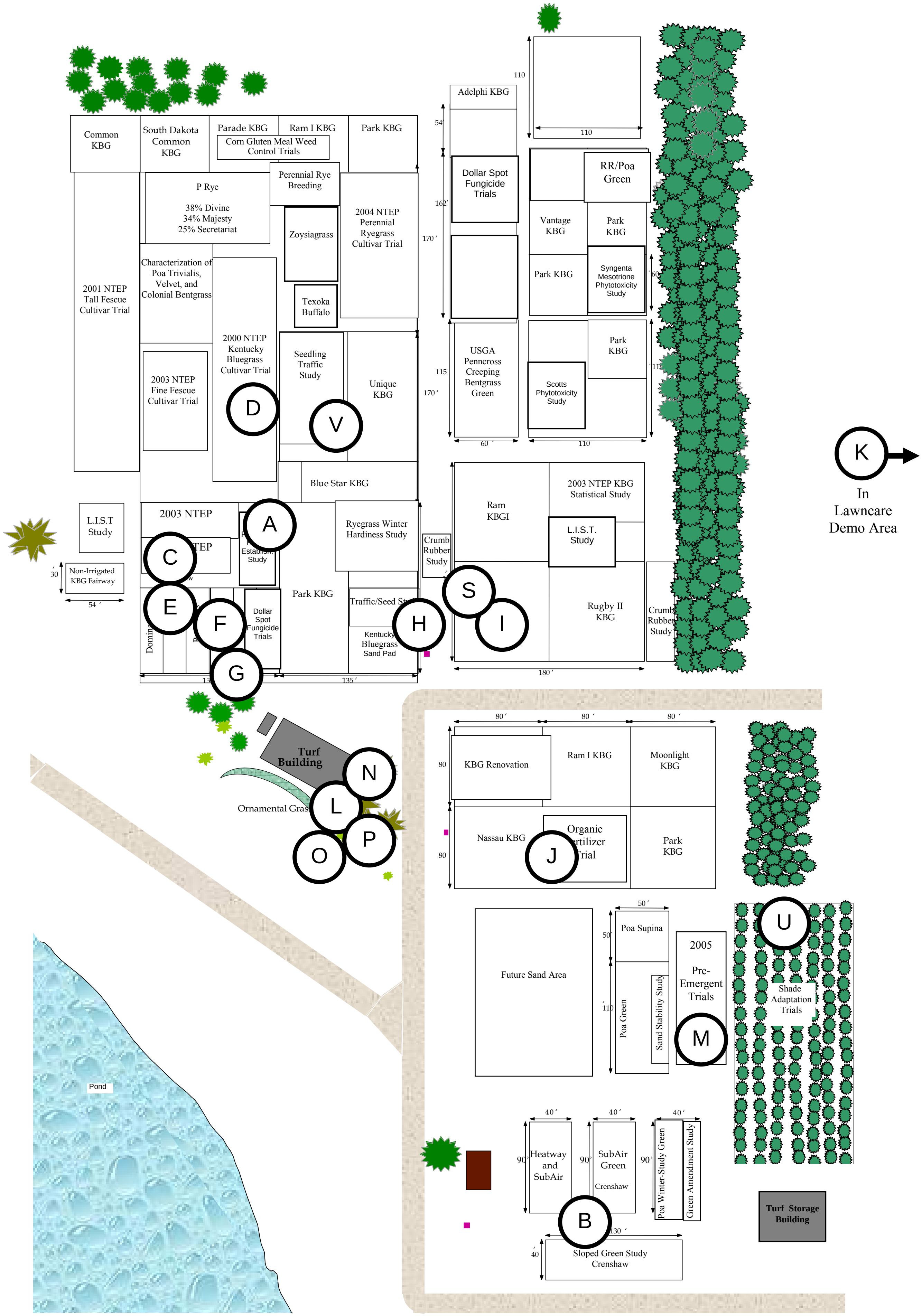
2005 Iowa Turfgrass Research Report

Iowa State University
University Extension
Ames, IA
FG-469/July 2005

Department of Horticulture
Department of Plant Pathology
Department of Entomology
Cooperative Extension
In Cooperation with the Iowa Turfgrass Institute


Common KBG
South Dakota Common KBG
Parade KBG
Ram I KBG
Park KBG
Corn Gluten Meal Weed Control Trials
Perennial Rye Breeding
P Rye
38% Divine
34% Majesty
25% Secretariat
Zoysiagrass
2004 NTEP Perennial Ryegrass Cultivar Trial
2001 NTEP Tall Fescue Cultivar Trial
Characterization of Poa Trivialis, Velvet, and Colonial Bentgrass
Texoka Buffalo
2000 NTEP Kentucky Bluegrass Cultivar Trial
Seedling Traffic Study
Unique KBG
2003 NTEP Fine Fescue Cultivar Trial
Blue Star KBG
L.I.S.T Study
2003 NTEP
Ryegrass Winter Hardiness Study
Non-Irrigated KBG Fairway
Park KBG
Dollar Spot Fungicide Trials
Traffic/Seed St
Kentucky Bluegrass Sand Pad
135 ′
Adelphi KBG
Dollar Spot Fungicide Trials
110
110
RR/Poa Green
Vantage KBG
Park KBG
Park KBG
Syngenta Mesotrione Phytotoxicity Study
Park KBG
USGA Penncross Creeping Bentgrass Green
Scotts Phytotoxicity Study
60 ′
110
115
170 ′
162′
54′
Ram KBGI
2003 NTEP KBG Statistical Study
L.I.S.T. Study
Crumb Rubber Study
Rugby II KBG
Crumb Rubber Study
180 ′
In Lawncare Demo Area
Turf Building
Ornamental Gras
80 ′
KBG Renovation
Ram I KBG
Moonlight KBG
Nassau KBG
Organic rtilizer Trial
Park KBG
50 ′
Poa Supina
Future Sand Area
2005 Pre-Emergent Trials
Poa Green
Sand Stability Study
Shade Adaptation Trials
Pond
40 ′
Heatway and SubAir
SubAir Green
Crenshaw
Poa Winter-Study Green
Green Amendment Study
90′
130 ′
Sloped Green Study Crenshaw
Turf Storage Building
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
S
U
V

Iowa Turfgrass Field Day Program

July 28, 2005

6:30 am Equipment Display Set-up
7:30 am Registration (coffee & donuts)
8:30 am Introduction – Registration Tent

GCSAA Certification
Application has been made for GCSAA Education points & Service points.
Check www.iowaturfgrass.org for details.

TIME	#1 Lawn Care-Grounds Tour	#2 Golf Course Tour	#3 Sports Turf Tour	#4 Landscape Tour	Pesticide Courses
9:00	**M:** Crabgrass Herbicide Trials *-Luke Dant & Nick Christians*	**IGCSA Demonstration**	**M:** Crabgrass Herbicide Trials *-Luke Dant & Nick Christians*	Home Demonstration Garden Crabapples Landscape Plant Trials Hazard Trees in the Landscape *-Dr. Jeff Iles & James Romer*	
9:15					
9:30	**U:** New Shade Trial *-Nick Christians*		**V:** Athletic Field Traffic Tolerance: Seeding KB, PR, TF into Roundup Killed Mature Turf *-Federico Valverde*		
9:45					
10:00	**IPLCA Demonstration**	**M:** Crabgrass Herbicide Trials *-Luke Dant & Nick Christians*	**H:** KB, PR Seedlings and Multiple Seeding *-Federico Valverde*		**Sign in at Turfgrass Research Building**
10:15		**B:** Bentgrass Control in Kentucky Bluegrass Turf *-Marcus Jones*	**I:** KB, PR Annual Overseeding, spring vs. fall *-Federico Valverde*		**L:** Effects of Pesticides on Groundwater and Other Non-Target Sites *-Dr. Mark Shour* Drift & Persistance *-Mark Hanna*
10:30		**C:** Fariway and Putting Green Bentgrass Varieties *-Dr. Nick Christians*	**S:** KB, PR, TF Seeding Rates in Bare Soil *- Valverde & Ryan Pirtle*		
10:45		**E:** Calcium soil testing for sand greens *-Rodney St. John*	**K:** Alternative Weed Control Products *-Ryan Holl & Christians*		
11:00	**J:** Fertilizer Trial *-Chris Blume*	**F:** Mowing Quality and Turf Performance *-Mark Howieson*	**ISTMA Demonstration**		
11:15	**K:** Alternative Weed Control Products *-Ryan Holl & Dr. Nick Christians*	**G:** Breeding – Roundup Ready Bentgrass and Bluegrasses. *-Shan Rajasekar, Yanwen Xiong, and Chris Blume*			
11:30					**O:** Laws and Regulations. *-Chuck Eckerman*
11:45	**D:** NTEP Cool Season Grass Variety Trials *-Dr. Nick Christians*	**A:** Establishing Roundup Ready Bentgrass *-Luke Dant*			
12:00	Lunch is Served in Exhibit Area				
1:00	Turfgrass Identification and Weed, Disease, and Insect Tour – Dr. Donald Lewis & Dr. Nick Christians **NOTE: Must attend this session along with stations L and O to receive recertification credits (3OT & 10).**				

ITI/IGCSA Benefit Tournament
Monday, September 12, 2005
Wakonda Club, Des Moines

72nd Annual Iowa Turfgrass Conference and Trade Show
January 30-31, February 1, 2006
Polk County Convention Complex, Des Moines

Introduction

Nick E. Christians , David D. Minner, and Shui-zhang Fei

The following research report is the 26th yearly publication of the results of turfgrass research projects performed at Iowa State University. This is the eighth year that the entire report is available on the Internet. This report and the previous years' reports can be accessed at:

http://turfgrass.hort.iastate.edu/

In 2003-2004, a new Roundup Ready® ETQ (Enhanced Turf Quality) Kentucky bluegrass study was initiated. The trials on fairway and green conversion with Roundup Ready® creeping bentgrass are in their third year. Morphological and genetic characterization of a number of alternative turfgrass species, including *Poa trivialis*, colonial and velvet bentgrass is in progress. The field study of winter hardiness of perennial ryegrass is in its second year. An important gene potentially responsible for freezing tolerance has been isolated from perennial ryegrass and further studies on its function are underway.

New fairway height creeping bentgrass, green height creeping bentgrass, and fine fescue studies were established in the fall of 2003. These plots will be on the field day program on July 28, 2005.

We would like to acknowledge Will Emley, superintendent of the ISU Horticulture Research Station; Rodney St. John, manager of the turf research area; Federico Valverde, research associate; Ken LaChance-Yates, undergraduate research associate; Dr. Young Joo, visiting scientist from Korea and Dr. Fernando C. Sanchez, a visiting scientist from the Philippines; Luke Dant, Mark Howieson, Marcus Jones, Yanwen Xiong, Chris Blume, graduate students; and all others employed at the field research area in the past year for their efforts in building the turf program.

We would like to express special thanks to our industry supporters who provided equipment and supplies to the turf program in 2004. Without their support, many of the things we do would not be possible. See the last page for a list of supporters. If we missed anyone that should be on the list, please contact Nick Christians and your company name will be added to the web site list.

Special thanks to Mark Hoffman, Rodney St. John, and Sherry St. John for helping to prepare this publication.

Edited by Nick Christians, David Minner and Shui-Zhang Fei, Iowa State University, Department of Horticulture, Ames, IA 50011-1100.

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2004 Weather Data for the Turf Research Farm at Gilbert, IA.

Minimum air temperature (Air min), maximum air temperature (Air max), and soil temperature at 4in. (Soil4 min and max) measured in degrees Fahrenheit (ºF). Average wind speed (Wind avg) measured in mph. Rain measured in inches.

