	4 FL OZ/M	Early	0 b	7 b
Insignia	0.7 OZ/M	Early		
Manicure Ultra	5 OZ/M	Late		
12 Spectator Ultra	4 FL OZ/M	Early	0 b	5.3 d
Revere 4000	12 FL OZ/M	Late		
13 Insignia	0.7 OZ/M	Early	0 b	7 b
18 Plus	4 FL OZ/M	Late		
Manicure Ultra	5 OZ/M	Late		
14 Armada	1.2 OZ/M	Early	0 b	5.8 cd
Revere 4000	12 FL OZ/M	Late		
15 Tartan	2 FL OZ/M	Late	0 b	7.3 b
Daconil WeatherStik	5.5 FL OZ/M	Late		
16 Tartan	2 FL OZ/M	Late	0 b	7 b
Turfcide 400	6 FL OZ/M	Late		
17 Tartan	2 FL OZ/M	Late	0 b	7.3 b
Chipco 26019GT	6 FL OZ/M	Late		
18 Tartan	2 FL OZ/M	Late	0 b	8 a
Prostar	2.2 OZ/M	Late		
19 TBZ+TFS Green	2 FL OZ/M	Late	0 b	7.5 ab
20 TBZ+TFS Green	2 FL OZ/M	Late	0 b	7.3 b
Chipco 26019GT	4 FL OZ/M	Late		
21 Lynx	1 FL OZ/M	Late	0 b	7.5 ab
Chipco 26019GT	4 FL OZ/M	Late		
Daconil WeatherStik	5.5 FL OZ/M	Late		
22 Spectro	4 OZ/M	Early	0 b	7 b
26/36	4 FL OZ/M	Late		
CLEX-9	1.2 OZ/M	Late		

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

<sup>a</sup>Early and late fungicide treatments were applied on Oct. 16, 2006 and Nov. 6, 2006, respectively

<sup>b</sup>Mean percent diseased area

<sup>c</sup>Color was rated on a scale of 1-9 where 1 = straw colored, 7 = acceptable, 9 = dark green

# **Snow Mold Ratings Recorded on March 29th, 2007 at The Legend at Giants Ridge**

Treatment	Rate	Timing <sup>a</sup>	% Snow mold <sup>b</sup>	Color <sup>c</sup>
23 Spectro	4 OZ/M	Early	0 b	7 b
26/36	4 FL OZ/M	Late		
Daconil Ultrex	5.5 OZ/M	Late		
24 Spectro	4 OZ/M	Early	0 b	7 b
26/36	4 FL OZ/M	Late		
Endorse	4 OZ/M	Late		
25 Turfcide 400	12 FL OZ/M	Late	0 b	5.8 cd
26 Turfcide 400	9 FL OZ/M	Late	0 b	5.8 cd
Daconil Ultrex	3.7 OZ/M	Late		
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)				
<sup>a</sup> Early and late fungicide treatments were applied on Oct. 16, 2006 and Nov. 6, 2006, respectively				
<sup>b</sup> Mean percent diseased area				
<sup>c</sup> Color was rated on a scale of 1-9 where 1 = straw colored, 7 = acceptable, 9 = dark green				

## **2006-2007 Snow Mold Control Evaluation The Quarry at Giants Ridge – Biwabik, MN**

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<sup>1</sup>Department of Plant Pathology, <sup>2</sup>Department of Horticulture  
University of Wisconsin-Madison

Dr. Brian Horgan  
Department of Horticultural Science, University of Minnesota

### **OBJECTIVES**

The primary objective was to evaluate fungicide efficacy for the control of snow scald (*Myriosclerotinia borealis*), which was observed in 2005 at this site. Also, fungicide efficacy for the control of Typhula blight (caused by *Typhula ishikariensis* and *Typhula incarnata*), and pink snow mold (caused by *Microdochium nivale*) was evaluated.

### **MATERIALS AND METHODS**

This evaluation was conducted at Giants Ridge Golf Resort in Biwabik, MN on a creeping bentgrass (*Agrostis stolonifera*) golf course fairway maintained at a height of 0.5 inches. Individual plots measured 3 ft x 10 ft (30 ft<sup>2</sup>), 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<sub>2</sub> pressurized boom sprayer equipped with two XR Teejet 8005 VS nozzles. All fungicides were agitated by hand and applied in the equivalent of 2 gallons of water per 1000ft<sup>2</sup>. Approximately 2.25 lb/1000 ft<sup>2</sup> of nitrogen fertilizer was applied to the experimental plot throughout the 2006 growing season. Early treatments were applied on October 16<sup>th</sup>, 2006 and late treatments were applied on November 6<sup>th</sup>, 2006. There was continuous snow cover on the plots from late December until late March, a total of approximately 90 days. Percent snow mold, color, and snow scald occurrence were all recorded on March 29th, 2007. Data obtained were subjected to an analysis of variance to determine significant differences between treatment means. The mean percent snow mold damage, mean color, and occurrence of snow scald for each individual treatment is located in the table below.