January

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	24.3	49.6	2.2	30.3	31.7	0
2	27.4	49.1	1.2	31.7	31.8	0
3	18.7	31.4	5.5	29.4	31.8	0
4	10.4	19.1	8.0	27.7	29.5	0
5	-3.2	10.6	7.1	17.7	27.7	0
6	-3.5	18.8	5.9	15.2	24.9	0
7	2.2	26.0	0.8	16.9	27.5	0
8	15.9	29.3	1.1	23.0	28.6	0
9	4.1	27.6	0.0	25.4	28.7	0.02
10	17.6	28.8	1.2	27.2	29.6	0
11	24.1	49.4	2.9	27.5	31.2	0
12	23.5	44.3	2.0	31.1	31.6	0
13	22.5	35.1	1.9	31.0	31.6	0
14	15.7	39.1	7.1	26.5	31.3	0
15	10.4	37.6	1.8	23.2	30.6	0
16	25.6	38.5	2.7	27.1	31.3	0.34
17	25.0	33.6	5.0	31.2	31.6	0.01
18	1.7	25.0	10.8	16.7	31.6	0
19	-0.1	17.8	1.6	13.8	24.5	0
20	10.7	21.7	1.0	19.4	24.2	0
21	11.0	42.6	6.6	22.7	30.3	0
22	-2.6	18.0	5.7	13.6	25.0	0
23	17.9	51.1	3.7	20.6	29.7	0
24	11.5	24.5	7.1	21.4	28.6	0
25	15.0	28.5	9.2	20.6	27.3	0
26	12.5	21.5	7.0	24.7	26.8	0
27	-9.6	12.7	6.3	26.2	27.1	0
28	-11.9	0.0	4.7	25.0	26.2	0
29	-11.9	-0.1	4.7	24.2	25.1	0
30	-12.0	-2.3	2.6	23.7	24.6	0
31	-9.0	13.3	2.8	23.5	25.1	0

February

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	12.2	22.3	2.6	25.0	26.4	0
2	6.3	25.7	5.9	26.4	27.6	0
3	-10.4	8.1	3.5	27.4	27.6	0
4	-10.0	18.6	2.5	27.0	27.7	0
5	16.5	25.6	6.7	27.7	28.4	0
6	11.2	24.7	7.7	28.4	29.0	0
7	-9.2	12.1	4.0	28.9	29.0	0
8	-10.2	32.0	5.2	28.4	28.9	0
9	18.3	30.1	5.9	28.6	29.2	0.03
10	9.8	26.2	4.2	29.0	29.2	0
11	10.9	27.0	6.2	29.0	29.3	0
12	0.9	17.3	4.3	29.0	29.4	0
13	1.7	31.3	6.9	28.5	29.2	0
14	2.6	23.1	5.7	28.7	29.0	0
15	-3.6	25.0	2.1	28.0	28.8	0
16	6.5	29.1	1.8	27.7	28.4	0
17	9.2	30.1	0.6	27.9	28.7	0
18	19.3	44.3	3.7	28.5	30.8	0
19	29.2	42.5	2.2	30.8	31.3	0
20	32.3	36.0	9.6	31.3	31.5	0.32
21	27.3	40.5	3.7	31.4	31.6	0
22	29.7	46.2	1.7	31.5	31.6	0.09
23	31.0	34.9	6.1	31.6	31.7	0
24	32.3	34.2	3.0	31.6	31.7	0
25	27.4	38.4	1.1	31.6	31.7	0
26	25.2	44.5	0.6	30.9	31.9	0
27	30.6	46.3	2.9	31.8	32.0	0
28	34.8	54.4	2.8	31.9	35.5	0
29	40.4	56.8	3.5	31.7	41.7	0.04

March

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	38.4	50.5	5.0	35.3	39.9	0.22
2	34.3	40.0	4.4	33.7	36.8	0
3	33.2	38.5	0.7	32.4	36.0	0.05
4	35.5	40.0	6.3	33.8	36.1	0.64
5	34.2	39.8	7.3	34.7	38.6	0.39
6	30.0	57.0	6.6	32.4	43.6	0
7	29.9	42.9	9.2	32.9	39.3	0
8	24.4	56.9	5.4	32.5	42.4	0
9	31.8	48.5	4.1	33.8	45.6	0
10	32.3	55.7	6.3	33.8	43.8	0.02
11	15.3	36.2	10.6	32.4	35.6	0
12	14.1	44.2	2.4	31.2	32.4	0
13	31.6	56.1	8.9	31.9	39.7	0.09
14	27.6	46.7	7.7	33.9	42.2	0
15	27.5	31.6	5.9	33.1	35.4	0.11
16	26.0	35.1	4.2	32.9	33.2	0.1
17	27.6	42.7	1.5	32.7	32.9	0.06
18	28.5	44.6	3.9	32.5	40.3	0.18
19	27.6	64.4	4.7	33.3	46.5	0
20	27.0	54.8	10.6	37.2	50.5	0
21	20.4	38.1	6.6	33.8	41.8	0
22	17.7	46.1	3.3	33.1	44.0	0
23	35.2	63.5	3.2	34.6	53.3	0.02
24	45.9	77.7	6.6	43.8	59.6	0.05
25	57.9	63.8	7.4	54.2	57.4	0.06
26	58.1	70.7	2.2	54.9	61.7	0
27	55.2	64.6	4.8	57.1	59.4	1.19
28	42.8	58.0	7.3	47.2	57.3	0
29	34.8	59.1	5.9	42.7	57.2	0
30	29.9	37.8	6.7	38.0	44.5	0
31	24.8	73.9	5.1	36.0	49.8	0

April

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	26.9	58.0	2.2	36.2	55.2	0
2	28.1	64.6	3.1	38.2	59.4	0
3	36.6	56.8	8.3	42.1	56.6	0
4	25.4	60.2	1.6	39.3	61.4	0
5	32.6	68.8	5.6	42.1	62.4	0
6	39.4	72.9	4.8	50.0	67.9	0
7	32.2	74.1	3.4	46.3	70.2	0
8	37.4	63.8	7.9	48.2	66.2	0
9	34.4	60.9	4.0	47.8	63.8	0
10	25.1	48.6	7.1	46.2	61.7	0
11	20.2	51.9	1.6	40.2	62.1	0
12	48.9	66.8	2.7	51.1	66.9	0
13	45.5	54.7	6.8	48.1	54.6	0.81
14	44.3	61.6	6.1	50.3	58.9	0.13
15	40.2	59.8	5.4	45.4	60.6	0.12
16	32.9	68.9	5.0	41.5	60.8	0.12
17	56.6	86.9	12.6	50.8	69.1	0.12
18	52.7	71.6	7.3	56.8	66.6	0.06
19	43.7	54.2	5.2	51.6	56.8	0.27
20	26.9	58.0	2.2	36.2	55.2	0
21	28.1	64.6	3.1	38.2	59.4	0
22	36.6	56.8	8.3	42.1	56.6	0
23	25.4	60.2	1.6	39.3	61.4	0
24	32.6	68.8	5.6	42.1	62.4	0
25	39.4	72.9	4.8	50.0	67.9	0
26	32.2	74.1	3.4	46.3	70.2	0
27	37.4	63.8	7.9	48.2	66.2	0
28	34.4	60.9	4.0	47.8	63.8	0
29	25.1	48.6	7.1	46.2	61.7	0
30	20.2	51.9	1.6	40.2	62.1	0

2004 Weather Data for the Turf Research Farm at Gilbert, IA.

Minimum air temperature (Air min), maximum air temperature (Air max), and soil temperature at 4in. (Soil4 min and max) measured in degrees Fahrenheit (ºF). Average wind speed (Wind avg) measured in mph. Rain measured in inches.

May

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	40.7	59.2	4.6	45.8	61.9	0.25
2	33.6	53.8	4.3	43.4	57.0	0.15
3	28.2	61.0	4.5	40.5	61.0	0.19
4	45.0	72.4	5.1	47.7	66.0	0.17
5	36.1	80.4	4.8	46.7	67.4	0.28
6	59.5	82.0	4.5	57.3	70.4	0.07
7	52.1	64.6	9.6	52.5	60.7	0.1
8	52.5	84.7	4.8	52.1	71.4	0.21
9	63.0	81.4	8.2	60.7	74.5	0.02
10	63.2	77.6	3.9	64.0	73.8	0
11	59.2	82.3	6.0	61.9	78.7	0
12	57.3	75.3	4.7	64.8	71.3	0.33
13	43.6	57.4	7.9	53.0	64.8	0.71
14	38.6	58.1	4.3	48.8	64.7	0.13
15	33.5	63.6	1.8	46.8	66.9	0
16	48.6	75.0	5.0	52.2	73.2	0
17	58.4	76.2	5.1	61.1	70.5	0.44
18	53.8	70.9	3.4	58.7	72.1	0
19	55.2	74.3	4.7	60.2	70.6	0
20	65.6	85.4	2.5	64.8	79.8	0
21	66.2	86.5	6.7	66.7	79.1	0.02
22	62.0	80.3	4.7	66.9	79.6	1.77
23	53.0	65.9	3.9	62.8	70.6	0.76
24	48.3	67.2	6.2	58.8	69.4	0.93
25	50.0	65.6	3.8	59.5	70.5	0
26	46.2	70.8	2.9	56.9	74.2	0
27	59.7	81.1	4.4	63.0	78.3	0.1
28	53.4	78.6	2.8	61.2	80.6	0.14
29	61.8	80.5	6.9	65.9	76.6	0.28
30	60.0	75.6	5.1	66.5	76.1	0.4
31	55.3	75.0	7.4	62.1	74.5	0.05

June

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	55.3	67.3	7.1	59.5	66.8	0
2	54.6	72.0	3.2	60.1	71.9	0
3	51.0	77.2	0.5	58.7	82.2	0
4	53.0	82.6	0.4	63.2	87.6	0
5	60.5	75.3	2.6	67.6	75.4	0
6	58.6	83.5	2.1	64.9	88.0	0
7	69.2	88.7	7.1	71.9	91.5	0
8	73.7	88.7	5.6	75.8	88.9	0
9	71.3	83.2	5.8	75.4	89.1	0
10	68.7	80.4	0.8	75.5	84.4	0.36
11	65.5	86.1	4.4	75.3	86.8	0.21
12	64.2	85.5	3.2	71.6	89.4	0.11
13	62.1	84.0	1.0	69.8	87.9	0.1
14	63.1	83.7	1.4	72.6	87.4	0.36
15	62.2	81.6	2.5	71.2	85.1	0
16	63.3	78.1	3.3	72.3	80.0	0.74
17	59.6	78.3	3.2	67.9	82.6	0
18	58.5	67.6	4.2	68.3	75.7	0.01
19	47.2	70.9	2.3	62.1	83.1	0
20	56.5	69.9	3.0	67.1	75.3	0
21	57.1	77.3	1.4	66.9	79.7	0.69
22	50.0	78.1	2.4	62.7	80.2	0
23	61.1	82.0	3.6	65.5	86.0	0
24	47.6	63.8	2.6	62.7	74.3	0.33
25	43.2	74.9	2.0	56.9	78.7	0
26	48.5	79.7	1.5	61.6	83.6	0.08
27	61.1	75.1	1.2	67.8	76.1	0
28	50.6	78.1	1.7	63.1	84.3	0
29	54.3	81.9	2.0	66.4	89.2	0
30	55.6	82.8	1.6	69.0	92.0	0

July

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	62.3	86.5	2.0	73.0	94.7	0
2	67.4	81.1	3.3	76.1	87.0	0.82
3	66.7	74.8	2.7	73.1	77.3	0.24
4	63.6	86.1	2.2	69.8	87.8	0
5	63.8	81.1	2.9	72.6	81.4	0.34
6	61.4	73.4	4.5	70.5	78.2	0
7	57.3	70.5	2.9	66.1	79.2	0
8	56.6	75.8	4.0	67.2	82.3	0.02
9	66.9	79.8	2.5	71.1	80.8	0.24
10	63.8	84.5	1.4	70.5	86.9	0
11	67.8	75.8	1.9	74.5	79.1	1.22
12	64.1	87.6	1.5	71.1	90.0	0
13	64.1	87.8	2.6	77.6	94.0	0
14	61.0	81.7	2.7	73.4	92.6	0
15	59.8	84.5	1.4	73.3	95.9	0
16	65.4	84.6	3.1	78.9	95.9	0
17	61.0	79.2	2.5	74.9	94.0	0
18	57.7	81.7	0.7	74.0	94.0	0
19	63.5	87.6	3.2	75.8	97.4	0
20	68.2	91.9	1.4	80.0	102.3	0
21	71.7	89.6	2.3	81.6	92.2	0.22
22	67.8	84.8	1.1	79.1	88.3	0
23	61.8	75.2	4.6	74.2	88.8	0
24	55.3	71.0	0.4	72.9	82.2	0
25	49.1	79.9	0.5	66.5	92.0	0
26	51.7	82.1	0.1	70.1	95.8	0
27	54.0	79.7	1.9	72.9	95.1	0
28	58.8	81.2	3.4	73.3	93.7	0
29	63.3	84.9	2.6	76.9	96.0	0.03
30	59.5	80.0	2.3	76.1	89.9	0
31	55.7	85.0	2.3	73.3	97.7	0

August

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	64.2	81.8	3.5	74.8	85.5	0.65
2	67.2	89.0	3.3	73.5	86.8	0.17
3	66.0	87.8	2.3	76.0	88.4	1.07
4	63.1	78.0	0.0	73.2	80.9	0.02
5	54.6	74.2	0.0	67.0	84.2	0
6	49.4	77.9	0.0	64.2	89.5	0
7	59.3	77.9	0.0	70.1	89.7	0
8	62.7	81.4	0.0	72.4	87.8	0.01
9	56.9	76.2	2.5	70.5	88.9	0
10	52.9	65.8	3.2	70.1	77.7	0
11	47.9	65.5	3.4	63.3	79.5	0
12	47.9	71.1	1.1	63.0	82.5	0
13	46.0	72.0	1.0	63.6	80.9	0
14	46.1	76.5	0.3	63.5	85.7	0
15	45.7	75.8	2.0	64.3	89.0	0
16	57.8	78.6	3.8	68.8	77.1	0.17
17	61.0	78.2	1.9	68.1	83.1	0.01
18	54.9	72.9	2.7	66.6	74.3	0.2
19	44.9	68.8	1.6	58.4	77.3	0
20	51.7	77.8	1.9	62.1	85.2	0
21	48.0	74.8	2.5	63.1	85.5	0
22	62.3	83.7	5.8	67.8	89.8	0
23	65.9	84.5	2.2	74.1	90.6	0
24	66.2	80.8	1.5	73.6	88.3	0.05
25	65.8	78.4	2.8	72.8	78.6	0.36
26	66.5	86.1	3.4	72.3	85.4	1.18
27	61.6	81.4	4.1	70.4	83.8	0
28	57.7	74.2	4.4	69.5	80.7	0
29	52.1	75.3	1.6	65.3	83.1	0
30	58.2	82.8	1.5	67.4	89.2	0
31	54.0	83.0	2.7	67.7	87.0	0

2004 Weather Data for the Turf Research Farm at Gilbert, IA.

Minimum air temperature (Air min), maximum air temperature (Air max), and soil temperature at 4in. (Soil4 min and max) measured in degrees Fahrenheit (ºF). Average wind speed (Wind avg) measured in mph. Rain measured in inches.

September

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	66.0	88.8	2.5	72.1	93.8	0
2	64.2	83.4	2.6	73.7	92.2	0
3	62.0	84.3	1.5	72.4	91.7	0
4	63.2	84.9	2.2	73.1	92.1	0
5	65.7	83.9	4.5	75.9	88.2	0.73
6	54.9	77.8	4.1	68.4	80.5	0.01
7	46.9	72.9	2.2	61.5	78.4	0
8	48.6	74.6	1.7	61.0	80.4	0
9	52.4	78.0	2.7	63.4	81.6	0
10	59.0	83.6	4.9	66.1	83.0	0
11	60.7	84.6	2.1	68.5	85.5	0
12	54.7	84.6	2.7	67.8	85.6	0
13	61.8	86.3	5.2	69.6	84.8	0
14	66.4	84.5	3.0	72.2	78.3	0.17
15	55.9	79.3	6.3	68.0	75.5	0.01
16	49.4	78.0	1.4	61.9	78.0	0.01
17	50.1	70.8	2.3	61.4	69.0	0.01
18	56.8	81.4	3.4	62.4	74.7	0
19	62.2	86.6	4.4	64.8	80.4	0
20	59.5	80.2	4.5	65.7	79.4	0
21	57.9	83.3	3.1	64.9	80.3	0
22	56.9	83.5	2.1	66.6	82.0	0
23	62.6	75.8	4.8	66.2	73.7	0.02
24	50.6	79.3	2.4	60.2	75.3	0
25	45.1	79.2	1.0	60.4	76.2	0
26	42.8	80.9	1.4	59.7	76.2	0
27	49.2	83.5	3.0	62.0	75.9	0
28	44.3	69.8	4.5	60.9	74.5	0
29	35.4	70.7	1.6	56.2	72.0	0
30	47.3	77.1	3.9	58.6	70.4	0

October

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	35.4	68.1	5.5	52.8	66.3	0.03
2	29.4	59.8	2.0	46.3	60.2	0.3
3	44.6	76.7	4.9	48.7	63.2	0
4	33.4	55.8	4.2	48.9	61.3	0
5	32.5	67.3	2.7	46.4	61.4	0
6	41.7	78.2	2.3	50.4	65.8	0
7	55.3	67.4	3.8	56.6	63.2	0.06
8	44.8	77.1	3.9	59.4	70.6	0
9	37.2	75.1	0.3	52.3	68.4	0
10	36.6	70.9	1.2	51.2	66.5	0
11	42.4	64.5	2.1	52.1	62.5	0
12	44.4	61.0	1.6	52.4	61.0	0
13	43.3	56.0	5.6	51.1	56.4	0.04
14	31.7	49.8	4.1	45.9	51.5	0
15	31.3	53.4	4.3	44.8	51.4	0.01
16	28.9	49.1	4.8	44.4	53.2	0
17	28.1	58.2	1.9	42.9	54.0	0
18	44.5	55.1	7.3	48.4	52.8	0
19	44.5	50.4	2.6	48.7	52.2	0.02
20	48.1	51.6	3.5	50.4	52.0	0
21	49.7	57.5	5.4	50.8	54.0	0
22	54.7	66.8	5.7	53.9	60.1	0
23	43.9	66.8	7.4	52.6	59.7	0
24	34.9	72.5	1.9	47.1	61.3	0
25	44.9	63.6	4.9	50.1	61.1	0
26	49.1	54.8	5.0	52.4	55.3	0.3
27	51.4	56.3	3.3	53.5	56.5	0
28	52.9	68.6	3.6	54.3	59.8	0.02
29	58.0	80.2	8.3	59.6	67.7	0.44
30	36.9	58.2	9.2	48.6	60.4	0.01
31	30.4	54.3	1.7	43.6	53.9	0

November

Day	Air Min	Air Max	Wind Avg	Soil4 min	Soil4 max	Rain in.
1	44.3	48.5	8.1	47.9	49.5	0.94
2	31.0	46.9	5.4	43.5	49.0	0
3	26.1	52.2	1.7	39.0	50.3	0
4	32.5	52.8	3.9	40.6	49.2	0
5	29.5	63.6	3.3	37.4	48.2	0
6	34.8	76.5	1.6	40.6	53.2	0
7	32.1	54.9	4.2	42.7	51.2	0
8	31.6	51.2	0.5	41.6	48.3	0
9	33.0	64.3	3.3	38.9	49.4	0
10	39.9	61.6	4.1	43.3	51.0	0.06
11	24.9	44.9	5.6	37.3	45.8	0
12	16.6	47.8	0.4	34.2	43.1	0
13	17.9	48.1	0.3	33.5	41.8	0
14	28.7	47.8	0.5	34.1	41.7	0
15	41.5	50.4	0.8	40.2	46.9	0
16	44.9	61.1	3.4	44.4	51.2	0
17	58.8	68.7	3.5	50.3	57.9	0.01
18	47.9	59.8	2.5	50.5	55.6	0.61
19	44.3	54.5	1.7	49.6	52.6	0.12
20	29.4	44.6	4.2	41.9	49.6	0
21	29.5	43.0	0.4	40.4	44.6	0
22	36.9	45.6	4.2	41.3	43.8	0
23	31.1	42.5	5.2	37.3	43.3	0
24	20.8	38.7	5.0	34.9	38.7	0
25	17.3	41.9	1.3	33.2	36.2	0
26	32.6	51.0	0.1	34.4	42.2	0.1
27	29.5	43.3	7.2	35.4	41.1	0.16
28	20.8	35.2	0.7	33.8	35.4	0
29	20.2	32.0	2.7	34.1	36.9	0
30	17.2	35.4	0.7	33.0	34.2	0

December

Day	Air min	Air max	Wind avg	Soil4 min	Soil4 max	Rain in.
1	20.6	41.7	1.8	32.3	33.1	0
2	24.0	46.8	3.1	32.6	34.4	0
3	22.0	43.5	2.8	32.7	33.4	0
4	29.6	52.0	2.3	33.0	39.1	0
5	27.5	41.1	3.3	33.2	36.0	0.3
6	33.9	41.0	0.4	34.8	38.8	0.01
7	27.8	41.6	2.4	35.6	39.8	0.01
8	27.7	43.1	2.7	33.9	37.5	0
9	33.2	48.4	2.0	35.8	41.8	0
10	33.2	40.4	10.0	36.6	40.2	0
11	28.6	37.4	4.7	35.0	38.0	0
12	29.3	43.9	10.1	34.7	38.8	0
13	12.8	29.5	10.3	31.2	34.8	0
14	6.4	31.0	3.5	28.8	31.3	0
15	19.5	46.1	6.3	28.7	31.5	0
16	21.0	40.9	4.2	30.7	31.5	0
17	11.0	34.9	2.6	28.7	31.4	0
18	9.3	40.2	9.1	28.9	31.4	0
19	-1.5	16.6	5.8	24.6	29.7	0
20	16.6	36.5	5.4	26.6	30.7	0
21	3.8	33.6	8.5	26.3	30.7	0
22	-1.8	10.0	4.5	23.2	27.1	0
23	-6.4	6.2	4.8	20.6	24.8	0
24	-8.1	21.3	5.3	18.6	25.4	0
25	21.1	31.2	2.5	25.4	29.9	0
26	16.1	24.0	5.3	26.6	29.4	0
27	15.1	36.7	3.8	25.1	29.5	0
28	21.1	43.9	2.1	28.5	31.1	0
29	16.5	36.4	1.4	28.1	30.6	0
30	36.2	61.0	7.4	30.0	32.3	0
31	23.3	46.8	4.8	31.6	31.9	0

1999 Perennial Ryegrass Cultivar Trial

Rodney A. St. John and N. E. Christians

This was the fourth full year of the trial that began in the fall of 1999 with the establishment of 134 cultivars of perennial ryegrass at the Iowa State University Horticulture Research Station. The study was established on an irrigated area that was maintained at a 2-inch mowing height and fertilized with 3 to 4 lb N/1000 ft2/yr. The area received herbicide treatments as required.

The visual quality was evaluated monthly in 2004 for May and June (Table 1). Following the June rating, the area was killed and a new perennial ryegrass trial was established in the fall of 2004. The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. The yearly average of the two months of data for each cultivar was calculated and is listed in the last column (Mean). The first cultivar listed in Table 1 had the highest average visual quality rating for the entire 2004 season. The cultivars are listed in descending order by average quality. The last row states the LSD (least significant difference), which is a statistical measurement of how widely the datum in each column must vary before they are considered to be different from one another.

Data for genetic color (GenColor) and leaf texture (LeafTex) were also collected in June 2002. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Leaf texture was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture. Spring greenup (Greenup) data were taken in April 2004 and were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf.

Table 1. 2003 visual quality and other ratings for the 1999 National Perennial Ryegrass Study.

Cultivar	GenColor	Greenup	LeafText	Quality May	Quality June	Mean Quality
Paragon	9	7	8	9	9	9
Pick PR QH-97	9	7	8	9	9	9
PST-2M4	9	7	8	9	8	9
APR 1236	8	7	8	9	8	9
Pick RC2	8	8	8	9	8	9
LTP 98-501	9	8	8	9	8	9
CIS-PR-84	9	7	8	8	9	9
APR 1237	8	6	8	9	8	9
PST-2RT	8	7	8	8	8	8
PST-2A6B	9	7	8	9	8	8
PST-2SBE	9	6	8	9	8	8
PST-2BR	8	7	8	9	8	8
ABT-99-4.721	8	7	8	8	8	8
Seville II	9	7	8	8	8	8
AG-P981	8	7	8	9	8	8
APR 1232	9	8	8	8	8	8
SRX 4801	8	7	8	8	8	8
ABT-99-4.724	9	8	8	8	8	8
ABT-99-4.461	9	7	8	8	8	8
ABT-99-4.629	9	7	8	8	8	8
ABT-99-4.903	8	8	8	9	8	8
Radiant	8	7	8	8	8	8
APR 1233	9	8	8	9	8	8
CIS-PR-80	9	8	8	9	8	8
R8000	9	7	8	9	8	8
Ascend	8	8	8	9	8	8
B1	9	8	8	8	9	8
Exacta	8	8	8	8	8	8
Affirmed	8	7	8	8	8	8
BAR 9 B2	9	7	8	9	7	8
Pick PR B-97	8	6	8	8	8	8
PST-2LA	8	8	8	8	8	8

Manhattan 3	8	7	8	8	8	8
ABT-00-4.339	8	8	8	8	8	8
ABT-99-4.815	8	7	8	8	8	8
ABT-99-4.834	8	6	8	8	8	8
Cathedral II	8	7	8	8	8	8
Pennant II	8	7	8	8	8	8
Allsport	8	7	8	8	8	8
Line Drive	9	7	8	8	8	8
APR 1231	8	7	8	8	8	8
SR 4500	8	7	8	8	8	8
CAS-LP84	8	7	8	8	8	8
MP108	8	7	8	8	8	8
MP103	8	7	8	8	8	8
PST-2L96	8	7	8	8	8	8
ABT-99-4.633	9	7	8	8	8	8
ABT-99-4.753	9	6	8	8	8	8
Pick EX2	8	7	8	8	8	8
Pennington-11301	9	6	8	8	8	8
CIS-PR-85	8	8	8	8	8	8
Fiesta III	8	7	8	8	8	8
Pizzazz	8	7	8	8	8	8
Promise	8	7	8	8	8	8
Nexus	9	7	8	8	8	8
CIS-PR-69	8	7	8	8	8	8
Majesty	8	7	8	8	8	8
Churchill	8	7	8	8	8	8
LTP-ME	8	7	8	8	8	8
Premier II	8	7	8	8	8	8
Premier	9	7	8	8	8	8
JR-187	8	7	8	8	8	8
JR-317	8	6	8	8	8	8
JR-151	8	7	8	8	8	8
Pick MDR	9	7	8	8	8	8
Pick PRNGS	8	7	8	8	8	8
PST-2SLX	8	7	8	8	8	8
PST-CATS	8	7	8	8	8	8
Brightstar II	8	7	8	8	8	8
Carger II	8	7	8	8	8	8
Phantom	8	7	8	8	8	8
Wilmington	8	7	8	8	8	8
SRX 4RHT	8	8	8	8	8	8
MDP	8	7	8	8	8	8
EPD	8	7	8	8	8	8
MP58	8	7	8	8	8	8
ABT-99-4.115	8	7	8	8	8	8
ABT-99-4.960	8	7	8	8	8	8
ABT-99-4.965	8	7	8	8	8	8
CIS-PR-72	8	7	8	8	8	8
PST-2JH	8	7	8	8	8	8
PST-2CRR	9	7	8	7	8	8
PST-2CRL	8	7	8	8	8	8
Palmer III	8	8	8	8	8	8
ABT-99-4.464	9	7	8	8	8	8