### **RESULTS AND DISCUSSION**

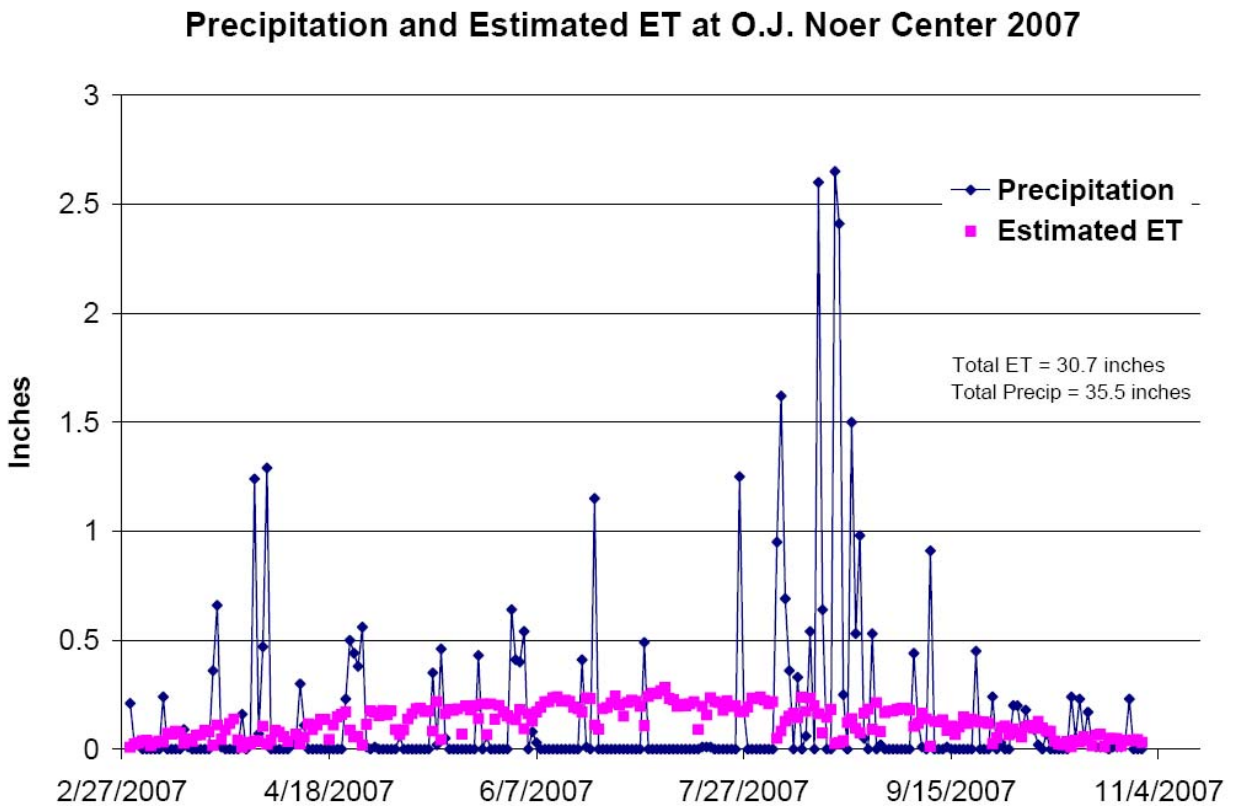
The disease pressure at the experimental site was very low this year, with damage approximately 2.3% in the check plots at The Quarry. The predominant snow mold species that caused damage was *Typhula ishikariensis*. Snow scald damage was not observed anywhere on the experimental plot. There was no disease present on any of the treated plots. The untreated check plot was given a color rating of 7, and those treatments containing PCNB were statistically more yellow in color. Within approximately two weeks of the rating date, the color in those treatments was no longer distinguishable from the untreated controls.

## Snow Mold and Color Ratings Recorded on March 29th, 2007 at The Quarry

Treatment	Rate	Timing <sup>a</sup>	Snow scald <sup>b</sup>	% Snow mold <sup>c</sup>	Color <sup>d</sup>
1 Untreated Control				2.3 a	7 a
2 Insignia	0.7 OZ/1000 FT	Early		0 b	6 b
Manicure Ultra	5 OZ/1000 FT	Late			
Revere 4000	12 FL OZ/1000	Late			
3 18 Plus	4 FL OZ/1000	Late		0 b	5.5 b
Manicure Ultra	5 OZ/1000 FT	Late			
Revere 4000	12 FL OZ/1000	Late			
4 Spectator Ultra	4 FL OZ/1000	Early		0 b	7 a
Insignia	0.7 OZ/1000 FT	Early			
Manicure Ultra	5 OZ/1000 FT	Late			
5 Spectator Ultra	4 FL OZ/1000	Early		0 b	5.3 b
Revere 4000	12 FL OZ/1000	Late			
6 Insignia	0.7 OZ/1000 FT	Early		0 b	7 a
18 Plus	4 FL OZ/1000	Late			
Manicure Ultra	5 OZ/1000 FT	Late			
7 Armada	1.2 OZ/1000 FT	Early		0 b	5.3 b
Revere 4000	12 FL OZ/1000	Late			
8 Turfcide 400	12 FL OZ/1000	Late		0 b	5.5 b
9 Turfcide 400	9 FL OZ/1000	Late		0 b	6 b
Daconil Ultrex	3.7 OZ/1000 FT	Late			
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)					
<sup>a</sup> Early and late fungicide treatments were applied on Oct. 16, 2006 and Nov. 6, 2006, respectively					
<sup>b</sup> Occurrence of snow scald at one plot (X) or two plots (XX).					
<sup>c</sup> Mean percent diseased area					
<sup>d</sup> Color was rated on a scale of 1-9 where 1 = straw colored, 7 = acceptable, 9 = dark green					



## APPENDIX B



**Figure 1.** Precipitation and estimated ET for 2007 at the O.J. Noer Turfgrass Research and Education Center in Madison, WI. Conditions were very dry in early summer, and very wet in late summer.