ABT-99-4.600	8	7	8	8	8	8
Panther	8	7	8	8	8	8
DP LP-1	8	7	8	8	8	8
SRX 4120	8	7	8	8	8	8
EP53	8	7	8	8	8	8
EP57	8	7	8	8	8	8
Skyhawk	8	7	8	8	8	8
MEPY	8	7	8	8	8	8
AT-99-4.560	8	7	8	8	8	8
ABT-99-4.625	8	7	8	8	8	8
Jet	8	7	8	8	8	8
Calypso	8	7	8	7	8	8
Buccaneer	9	7	8	8	8	8
Passport	8	7	8	8	8	8
DLF-LDD	8	8	8	7	8	8
Roberts-627	8	6	8	8	8	8
CIS-PR-75	8	7	8	8	8	8
CIS-PR-78	8	7	8	8	8	8
Divine	8	7	8	8	8	8
Pleasure XL	8	7	8	8	8	8
APR 1235	8	8	8	8	8	8
Barlennium	8	8	8	7	8	8
JR-128	8	7	8	7	8	8
Catalina	8	7	8	7	8	8
6011	8	7	8	8	8	8
APR 777	7	7	8	7	8	8
APR 776	8	6	8	8	7	8
Elfkin	8	7	8	7	8	8
ABT-99-4.709	8	7	8	8	8	8
SRX 4820	9	8	8	7	8	8
BY-100	8	7	8	7	8	8
Racer	8	7	8	8	8	8
LPR 98-144	8	7	8	8	8	8
Affinity	8	7	8	8	8	8
Pick PR 1-94	7	7	8	7	8	8
Headstart	7	7	8	7	8	8
Secretariat	7	7	8	7	8	8
APR 1234	8	7	8	8	7	8
Edge	8	7	8	7	7	7
DP 17-9069	8	6	8	7	7	7
LPR 98-143	8	7	7	7	8	7
YatsuGreen	7	6	8	7	7	7
WVPB-R-84	8	7	8	7	7	7
NJ-6401	8	7	8	7	7	7
Koos R-71	7	7	8	7	7	7
DP 17-9391	7	6	8	7	7	7
WVPB-R-82	7	6	8	6	7	7
Linn	7	5	7	6	7	7
DP 17-9496	6	5	7	6	7	6
LSD 0.05	**1.0**	**1.1**	**0.3**	**1.3**	**0.8**	**0.9**

2000 High-Maintenance Kentucky Bluegrass Cultivar Trial

Nick E. Christians and Rodney A. St. John

The National Turfgrass Evaluation Project (NTEP) has sponsored several regional Kentucky bluegrass cultivar trials conducted at most of the northern agricultural experiment stations. This trial was established in the fall of 2000. The area receives 4 lb N/1000 ft^2/yr and is irrigated as needed. The objective of this study is to investigate cultivar performance under a high-maintenance cultural regime similar to that used on irrigated home lawns in Iowa.

The visual quality was evaluated monthly in 2004 from May through October (Table 1). The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. The yearly average of the monthly data for each cultivar was calculated and is listed in the last column (Mean). The first cultivar listed in Table 1 had the highest average visual quality rating for the entire 2004 season. The cultivars are listed in descending order by average quality. The last row states the LSD (least significant difference), which is a statistical measurement of how widely the datum in each column must vary before they are considered to be different from one another.

Data for genetic color (GenColor) and leaf texture (LeafTex) were also collected in June 2004. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Leaf texture was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture. Spring greenup (GreenUp) data were taken in April 2004 and were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf. In June and September 2004, considerable leaf spot damage was observed on some cultivars. Leaf spot ratings (LfSpJun and LfSpSep) were made on a scale of 9=no damage and 1=most severely damaged. Rust was also observed late in the season. Rust damage (StemRust) was rated on a scale of 9=no damage and 1=most damage.

Table 1. 2004 visual quality and other ratings for the High-Maintenance Kentucky Bluegrass Cultivar Trial

							-------------Visual Quality-------------						
Kentucky Bluegrass Cultivar	**Gen Color**	**Green Up**	**LeafTex**	**Rust**	**LfSpJun**	**LfSpSep**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Mean**
Midnight II (A98-739)	8.3	5.7	7.0	9.0	9.0	9.0	7.7	8.3	9.0	7.7	9.0	7.7	8.2
A97-1432	7.3	7.7	7.0	9.0	9.0	9.0	7.3	8.0	8.0	8.0	8.3	8.3	8.0
Ginney (J-1368)	8.0	6.7	6.3	9.0	9.0	9.0	8.0	7.7	7.7	8.0	8.7	8.0	8.0
Unknown	8.3	6.0	7.0	9.0	9.0	9.0	7.7	8.3	7.3	8.0	8.7	8.0	8.0
Blue Velvet (J-1513)	7.7	5.7	7.0	9.0	9.0	9.0	7.0	7.7	8.0	7.7	9.0	8.3	7.9
Midnight	7.7	5.7	7.0	9.0	9.0	9.0	7.0	8.0	8.3	7.3	9.0	7.7	7.9
Tsunami (J-2487)	8.0	6.7	7.0	9.0	9.0	9.0	7.3	8.0	7.3	8.0	8.7	8.0	7.9
Bluestone (PST-731)	8.0	7.0	7.0	9.0	9.0	9.0	6.7	7.7	8.7	7.7	8.3	7.7	7.8
Courtyard (J-1838)	8.0	5.3	7.0	9.0	9.0	9.0	6.7	7.3	8.0	8.3	8.7	7.7	7.8
Freedom III (J-2890)	8.3	5.7	7.0	9.0	9.0	9.0	7.0	7.7	7.3	8.0	8.7	8.3	7.8
Impact	8.0	7.0	7.0	9.0	9.0	9.0	7.0	8.0	8.7	7.7	8.3	7.3	7.8
Awesome (J-1420)	8.0	4.3	7.0	9.0	9.0	9.0	7.3	8.0	8.0	7.7	7.7	7.3	7.7
Beyond (J-1880)	8.0	7.7	7.0	7.0	9.0	9.0	7.7	7.7	6.7	7.7	9.0	7.7	7.7
Moonlight	8.0	6.0	7.0	9.0	9.0	9.0	6.7	8.0	8.7	8.0	7.7	7.0	7.7
Nu Destiny (J-2695)	8.0	5.0	7.0	9.0	9.0	9.0	6.7	7.3	7.7	8.0	8.7	8.0	7.7
Alexa (J-2561)	7.7	5.3	7.0	9.0	9.0	9.0	6.7	7.0	7.7	8.0	9.0	7.0	7.6
Award	7.3	6.0	7.0	9.0	9.0	9.0	6.7	7.3	8.3	7.7	8.7	7.0	7.6
Barrister (J-1655)	7.7	5.3	7.0	9.0	9.0	9.0	6.7	7.7	7.7	7.0	9.0	7.3	7.6
Bedazzled	6.7	8.0	6.3	9.0	9.0	6.7	6.7	7.0	7.7	7.7	9.0	7.7	7.6
Excursion (J-1648)	7.7	5.0	7.0	9.0	9.0	9.0	6.3	7.3	8.3	7.0	8.0	8.3	7.6
Langara	8.0	7.3	7.0	9.0	9.0	9.0	7.0	8.3	8.0	7.0	8.3	6.7	7.6
Quantum Leap	8.0	5.7	7.0	9.0	9.0	9.0	7.0	7.3	8.0	7.7	7.7	8.0	7.6
Rugby II	7.7	6.7	7.0	9.0	9.0	9.0	7.0	7.7	7.3	7.3	9.0	7.3	7.6
Arcadia	8.3	6.0	7.0	9.0	9.0	9.0	7.3	7.7	7.3	7.0	8.7	7.0	7.5
Perfection (J-1515)	7.0	5.3	6.3	9.0	9.0	9.0	6.0	7.0	7.3	7.3	8.3	8.3	7.4
Total Eclipse	7.7	6.3	7.0	9.0	9.0	9.0	6.7	6.3	7.0	7.3	9.0	8.3	7.4
Everglade	7.3	5.3	6.3	9.0	9.0	9.0	5.7	6.3	7.7	7.7	8.3	8.0	7.3
Odyssey	8.0	6.7	7.0	9.0	9.0	9.0	7.7	7.3	6.7	6.7	8.7	7.0	7.3
PST-161	7.3	7.0	7.0	9.0	9.0	9.0	6.0	7.0	8.3	7.3	8.3	6.0	7.2
Sonoma	6.7	6.0	7.0	9.0	9.0	9.0	5.7	6.7	6.7	7.7	9.0	7.3	7.2

Diva (Pro Seeds -453)	6.7	7.7	7.0	9.0	9.0	9.0	6.3	7.0	6.0	7.3	8.0	7.7	7.1
Goldstar (A98-296)	8.0	7.0	7.0	9.0	9.0	9.0	6.3	6.3	7.3	7.3	8.3	6.7	7.1
North Star	6.7	3.3	7.0	9.0	9.0	7.7	5.7	7.7	6.7	7.0	7.7	7.7	7.1
Nuglade	7.3	6.0	7.0	9.0	9.0	9.0	6.7	6.7	7.7	7.0	7.7	6.3	7.0
Glenmont (H94-293)	8.0	6.7	7.0	9.0	9.0	9.0	7.3	7.0	6.7	7.3	7.0	6.0	6.9
Kingfisher (SRX 2394)	7.7	7.0	6.3	9.0	9.0	9.0	7.0	7.0	7.3	7.0	6.7	6.7	6.9
Mallard (A97-1439)	7.7	5.3	7.0	9.0	9.0	9.0	6.7	6.7	7.3	7.3	7.7	6.0	6.9
BA 82-288	7.0	6.3	7.0	9.0	8.7	9.0	6.7	6.3	7.0	6.7	8.0	6.0	6.8
BAR PP 0468	6.7	6.7	7.0	9.0	9.0	9.0	5.7	7.0	6.3	7.3	8.0	6.3	6.8
Baronette (BA 81-058)	6.7	6.7	7.0	9.0	9.0	9.0	6.3	6.7	7.3	6.7	7.3	6.7	6.8
J-2885	7.7	6.0	6.3	9.0	9.0	9.0	6.0	7.3	7.3	6.7	7.0	6.7	6.8
Misty	6.3	4.7	7.0	9.0	9.0	9.0	6.0	6.0	6.7	7.3	7.7	7.0	6.8
Monte Carlo (A96-402)	7.3	6.3	7.0	9.0	9.0	9.0	6.3	6.0	7.7	7.0	8.0	6.0	6.8
SR 2284 (SRX 2284)	7.3	6.3	7.0	9.0	9.0	9.0	6.7	7.0	7.0	6.7	7.3	6.3	6.8
A96-739	6.7	7.0	7.0	9.0	9.0	9.0	6.7	6.3	6.7	6.7	7.7	6.0	6.7
Blacksburg II (PST-1BMY)	6.7	7.0	7.0	9.0	9.0	8.0	6.3	6.0	6.7	6.7	8.0	6.3	6.7
Boutique	7.7	7.3	7.0	9.0	9.0	9.0	6.7	7.3	6.7	6.7	6.3	6.3	6.7
Dynamo (B3-185)	7.7	6.3	7.0	9.0	9.0	9.0	6.3	7.3	7.0	6.7	6.3	6.7	6.7
Showcase	7.3	6.7	7.0	9.0	9.0	8.0	6.7	6.7	6.3	6.3	7.7	6.3	6.7
Voyager II (PST-1QG-27)	7.0	6.0	7.0	9.0	9.0	9.0	6.3	6.3	6.3	6.7	7.7	7.0	6.7
A98-183	7.7	6.7	7.0	9.0	9.0	9.0	5.7	6.3	6.0	6.0	8.0	7.3	6.6
Arrow (A97-1567)	7.0	6.7	7.0	9.0	9.0	9.0	6.3	7.0	6.7	6.3	7.3	6.0	6.6
BAR PP 0471	6.7	6.3	7.0	9.0	9.0	9.0	6.3	7.0	5.7	6.0	7.7	6.7	6.6
BAR PP 0573	7.0	7.0	7.0	9.0	9.0	9.0	6.3	7.3	7.0	5.7	7.0	6.3	6.6
Blue Ridge (A97-1449)	6.3	7.0	7.0	9.0	9.0	9.0	6.3	7.3	8.0	6.3	6.3	5.3	6.6
Bordeaux	7.3	5.3	7.0	9.0	9.0	7.3	6.3	7.0	7.3	7.0	6.3	5.3	6.6
Cabernet	7.7	8.7	7.0	9.0	9.0	8.0	6.3	6.3	8.3	7.0	6.3	5.0	6.6
Casablanca (B3-171)	7.0	6.7	7.0	9.0	9.0	7.3	6.3	6.7	6.3	6.3	8.0	6.0	6.6
Everest	8.0	5.3	5.7	9.0	9.0	9.0	5.3	6.0	7.0	6.7	7.3	7.0	6.6
Liberator	8.0	6.3	7.0	9.0	8.3	9.0	6.3	6.3	6.3	6.3	7.7	6.7	6.6
PP H 7907	7.3	6.3	7.0	9.0	9.0	8.0	5.7	7.0	7.0	6.7	6.0	7.0	6.6
Royale (A97-1336)	6.7	7.3	7.0	9.0	9.0	9.0	7.0	6.0	6.7	6.7	6.7	6.3	6.6
Royce (A98-304)	6.3	5.7	7.0	7.0	9.0	9.0	6.0	6.0	6.7	7.0	7.7	6.0	6.6
Unique	6.0	7.0	7.0	9.0	9.0	9.0	6.7	6.3	6.3	6.7	7.0	6.7	6.6
A97-1330	7.3	6.0	7.0	9.0	9.0	9.0	5.7	6.7	6.7	7.0	6.0	7.0	6.5
A98-139	6.7	8.0	7.0	9.0	9.0	9.0	5.7	6.3	6.3	7.7	6.7	6.3	6.5
Apollo	7.7	6.0	7.0	9.0	9.0	9.0	5.7	6.7	6.3	7.0	7.3	6.0	6.5
Blue-Tastic (1B7-308)	8.3	6.7	7.0	9.0	8.7	6.7	7.0	7.7	7.7	6.3	5.3	5.0	6.5
SI A96-386	6.7	5.7	7.0	9.0	9.0	9.0	6.7	6.7	6.7	6.7	6.7	5.7	6.5
Skye (A97-1715)	6.7	7.7	7.0	9.0	9.0	9.0	5.7	5.7	6.0	7.0	7.7	7.0	6.5
A98-407	7.0	6.0	7.0	9.0	9.0	9.0	6.0	7.0	6.7	6.7	6.3	6.0	6.4
BH 00-6003	6.3	6.7	7.0	9.0	9.0	9.0	6.0	6.0	6.3	7.0	7.0	6.3	6.4
Blue Knight	7.7	4.7	7.0	9.0	9.0	7.0	6.7	7.3	7.0	6.0	6.0	5.3	6.4
DLF 76-9037	6.3	6.0	7.0	9.0	9.0	9.0	6.0	5.7	6.3	6.7	7.3	6.3	6.4
Eagleton	6.0	5.7	6.3	9.0	9.0	9.0	5.7	6.3	7.3	6.3	7.3	5.3	6.4
HV 238	6.0	6.0	7.3	9.0	9.0	9.0	6.3	6.7	6.7	6.0	7.0	6.0	6.4
Moonshine (PST-1804)	6.0	6.7	7.0	9.0	9.0	9.0	5.7	6.3	6.0	7.0	7.0	6.7	6.4
Rambo	7.3	7.0	7.0	9.0	8.3	9.0	6.0	6.3	7.0	5.7	7.0	6.3	6.4
Rita	7.7	7.3	7.0	9.0	9.0	7.7	6.0	5.7	7.0	6.3	7.3	6.0	6.4
Wildwood	7.7	6.0	7.0	9.0	9.0	6.7	7.3	7.0	7.0	6.7	5.3	5.0	6.4
A97-1409	7.7	6.3	7.0	9.0	9.0	9.0	6.3	6.3	6.7	6.7	7.3	4.7	6.3
A98-365	6.3	6.3	7.0	9.0	9.0	9.0	6.0	6.3	6.0	6.7	6.7	6.0	6.3

Ascot	7.7	5.7	7.0	9.0	8.7	9.0	6.7	6.3	6.3	5.7	6.7	6.3	6.3
BA 83-113	7.3	7.3	7.0	9.0	9.0	9.0	6.3	6.3	6.7	6.0	6.0	6.7	6.3
BARZAN	7.0	4.3	7.0	9.0	9.0	7.3	5.3	6.7	7.3	6.0	6.3	6.0	6.3
Brooklawn	6.3	7.3	7.0	9.0	9.0	9.0	6.0	6.7	5.7	6.3	7.3	6.0	6.3
Marquis	6.7	6.3	7.0	9.0	9.0	7.0	6.3	6.3	6.7	6.0	6.0	6.7	6.3
PST-222	7.7	6.0	7.0	9.0	9.0	9.0	6.3	6.0	6.7	6.3	6.0	6.3	6.3
PST-B4-246	6.7	5.3	7.0	9.0	9.0	7.7	7.0	6.3	7.0	6.3	5.7	5.3	6.3
PST-B5-125	7.7	6.3	7.0	9.0	9.0	4.3	6.7	7.0	7.3	6.3	5.0	5.7	6.3
SRX 2114	7.0	5.7	7.0	9.0	9.0	6.3	6.3	7.0	6.7	6.3	6.3	5.3	6.3
Abbey	7.0	6.3	7.0	9.0	9.0	9.0	5.3	5.7	6.3	6.3	6.3	7.3	6.2
BA 00-6001	7.0	5.7	7.0	9.0	8.0	6.3	6.3	6.7	6.3	6.0	6.3	5.7	6.2
Champagne	6.0	5.7	7.3	9.0	8.3	9.0	5.3	6.7	6.0	6.0	6.7	6.3	6.2
Chicago II	8.3	6.0	6.3	9.0	7.7	4.0	6.3	7.0	7.3	6.0	5.0	5.7	6.2
Hallmark	7.3	5.3	7.0	9.0	8.0	7.0	6.3	7.3	6.7	6.3	5.3	5.0	6.2
Mongoose (A98-881)	6.0	7.7	7.0	9.0	9.0	9.0	5.3	6.7	6.0	6.0	7.0	6.0	6.2
PST-York Harbor 4	6.7	6.7	7.0	9.0	9.0	7.3	6.3	6.7	7.3	6.3	5.0	5.3	6.2
Raven	7.0	6.0	6.3	9.0	9.0	7.3	5.7	6.3	6.3	6.3	6.0	6.7	6.2
Avalanche (PST-1701)	5.7	6.7	7.0	9.0	9.0	9.0	5.3	6.3	5.7	6.3	7.3	5.3	6.1
Baron	6.3	5.7	7.0	9.0	9.0	7.0	5.7	6.3	6.7	5.3	6.0	6.3	6.1
Durham (A96-427)	7.3	7.3	7.0	9.0	9.0	9.0	6.3	7.3	6.7	6.0	5.3	5.0	6.1
H92-203	7.0	6.0	7.0	9.0	9.0	9.0	6.3	6.0	5.3	6.0	6.7	6.3	6.1
PST-B3-170	7.7	4.3	7.0	9.0	9.0	6.0	6.3	6.7	7.3	6.3	5.0	4.7	6.1
A96-451	6.7	5.3	7.0	9.0	9.0	8.0	5.3	6.3	5.7	6.7	6.3	5.7	6.0
Alpine	7.0	5.3	7.0	9.0	9.0	8.0	6.7	6.7	6.7	6.0	5.0	5.0	6.0
Freedom II	7.0	6.7	7.0	9.0	8.3	7.3	6.7	7.3	6.3	5.0	5.0	5.7	6.0
Jefferson	6.0	8.3	7.0	9.0	9.0	9.0	5.7	6.3	6.3	6.0	6.3	5.3	6.0
Lakeshore (A93-200)	6.3	7.0	7.0	9.0	9.0	9.0	5.3	6.3	5.7	5.7	6.3	6.7	6.0
A98-1028	6.3	8.3	7.0	9.0	9.0	9.0	5.3	6.7	5.0	6.0	6.7	5.7	5.9
Bodacious	7.0	6.7	7.0	7.3	9.0	6.3	6.7	6.0	6.7	6.0	5.0	5.0	5.9
Champlain (A98-1275)	7.0	5.0	6.3	9.0	9.0	8.0	6.7	6.3	5.3	6.0	5.3	6.0	5.9
Envicta	6.7	6.0	7.0	9.0	9.0	9.0	5.0	6.7	7.0	6.0	4.7	6.0	5.9
H92-558	7.0	6.0	6.3	9.0	8.3	7.3	6.3	7.0	6.7	5.7	4.3	5.3	5.9
Mercury (PICK-232)	7.3	7.7	7.0	9.0	8.0	7.0	6.0	6.7	6.3	5.7	5.7	5.0	5.9
Princeton 105	6.7	5.0	7.0	9.0	8.7	7.3	7.0	7.3	5.3	5.3	5.0	5.3	5.9
PST-H6-150	6.3	6.0	7.0	9.0	9.0	9.0	6.0	6.0	6.0	6.0	5.7	5.7	5.9
A96-742	6.0	8.0	7.7	9.0	9.0	9.0	5.0	6.0	5.7	6.3	6.7	5.3	5.8
Blue Sapphire (NA-K991)	7.3	6.0	6.7	9.0	9.0	4.0	6.3	6.3	6.3	6.0	5.3	4.7	5.8
Bluemax (PST-B5-89)	8.7	6.3	6.7	5.7	9.0	9.0	6.3	7.7	5.7	6.0	4.0	5.0	5.8
Chelsea	6.0	5.3	8.0	9.0	9.0	9.0	5.3	6.3	5.7	6.3	6.0	5.3	5.8
DLF 76-9034	6.0	7.0	6.3	9.0	9.0	9.0	5.0	5.7	5.3	6.0	7.0	6.0	5.8
Jewel	6.3	6.3	7.0	9.0	9.0	9.0	5.7	6.3	6.0	5.7	6.0	5.3	5.8
Lily	6.0	5.0	7.0	9.0	8.3	4.3	6.7	6.7	6.0	5.3	4.7	5.3	5.8
NA-K992	6.3	5.7	7.0	9.0	8.3	7.7	6.0	6.7	6.3	5.3	5.7	4.7	5.8
PST-604	6.7	7.0	7.0	9.0	9.0	9.0	5.7	6.3	6.7	5.3	5.3	5.7	5.8
PST-H5-35	6.0	7.0	7.3	9.0	8.7	7.0	6.3	6.7	6.3	5.3	5.3	5.0	5.8
BAR PP 0566	7.7	6.3	7.0	9.0	9.0	9.0	6.0	6.0	5.7	5.3	6.0	5.3	5.7
Boomerang	7.7	6.0	7.0	7.3	9.0	9.0	6.0	6.7	5.7	5.7	5.0	5.3	5.7
Brilliant	6.7	6.3	7.0	9.0	8.0	9.0	6.0	5.7	5.3	5.3	6.7	5.0	5.7
PP H 7929	6.7	5.7	7.0	9.0	9.0	7.0	5.3	6.7	6.3	5.3	5.7	5.0	5.7
Serene	6.7	7.3	7.0	7.0	9.0	7.3	6.0	6.3	6.7	6.7	4.3	4.3	5.7

99AN-53	7.0	6.7	7.0	9.0	9.0	7.0	5.0	7.0	6.3	6.0	4.7	4.7	5.6
Cheetah (PP H 6370)	6.3	4.7	7.3	9.0	7.7	6.0	5.3	6.3	5.3	5.3	6.3	5.0	5.6
CVB-20631	6.0	4.7	7.0	9.0	8.0	7.3	6.0	5.7	6.3	5.3	5.3	5.0	5.6
Goldrush	7.3	5.7	7.0	9.0	8.0	6.7	5.7	5.7	6.0	5.0	5.0	6.0	5.6
Shamrock	5.7	7.3	7.0	9.0	9.0	9.0	5.3	6.7	6.3	5.7	5.0	4.3	5.6
BA 84-140	6.7	6.0	7.0	7.3	9.0	7.3	6.0	6.3	6.7	6.0	4.0	4.0	5.5
Bariris	6.0	6.0	7.0	9.0	8.0	6.0	6.0	7.0	5.7	5.3	4.3	4.7	5.5
Baronie	6.0	5.3	7.3	9.0	7.7	9.0	5.0	6.3	5.7	5.3	5.3	5.3	5.5
BH 00-6002	5.7	6.7	7.0	9.0	9.0	8.3	5.7	6.0	5.3	5.7	5.3	5.0	5.5
Julia	6.0	6.7	7.0	9.0	9.0	7.7	6.0	6.3	5.3	5.3	5.3	4.7	5.5
SRX 27921	7.7	6.0	6.3	9.0	8.7	7.3	6.3	5.7	6.0	5.7	4.7	4.7	5.5
Washington	5.7	8.3	7.3	9.0	9.0	9.0	4.7	5.7	5.7	5.7	6.3	5.0	5.5
A97-857	6.0	6.7	7.3	9.0	8.3	7.0	5.0	6.0	6.0	5.7	5.0	4.7	5.4
DLF 76-9036	7.3	5.7	7.0	7.0	9.0	7.0	5.7	5.7	6.3	5.0	4.7	5.0	5.4
Fairfax	6.0	5.7	7.0	7.0	8.0	5.7	5.3	7.3	5.7	5.0	4.0	5.0	5.4
HV 140	7.0	5.3	7.0	9.0	8.7	7.7	6.3	6.0	5.3	5.3	5.0	4.7	5.4
Kenblue	6.0	8.7	8.0	9.0	9.0	9.0	5.0	6.0	5.7	5.7	5.0	5.0	5.4
PP H 7832	6.3	6.3	7.0	9.0	7.7	7.7	5.7	6.7	5.7	5.0	4.7	5.0	5.4
SRX QG245	6.3	6.0	7.0	7.3	8.3	5.0	5.7	6.7	5.7	5.7	4.0	5.0	5.4
Bartitia	5.7	5.3	7.0	9.0	8.0	7.0	5.7	6.3	5.7	4.7	5.3	4.3	5.3
Coventry	6.7	6.0	6.3	9.0	8.0	3.0	5.7	6.7	5.7	4.7	4.7	4.3	5.3
B5-144	6.7	5.3	7.0	9.0	8.3	5.0	5.7	6.7	5.7	5.0	3.7	4.7	5.2
B5-43	7.0	7.0	7.0	9.0	8.7	5.7	5.7	6.7	5.3	4.7	4.0	4.7	5.2
B5-45	6.0	6.0	7.0	9.0	9.0	7.0	5.3	6.0	6.0	4.7	4.0	5.0	5.2
PICK 453	6.3	5.0	6.7	9.0	7.3	6.0	5.7	6.7	5.0	5.0	4.3	4.7	5.2
SRX 26351	5.7	4.7	7.0	9.0	8.0	4.0	6.3	7.3	5.3	4.3	3.7	4.3	5.2
B4-128A	5.3	6.3	7.3	9.0	7.0	6.7	5.3	6.3	4.7	5.3	4.3	4.3	5.1
Limousine	5.7	7.0	7.3	9.0	7.7	4.7	5.3	6.0	5.3	5.0	4.3	4.3	5.1
Baritone	6.0	6.0	5.7	9.0	8.0	7.0	5.0	5.7	5.7	5.0	4.3	4.3	5.0
Rampart (Pick 417)	7.7	7.3	7.0	9.0	8.0	5.7	6.3	6.7	5.0	4.3	3.7	4.0	5.0
Allure	5.7	6.0	6.3	9.0	8.3	5.3	5.3	6.3	5.3	4.7	3.7	4.3	4.9
Wellington	5.3	8.3	7.3	9.0	7.3	3.0	4.7	5.7	5.7	5.0	3.7	4.0	4.8
Blackstone	6.7	5.7	7.0	9.0	7.3	7.3	5.7	6.3	5.0	4.3	3.0	3.7	4.7
GO-9LM9	5.7	7.3	8.0	9.0	7.7	5.3	4.7	5.3	4.7	5.0	4.3	4.3	4.7
PST-108-79	5.3	6.7	7.3	9.0	5.7	6.7	6.3	7.0	4.0	4.0	3.3	3.3	4.7
Chateau	5.7	6.7	7.0	9.0	7.0	5.7	5.0	5.3	4.7	4.3	3.7	4.3	4.6
DLF 76-9032	7.3	5.7	7.3	9.0	6.3	4.7	6.3	5.7	4.3	3.7	3.7	4.0	4.6
Limerick	6.0	4.0	7.0	9.0	7.3	3.0	5.3	6.0	5.7	4.0	3.7	3.0	4.6
Moon Shadow (Pick 113-3)	6.3	5.3	6.3	9.0	7.0	3.3	5.3	5.3	5.0	4.0	3.7	4.3	4.6
Julius	5.0	4.7	7.0	9.0	6.3	2.3	5.3	6.7	4.7	4.0	3.0	3.3	4.5
PP H 6366	6.3	4.3	6.3	9.0	6.0	2.3	5.3	6.0	4.7	3.0	3.0	3.3	4.2
CV	10.5	17.5	6.3	8.7	9.0	22.9	13.2	11.6	15.9	15.6	20.0	16.4	10.1
LSD	1.2	2.1	1.1	2.8	1.6	3.3	1.6	1.5	1.9	1.6	2.0	1.5	1.0

2001 National Tall Fescue Cultivar Evaluation

Shui-zhang Fei and Rodney A. St. John

This tall fescue trial was established in September 2001 and is part of the National Turfgrass Evaluation Program (NTEP). Similar trials are being conducted at many different locations around the US. The purpose of this trial is to evaluate adaptation and performance of 163 tall fescue cultivars under non-irrigated conditions with 2 lbs N /1000 ft^2 per year and a mowing height of 2.5-3.5".

This is the 4th year of the trial. Cultivars were evaluated for turf quality each month during the growing season based on a scale of 1 to 9 with 1 being the worst quality and 9 being the best quality. The values listed in the table are averages of three replications. A grand mean of turf quality was listed in the last column. In addition to turf quality, data on genetic color (GenColor, rated using a scale of 1-9 with 1 being light green and 9 being dark green), greenup (rated on a scale of 1-9 with 9 having the worst color and 9 having the best color in late April), leaf texture (LeafTex, rated using a scale of 1-9 with 1 being course and 9 being fine) were also included.

Table 1. 2004 Visual ratings on turfgrass genetic color, spring greenup, leaf texture and quality, for the 2001 Tall Fescue Cultivar Trial in Ames, IA.

				---------------------- Visual Quality--------------------						
Tall Fescue Cultivar	**GenColor**	**Greenup**	**LeafTex**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Mean**
Davinci (LTP-7801)	7.7	5.3	8.0	7.7	8.0	8.0	7.7	8.3	7.3	7.8
Justice (RB2-01)	8.0	6.3	8.0	7.0	8.0	7.3	7.7	8.3	8.3	7.8
2nd Millennium	8.0	6.3	8.0	6.7	7.3	8.3	7.7	8.3	8.0	7.7
Falcon IV (F-4)	7.3	6.0	8.0	7.3	8.0	7.3	7.7	8.3	7.7	7.7
Blackwatch (Pick-Od3-01)	8.3	6.3	7.7	7.3	8.0	7.3	7.3	8.0	7.7	7.6
Cochise III (018)	8.0	6.7	7.7	6.7	8.0	8.0	7.7	7.7	7.7	7.6
Finelawn Elite (DLSD)	8.3	6.0	8.0	6.7	7.7	7.3	7.7	8.0	8.0	7.6
R-4	8.0	6.3	8.0	6.7	7.7	7.7	7.7	8.0	7.7	7.6
Focus	8.0	6.0	7.3	7.3	7.3	7.3	7.7	8.0	7.3	7.5
Millennium	8.0	6.0	7.7	7.3	7.3	7.0	7.7	8.0	7.7	7.5
Picasso	8.0	6.0	7.7	7.7	7.3	7.0	7.3	8.0	7.7	7.5
Scorpion	7.3	6.0	8.0	7.7	7.3	7.3	7.3	8.0	7.3	7.5
Titan LTD.	6.7	6.0	8.0	7.0	7.3	7.3	7.7	8.0	7.7	7.5
Escalade (01-ORU1)	7.7	6.0	8.0	6.7	7.3	7.0	7.7	8.0	8.0	7.4
Fidelity (PST-5T1)	8.0	6.0	7.3	6.7	7.3	7.3	7.3	8.0	7.7	7.4
Firebird (CIS-TF-65)	8.0	6.0	7.3	6.7	7.3	7.3	7.3	8.3	7.7	7.4
Grande II	7.7	6.0	8.0	7.0	7.3	7.3	7.7	8.0	7.3	7.4
Jaguar 3	7.3	6.3	7.3	7.3	7.3	7.7	7.0	7.7	7.3	7.4
Lexington (UT-RB3)	8.3	6.0	7.0	6.7	7.3	7.3	7.0	8.3	7.7	7.4
Silverado II (PST-578)	8.0	6.0	8.0	7.3	7.3	7.3	7.3	8.0	7.3	7.4
Bingo	8.0	6.0	7.7	6.7	7.3	7.3	7.3	7.7	7.3	7.3
Dynamic (PST-57e)	7.3	6.0	8.0	6.7	7.3	7.3	7.0	8.0	7.7	7.3
JT-13	8.3	5.3	8.0	6.7	7.3	7.0	7.7	7.7	7.3	7.3
K01-E09	7.0	6.0	8.0	7.0	7.7	7.3	7.0	7.7	7.0	7.3
MA 127	8.0	6.0	7.3	6.7	7.7	7.0	7.3	7.7	7.7	7.3
Mustang 3	7.7	6.0	7.7	6.7	7.3	7.3	7.3	8.0	7.3	7.3
Padre (NJ4)	8.3	6.0	7.3	6.7	7.3	7.0	7.3	8.3	7.3	7.3
PICK-00-AFA	7.7	6.3	7.7	7.0	7.3	7.0	7.3	7.7	7.3	7.3
PST-5FZD	8.0	6.0	8.0	6.3	7.3	7.3	7.7	7.7	7.7	7.3
Quest	8.3	6.0	7.7	6.7	7.7	7.7	7.3	7.7	7.0	7.3
Rembrandt	7.7	6.3	7.7	6.7	7.3	7.3	7.3	7.7	7.3	7.3
Silverstar (PST-5ASR)	8.0	6.0	7.3	7.0	7.3	7.3	7.0	7.7	7.3	7.3
Tar Heel	7.3	6.0	7.0	7.0	7.0	7.3	7.3	7.7	7.3	7.3
Wyatt	7.3	6.0	8.0	7.0	7.0	7.3	7.3	7.7	7.3	7.3
ATF 704	8.0	6.0	7.7	6.7	7.3	7.0	7.0	7.7	7.3	7.2
BAR FA 1005	7.7	6.3	7.7	6.7	7.3	7.0	7.7	7.3	7.3	7.2
Barlexas II	7.7	6.0	8.0	7.3	7.3	7.0	7.3	7.3	7.0	7.2

CIS-TF-77	8.0	6.3	7.3	6.7	7.3	7.0	7.0	7.7	7.3	7.2
Dominion	7.7	6.0	7.3	7.0	7.3	7.0	7.0	7.3	7.3	7.2
Finesse II	8.3	6.0	8.0	6.3	7.3	7.0	7.3	8.0	7.3	7.2
Inferno (JT-99)	8.0	6.0	7.7	6.3	7.0	7.7	7.0	8.0	7.0	7.2
Legitimate	7.0	6.0	7.3	6.7	7.3	7.0	7.3	8.0	7.0	7.2
Masterpiece	7.7	6.0	7.7	6.7	7.0	7.0	7.0	7.7	7.7	7.2
MRF 211	8.3	6.0	7.0	6.7	7.7	7.3	7.0	7.3	7.3	7.2
Ninja 2 (ATF-800)	7.7	6.0	7.7	6.7	7.3	7.0	7.3	7.7	7.0	7.2
PICK TF H-97	8.0	6.0	8.0	7.0	7.0	7.3	7.3	7.3	7.0	7.2
PST-5BZ	8.3	6.0	7.7	7.0	7.3	7.3	6.7	7.3	7.7	7.2
PST-5LO	8.3	6.0	7.7	6.3	7.3	7.0	7.3	8.0	7.0	7.2
Raptor (CIS-TF-33)	7.7	6.0	8.0	7.0	7.3	7.0	7.3	7.7	7.0	7.2
Rebel Exeda	8.0	6.0	7.7	6.7	7.3	7.3	7.3	7.7	7.0	7.2
Rebel Sentry	8.0	6.0	7.3	7.0	7.3	7.3	7.3	7.3	7.0	7.2
Tar Heel Ii (PST-5TRL)	7.3	6.3	7.0	6.3	7.3	7.0	7.3	7.7	7.3	7.2
Tempest	7.3	6.3	7.0	7.3	7.0	7.0	7.3	7.3	7.0	7.2
Titanium (SBM)	8.0	6.0	7.7	6.3	7.7	7.0	7.3	7.7	7.3	7.2
Trooper (01-TFOR3)	7.7	6.3	7.3	7.0	7.0	7.3	7.3	7.3	7.0	7.2
Avenger (LLZ)	8.3	6.0	8.0	6.3	7.0	7.0	7.3	7.3	7.3	7.1
BAR FA 1003	7.7	6.0	7.3	6.3	7.0	7.3	7.3	7.7	7.0	7.1
Barlexas	7.3	6.7	7.3	7.3	7.0	7.0	7.0	7.3	7.0	7.1
Biltmore	8.3	6.0	7.3	6.3	7.0	7.0	7.3	7.3	7.3	7.1
Blade Runner (Roberts SM4)	8.0	6.3	7.3	7.0	7.0	7.0	7.0	7.3	7.3	7.1
Cayenne	8.3	6.0	7.3	6.3	7.0	7.3	7.3	7.7	7.0	7.1
CIS-TF-64	8.0	6.0	8.0	6.0	7.0	7.0	7.7	7.3	7.3	7.1
Covenant (ATF 802)	7.7	6.0	7.7	6.7	7.3	6.7	7.0	7.7	7.0	7.1
Coyote	8.0	6.3	7.7	7.0	7.0	7.0	7.0	7.3	7.0	7.1
DP 50-9082	7.7	6.0	8.0	6.7	7.0	7.0	7.7	7.3	7.0	7.1
Endeavor	7.3	6.3	7.3	6.7	7.3	7.3	7.0	7.3	7.0	7.1
MA 138	8.0	6.0	7.7	6.7	7.3	7.3	7.0	7.3	7.0	7.1
Magellan (OD-4)	7.7	6.0	7.0	6.0	7.0	7.0	7.3	7.7	7.7	7.1
MRF 26	8.3	6.0	7.0	6.7	7.0	6.7	7.0	7.7	7.3	7.1
Olympic Gold	7.3	6.0	7.3	6.7	7.3	7.0	7.0	7.3	7.3	7.1
Plantation	8.3	6.0	7.7	6.3	7.0	7.3	7.0	7.7	7.3	7.1
PST-DDL	7.7	6.0	7.3	6.3	7.3	6.7	7.3	7.7	7.0	7.1
Riverside (Proseeds 5301)	7.7	6.0	7.7	6.3	7.0	7.0	7.3	7.3	7.3	7.1
Tomahawk GT	8.0	6.0	7.7	6.7	7.0	7.0	7.3	7.7	7.0	7.1
Ultimate (01-RUTOR2)	7.7	6.0	7.7	6.3	7.0	7.0	7.0	7.7	7.3	7.1
UT-155	8.3	6.0	7.3	6.3	7.7	7.0	7.0	7.3	7.3	7.1
Wolfpack	7.7	6.0	7.7	6.3	7.0	7.0	7.3	7.3	7.7	7.1
DLF-J210	8.0	6.7	7.0	7.3	7.0	6.7	6.7	7.3	7.0	7.0
Expedetion (ATF-803)	8.0	6.3	8.0	6.7	6.7	7.3	6.7	7.3	7.3	7.0
JT-6	7.7	6.0	7.7	6.3	7.0	7.0	7.0	7.7	7.0	7.0
JT-9	7.7	6.0	7.7	6.3	7.0	7.3	7.3	7.0	7.0	7.0
Prospect	8.0	6.7	7.3	6.3	7.0	7.0	7.3	7.0	7.3	7.0
PST-5BAB	7.7	6.0	7.0	6.3	6.7	7.0	7.0	7.7	7.3	7.0
PST-5KI	8.0	6.7	7.0	6.3	7.0	6.7	7.0	7.3	7.7	7.0
PST-5S12	7.7	6.7	7.3	6.3	7.3	6.7	7.0	7.7	7.0	7.0
Rendition	8.0	6.0	8.0	6.3	7.3	6.7	7.0	7.3	7.3	7.0
Southern Choice II	8.0	6.0	7.3	6.7	7.0	7.0	7.0	7.3	7.0	7.0
Turbo (CAS-MC1)	8.0	6.3	7.3	6.7	7.0	7.0	7.0	7.3	7.0	7.0
ATF 702	8.0	5.7	7.7	6.3	6.7	7.0	7.0	7.7	7.0	6.9
BE1	8.0	6.0	7.3	6.3	6.7	7.0	6.7	7.3	7.3	6.9

Bonsai	7.0	6.0	7.3	6.3	7.0	7.0	7.0	7.0	7.0	6.9
Bravo	7.7	6.0	7.0	6.3	7.0	7.0	7.0	7.3	7.0	6.9
Cas-Ed	8.0	6.0	7.0	6.3	6.7	7.0	7.0	7.3	7.0	6.9
Constitution (ATF-593)	7.7	5.7	7.7	6.0	7.3	6.7	6.7	7.3	7.3	6.9
DP 50-9226	8.0	6.3	7.7	6.3	7.0	7.0	7.0	7.0	7.0	6.9
EA 163	7.7	6.0	7.3	6.3	7.0	7.0	6.7	7.3	7.3	6.9
Elisa	7.0	6.7	7.3	6.7	7.0	6.7	7.3	7.0	6.7	6.9
Floridian (GO-FL3)	7.7	6.3	7.0	7.0	6.7	7.0	6.7	7.3	6.7	6.9
Forte (BE-2)	7.3	6.0	7.7	6.3	6.7	7.0	7.0	7.0	7.3	6.9
Guardian-21 (Roberts DOL)	8.0	6.0	7.7	6.3	7.0	7.0	6.7	7.0	7.3	6.9
JTTFF-2000	7.7	6.0	7.7	6.3	7.0	6.7	7.0	7.3	7.3	6.9
Lancer	7.3	6.3	7.3	6.3	7.0	7.0	7.0	7.0	7.0	6.9
MA 158	8.0	6.0	7.0	6.0	6.7	7.0	7.3	7.3	7.0	6.9
Matador	8.0	6.0	7.3	6.3	7.0	7.0	7.0	7.0	7.0	6.9
MRF 210	8.3	6.0	7.7	6.7	7.3	6.7	7.0	7.0	7.0	6.9
MRF 28	8.0	6.0	7.0	6.3	7.3	6.7	7.0	7.3	7.0	6.9
PST-5NAS	8.0	6.0	7.7	6.3	6.7	7.0	7.3	7.3	7.0	6.9
SR 8250	7.7	6.3	7.3	6.3	7.0	7.3	7.0	7.0	7.0	6.9
Stetson	7.3	6.3	7.0	6.3	7.0	7.0	6.7	7.0	7.3	6.9
Stonewall (JT-18)	8.0	6.0	8.0	6.0	7.0	7.0	7.0	7.3	7.3	6.9
Tahoe (CAS-157)	8.3	6.0	7.0	6.3	6.3	6.7	7.0	7.7	7.3	6.9
B-7001	8.0	6.3	7.0	7.0	7.3	6.7	6.7	6.7	6.7	6.8
CIS-TF-60	8.3	6.3	7.3	6.3	6.7	7.0	6.7	7.0	7.0	6.8
CIS-TF-67	7.7	6.0	7.7	6.3	7.3	7.0	6.7	7.0	6.7	6.8
Falcon II	6.7	6.3	7.0	6.3	7.0	6.7	7.0	7.0	7.0	6.8
Five Point (MCN-RC)	8.0	6.0	7.3	6.7	6.7	6.7	6.7	7.3	7.0	6.8
GO-RD4	7.7	6.3	7.0	6.3	6.3	7.0	7.0	7.0	7.0	6.8
K01-WAF	7.7	6.3	7.7	6.3	7.0	6.7	6.7	7.0	7.0	6.8
Laramie	8.3	6.0	7.7	6.3	7.0	6.7	7.0	7.0	7.0	6.8
MRF 25	8.0	6.0	7.7	6.0	7.0	7.0	7.0	7.0	7.0	6.8
MRF 27	8.3	6.0	7.7	6.0	7.0	6.7	7.0	7.3	7.0	6.8
NA-TDD	8.3	6.0	8.0	5.7	7.0	7.0	7.0	7.0	7.0	6.8
PST-5JM	8.3	6.0	7.3	6.7	6.7	6.7	7.0	7.3	6.7	6.8
PST-5KU	8.0	6.0	7.3	6.3	7.0	7.0	6.7	6.7	7.0	6.8
Serengeti (GO-OD2)	7.3	6.3	7.3	6.0	7.3	6.7	6.7	7.0	7.0	6.8
South Paw (MRF 24)	7.3	6.3	7.0	6.3	7.0	6.7	6.7	7.0	7.0	6.8
SR 8600	8.0	6.0	7.7	6.3	7.0	6.7	7.0	6.7	7.0	6.8
T991	8.3	6.0	7.3	6.3	6.7	6.7	7.0	7.0	7.0	6.8
Watchdog	7.7	6.3	7.3	6.0	7.0	7.0	7.0	7.0	7.0	6.8
Apache III (PST-5A1)	8.0	6.0	7.3	6.3	7.0	6.7	6.7	7.0	6.7	6.7
ATF 586	8.0	6.0	7.0	6.0	6.7	6.7	6.7	7.0	7.0	6.7
ATF 707	7.7	6.0	7.7	6.0	7.0	6.7	6.7	6.7	7.0	6.7
ATF 799	8.0	6.0	7.7	6.3	6.7	6.7	6.7	6.7	7.0	6.7
Barrera	7.7	6.0	7.3	6.3	7.0	7.0	6.3	7.0	6.7	6.7
Barrington	7.7	6.3	7.7	6.3	7.0	6.7	6.7	6.7	6.7	6.7
Dynasty	7.7	6.0	7.7	6.0	7.0	6.7	7.0	6.7	7.0	6.7
Gremlin (P-58)	8.0	6.0	7.0	5.7	7.0	6.7	7.0	7.0	7.0	6.7
JT-12	7.3	6.0	8.0	6.0	6.7	6.7	7.0	7.0	7.0	6.7
JT-15	8.0	6.0	7.7	6.3	6.7	6.3	7.0	6.7	7.0	6.7
K01-8007	7.7	6.0	8.0	6.3	7.0	6.7	6.7	7.0	6.7	6.7
K01-E03	7.7	6.0	8.0	6.0	7.0	6.7	6.7	7.0	6.7	6.7
Pick ZMG	8.0	6.0	7.0	6.0	6.7	6.7	6.7	7.0	7.0	6.7
Regiment II (SRX 805)	7.7	6.0	7.3	6.0	7.0	6.7	7.0	7.0	6.7	6.7

Tracer	8.0	6.0	7.7	6.0	6.7	6.7	7.0	7.0	7.0	6.7
ATF 806	7.7	5.7	7.3	6.0	6.3	6.7	6.7	7.0	7.0	6.6
Daytona (MRF 23)	8.0	6.3	7.3	6.0	6.7	6.3	7.0	6.7	7.0	6.6
K01-8015	7.7	6.0	8.0	5.7	6.3	7.0	7.0	6.7	7.0	6.6
Kalahari	8.3	6.3	7.3	6.0	6.7	6.7	6.7	6.7	6.7	6.6
Kitty Hawk 2000	7.3	6.0	7.7	6.0	6.3	6.3	6.7	7.0	7.0	6.6
Matador GT (PST-5TUO)	8.0	6.3	7.7	6.3	6.7	6.7	7.0	6.7	6.3	6.6
SR 8550 (SRX 8BE4)	8.7	6.3	7.3	6.3	6.7	6.3	6.3	7.0	6.7	6.6
Tulsa II (ATF 706)	7.7	6.0	7.0	6.3	6.7	6.3	6.7	6.7	7.0	6.6
TF66	7.7	6.0	7.0	6.0	6.7	6.3	6.7	6.7	6.7	6.5
BAR FA 1CR7	7.7	6.3	8.0	6.0	6.7	6.3	6.3	6.3	6.7	6.4
GO-SIU2	7.3	6.0	7.0	5.7	6.7	6.3	6.3	6.7	7.0	6.4
MRF 29	8.3	6.0	7.3	5.7	6.3	6.3	6.7	6.3	7.0	6.4
PST-53T	8.3	6.0	7.3	5.7	6.3	6.7	6.7	6.7	6.7	6.4
Pure Gold	8.3	6.0	7.3	6.0	7.0	6.3	6.0	6.3	6.7	6.4
Signia	7.7	6.0	7.3	6.0	6.3	6.7	6.0	6.7	6.7	6.4
KY-31 E+	6.0	6.7	6.0	5.0	5.0	5.3	5.3	5.7	5.7	5.3
CV	6.1	5.2	6.1	10.5	7.2	7.5	6.9	8.3	6.6	5.7
LSD	1.0	0.9	1.0	2.3	1.1	1.4	1.1	1.3	1.1	0.8

2003 National Fine Fescue Cultivar Trial

Shui-zhang Fei and Rodney A. St. John

This fine fescue trial was established in September 2003 and is part of the National Turfgrass Evaluation Program (NTEP). Similar trials are being conducted at many different locations around the US. The purpose of this trial is to evaluate the regional adaptation of 53 fine leaf fescue cultivars under non-irrigated conditions with 2 lbs N /1000 ft^2 per year and a mowing height of 2.5-3.5".

This is the 2nd year of the trial. Cultivars were evaluated for turf quality each month during the growing season based on a scale of 1 to 9 with 1 being the worst quality and 9 being the best quality. The values listed in the table are averages of three replications. A grand mean of turf quality was listed in the last column. In addition to turf quality, data on genetic color (GenColor, was rated using a scale of 1-9 with 1 being light green and 9 being dark green), greenup (GreenUp)(rated on a scale of 1-9 with 1 having the worst green color and 9 having the best color in April) and percent ground coverage in the fall (GrCovFal) were also included.

Table 1. The 2004 visual quality and other turf attribute ratings for cultivars in the 2003 Fine Fescue Cultivar Trial.

				------------------------Visual Quality------------------------						
Fine Fescue Cultivar	**GenColor**	**GreenUp**	**Grcovfal**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Mean**
PICK CRF 1-03	8.0	9.0	93.3	7.3	7.7	7.3	7.3	7.7	7.7	7.5
IS-FRR 23	8.0	8.7	90.0	7.3	7.3	7.0	7.0	7.3	7.7	7.3
Razor	7.3	8.7	95.0	7.7	7.3	7.0	6.7	7.3	8.0	7.3
C03-RCE	7.3	9.0	90.0	7.0	7.3	7.3	7.0	7.0	7.3	7.2
Oxford	7.0	9.0	91.7	8.0	6.7	6.7	6.7	7.7	7.3	7.2
Reliant IV (A01630REL)	7.3	9.0	90.0	8.0	6.7	7.0	7.3	7.3	6.7	7.2
SRX 3K	7.0	9.0	93.3	6.7	6.7	7.0	7.7	8.0	7.3	7.2
SRX 55R	8.0	9.0	95.0	6.7	6.7	6.7	7.0	7.7	7.7	7.1
Dawson E	7.0	9.0	91.7	7.3	6.7	6.7	6.3	7.3	7.7	7.0
Longfellow II	7.7	9.0	91.7	7.0	6.7	7.0	7.0	7.0	7.3	7.0
Pathfinder	7.0	9.0	91.7	7.0	7.0	6.3	6.7	7.3	7.7	7.0
PST-8000	7.7	9.0	90.0	7.0	6.7	7.0	6.7	7.3	7.3	7.0
TL 53	7.7	9.0	91.7	7.3	6.7	6.7	7.3	7.0	7.0	7.0
BMXC-S02	7.7	9.0	88.3	7.0	6.7	6.7	6.7	7.0	7.3	6.9
BUR 4601	7.7	9.0	88.3	7.3	6.7	6.7	6.7	7.3	6.7	6.9
Celestial	7.7	9.0	90.0	7.0	6.7	7.0	6.7	7.3	7.0	6.9
DP 77-9579	7.3	8.7	91.7	6.3	6.7	6.7	6.7	7.7	7.3	6.9
IS-FRR 29	7.7	9.0	93.3	7.0	7.0	6.7	6.7	7.0	7.3	6.9
Musica	7.0	9.0	91.7	7.7	6.3	6.3	7.0	7.0	7.3	6.9
5001	7.7	9.0	91.7	6.3	6.7	6.7	6.3	7.3	7.3	6.8
DLF-RCM	7.3	8.7	91.7	6.7	6.3	7.0	6.7	6.7	7.3	6.8
IS-FRR 30	7.3	9.0	91.7	7.0	6.3	6.3	6.3	7.3	7.3	6.8
PICK HF #2	7.0	9.0	90.0	7.3	6.0	6.7	7.0	6.7	7.0	6.8
Predator	7.3	9.0	93.3	7.0	6.3	6.7	6.7	7.3	7.0	6.8
PST-4TZ	7.3	8.7	90.0	7.3	6.3	6.7	6.7	7.0	7.0	6.8
Scaldis	7.0	9.0	90.0	7.0	6.7	6.3	6.3	7.7	7.0	6.8
7 Seas	7.7	9.0	90.0	6.7	6.7	6.7	6.3	7.0	7.0	6.7
Boreal	7.0	8.7	93.3	7.7	7.0	5.3	6.0	7.0	7.3	6.7
Cascade	7.7	9.0	91.7	7.3	6.0	6.3	6.3	7.0	7.0	6.7
DP 77-9360	8.0	8.7	91.7	6.7	6.7	6.3	6.3	7.0	7.3	6.7
TL1	7.3	8.7	90.0	6.7	6.7	6.7	6.3	7.0	7.0	6.7
ACF 188	8.3	9.0	90.0	7.0	6.3	6.3	6.7	6.3	6.7	6.6
DP 77-9578	7.3	9.0	90.0	6.7	6.3	6.3	6.3	6.7	7.0	6.6
DP 77-9886	7.3	9.0	91.7	6.7	6.3	6.3	6.3	6.7	7.3	6.6
Jasper II	7.3	9.0	88.3	6.0	6.7	6.7	6.0	7.3	7.0	6.6
Oracle	6.7	9.0	90.0	7.3	6.3	6.3	6.0	6.7	7.0	6.6
Seabreeze	7.0	9.0	93.3	6.7	6.7	6.0	6.0	7.0	7.3	6.6
Ambassador	8.0	9.0	86.7	7.3	6.3	6.0	6.3	6.3	6.7	6.5

ASC 245	8.0	9.0	90.0	6.3	6.3	6.3	6.3	7.0	6.7	6.5
Audubon	7.7	9.0	91.7	6.3	6.3	6.0	6.3	7.0	7.0	6.5
Berkshire	7.0	9.0	90.0	7.3	6.0	6.0	5.7	7.0	7.0	6.5
C03-4676	7.0	8.7	86.7	7.0	6.3	6.3	6.3	6.3	6.7	6.5
C-SMX	7.3	9.0	88.3	6.3	6.3	6.0	6.3	7.0	6.7	6.4
Jamestown 5	7.7	9.0	90.0	6.3	6.0	6.3	6.3	6.7	7.0	6.4
SR 3000	7.0	9.0	90.0	6.7	6.0	6.3	6.0	7.0	6.7	6.4
SRX 51G	7.7	8.7	86.7	6.3	6.0	6.3	5.7	7.0	6.7	6.3
DP 77-9885	8.3	9.0	86.7	6.7	5.7	6.0	6.0	6.7	6.3	6.2
IS-FRC 17	8.0	8.7	88.3	6.7	6.0	5.7	5.7	6.3	6.7	6.2
IS-FL 28	7.0	8.7	86.7	6.7	5.3	5.7	5.7	6.7	6.3	6.1
Quatro	7.0	9.0	88.3	6.7	5.7	5.3	5.7	6.3	7.0	6.1
Shademaster	7.0	8.3	90.0	6.7	6.0	5.3	6.0	6.0	6.7	6.1
SPM	7.0	9.0	85.0	6.7	5.7	5.3	5.7	6.7	6.3	6.1
Culumbra II (ACF 174)	7.7	9.0	85.0	7.3	6.0	5.0	5.3	6.3	6.0	6.0
CV	6.1	3.2	3.9	10.8	9.6	11.3	9.8	8.4	7.2	7.2
LSD	0.9	1.1	11.0	2.6	1.5	1.8	1.4	1.5	1.1	1.2

2003 Fairway Height Bentgrass Cultivar Trial

N.E. Christians and Rodney St. John

This is the first year of data collection from the new fairway height bentgrass trial that was established in the fall of 2003. The area was maintained at a 0.5 inch mowing height. This is a National Turfgrass Evaluation (NTEP) trial and is being conducted at several research stations in the U.S. It contains 28 of the newest seeded cultivars and a number of experimentals. The cultivars are maintained with 4 lbs of N/1000 ft^2/growing season. Fungicides are used as needed in a preventative program. Herbicides and insecticides are also applied as needed.

The visual quality was evaluated monthly in 2004 from April through October (Table 1). The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. The yearly average of the monthly data for each cultivar was calculated and is listed in the last column (Mean). The first cultivar listed in Table 1 had the highest average visual quality rating for the entire 2004 season. The cultivars are listed in descending order by average quality. The last row states the LSD (least significant difference), which is a statistical measurement of how widely the datum in each column must vary before they are considered to be different from one another.

Data for genetic color (Gen Color) and leaf texture (Leaf Tex) were also collected in June 2004. Percent cover data (PctEstab) were collected late in the fall of 2003. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Leaf texture was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture.

Table 1. 2004 visual quality and other ratings for the Fairway Height Bentgrass Cultivar Trial. All cultivars are creeping bentgrass, with the exception of Bardot, Tiger II, IS-AT 7, SR 7150, PST-9NBC, and PST-9VN which are colonial bentgrasses.

				------------------------Visual Quality------------------------							
Bentgrass Cultivar	**GenColor**	**LeafTex**	**PctEstab**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Mean**
Declaration	8.0	8.0	63.3	6.0	6.7	7.7	8.0	7.3	8.0	8.0	7.4
T-1	9.0	6.7	58.3	6.3	6.3	6.3	7.3	7.7	8.7	9.0	7.4
L-93	7.3	7.7	68.3	6.3	6.3	6.7	7.0	7.3	8.0	8.3	7.1
Penneagle II	8.7	7.3	60.0	5.3	6.0	7.7	7.3	7.3	7.7	8.3	7.1
23R	8.0	8.3	60.0	5.3	6.7	7.0	7.3	7.3	7.7	7.7	7.0
Alpha	8.3	7.0	63.3	5.0	6.0	7.0	7.0	7.7	8.3	7.3	6.9
Pennlinks II	8.3	7.7	63.3	6.3	6.3	7.0	6.7	6.3	7.7	7.7	6.9
Independence	7.7	7.3	63.3	5.7	6.0	6.7	7.3	7.0	7.3	7.7	6.8
Bengal	7.7	7.3	60.0	5.7	6.7	6.0	6.7	6.7	7.3	7.3	6.6
LS-44	7.7	7.0	63.3	5.7	5.7	6.3	7.0	7.0	7.7	6.7	6.6
235050	7.7	7.7	57.0	5.3	6.0	6.0	7.0	7.3	6.7	7.0	6.5
IS-AP 14	7.0	7.3	68.3	5.7	6.0	6.3	6.7	7.0	7.3	6.3	6.5
PST-OEB	8.3	6.3	51.7	5.0	5.3	5.7	6.7	7.7	8.0	7.3	6.5
SR 1119	8.3	6.7	58.3	5.0	5.0	6.0	6.3	7.3	8.3	7.3	6.5
13-M	6.7	7.0	61.7	5.0	6.0	6.0	7.0	7.0	7.3	6.3	6.4
Kingpin (9200)	8.7	6.0	58.3	4.7	5.3	5.3	6.7	7.0	8.0	7.7	6.4
Penncross	7.7	5.7	66.7	6.0	6.3	5.7	6.0	7.0	7.7	5.7	6.3
SRX 1GPD	7.7	7.3	60.0	5.3	6.0	6.0	6.0	6.3	7.0	7.7	6.3
SRX 1PDH	7.3	6.7	58.3	5.3	5.7	6.0	7.0	6.0	7.3	6.7	6.3
Princeville	7.7	6.3	70.0	6.3	5.7	6.0	6.0	6.0	7.7	5.7	6.2
IS-AT 7	8.0	5.7	56.7	5.0	4.7	4.3	5.3	6.0	7.3	6.7	5.6
EWTR	7.3	5.7	60.0	4.0	3.7	4.3	5.7	6.3	7.7	6.7	5.5
SR 7150	8.3	5.7	48.3	4.7	4.0	4.3	5.3	5.7	7.3	7.0	5.5
Bardot	7.7	5.3	50.0	4.0	3.7	4.3	5.0	5.7	7.0	7.0	5.2
PST-9VN	7.7	5.7	55.0	4.0	4.0	3.7	5.0	5.3	7.3	6.3	5.1
Seaside	5.7	5.7	80.0	7.0	4.3	5.0	4.3	5.0	5.0	5.0	5.1
Tiger II	7.3	5.3	56.7	4.3	3.7	3.7	5.0	5.3	7.3	6.3	5.1
PST-9NBC	7.7	5.0	51.7	4.3	4.0	4.3	4.7	5.3	6.3	6.0	5.0
CV	7.4	12.4	10.7	11.6	14.1	12.7	10.3	12.0	10.3	11.2	6.1
LSD	1.0	1.4	11.6	1.0	1.2	1.2	1.0	1.4	1.5	1.3	0.6

2003 Green Height Bentgrass Cultivar Trial

N.E. Christians and R.A. St. John

This is the first year of data from the green height bentgrass trial established in the fall of 2003. The area is maintained at a 3/16-inch mowing height. This is a National Turfgrass Evaluation Program (NTEP) trial and is being conducted at several research stations in the U.S. It contains 26 seeded cultivars, including a number of experimentals. Most of the plots are creeping bentgrass, with the exception of SR 7200, Legendary, IS-AC 1, EFD, Vesper, and Greenwich which are velvet bentgrasses.

The cultivars are maintained with a fertilizer program of 1/4 lb N applied at 14-day intervals with a total of 4 lbs of N/1000 ft2/growing season. Fungicides are used as needed in a preventative program. Herbicides and insecticides are applied as needed.

The visual quality was evaluated monthly in 2004 from April through October (Table 1). The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. The yearly average of the monthly data for each cultivar was calculated and is listed in the last column (Mean). The first cultivar listed in Table 1 had the highest average visual quality rating for the entire 2003 season. The cultivars are listed in descending order by average quality. The last row states the LSD (least significant difference), which is a statistical measurement of how widely the datum in each column must vary before they are considered to be different from one another.

Percent establishment data (PctEstab) were taken in late-fall 2003. Data for leaf texture (LeafTex) and genetic color (GenColor) were collected in June 2004. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green.

Table 1. The 2004 visual quality and other ratings for cultivars in the 1998 Green Height Bentgrass Trial. SR 7200, Legendary, IS-AC 1, EFD, Vesper, and Greenwich which are velvet bentgrasses. All other cultivars are creeping bentgrasses.

				------------------------Visual Quality---------------------							
Bentgrass Cultivar	**GenColor**	**LeafTex**	**PctEstab**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Mean**
235050	7.3	8.3	70.0	6.0	6.3	7.0	7.7	7.7	9.0	9.0	7.5
T-1	8.0	7.0	73.3	5.7	5.3	7.0	7.3	7.7	8.7	9.0	7.2
23R	7.3	8.3	76.7	6.0	6.3	6.7	7.3	8.3	6.7	8.3	7.1
DSB	7.3	8.0	61.7	5.7	5.7	6.7	7.0	8.0	8.7	8.3	7.1
Declaration	7.7	8.0	70.0	6.0	5.7	6.3	6.7	8.0	8.3	8.3	7.0
IS-AP 9	7.7	7.3	63.3	6.0	5.7	6.0	7.0	7.3	9.0	7.3	6.9
Penn A-1	7.0	8.0	76.7	5.7	5.0	6.0	7.3	8.0	8.7	7.7	6.9
Independence	7.3	7.0	70.0	5.3	5.0	6.3	7.0	7.3	8.0	7.7	6.7
SRX 1GD	7.3	7.0	65.0	5.3	6.0	6.3	6.7	7.3	7.3	7.7	6.7
Alpha	7.3	7.3	65.0	5.7	6.0	6.0	6.0	7.0	8.3	6.7	6.5
Benchmark DSR	7.3	6.7	68.3	5.3	5.7	5.7	5.7	7.3	8.3	7.0	6.4
Bengal	7.0	7.3	70.0	5.3	5.7	5.7	6.3	6.3	8.0	7.3	6.4
CY-2	7.3	7.3	60.0	5.3	5.0	5.7	6.3	7.0	8.0	7.3	6.4
A03-EDI	6.7	7.7	73.3	5.3	5.3	6.3	6.3	6.3	7.3	7.0	6.3
Kingpin (9200)	6.7	6.7	66.7	5.3	5.7	5.3	6.0	7.3	7.7	7.0	6.3
LS-44	7.7	7.0	71.7	5.3	5.0	5.7	6.3	7.0	7.3	7.7	6.3
13-M	6.3	8.0	73.3	5.3	5.3	5.7	6.0	6.7	8.0	6.3	6.2
SRX 1GPD	6.7	7.7	61.7	4.7	5.0	5.3	6.3	6.0	7.7	8.3	6.2
Pennlinks II	7.3	7.7	73.3	5.7	6.0	6.3	6.0	6.3	6.3	5.7	6.0
Penncross	6.7	6.0	75.0	6.0	5.7	5.7	5.7	5.3	6.0	6.0	5.8
Legendary	6.0	9.0	61.7	4.7	5.0	4.7	6.0	5.0	7.0	7.7	5.7
Greenwich	6.3	8.7	56.7	4.7	5.3	4.7	5.3	6.0	6.3	6.0	5.5
IS-AC 1	6.0	9.0	65.0	5.0	4.3	4.7	5.7	4.7	6.3	7.7	5.5
EFD	6.7	8.7	63.3	4.0	4.3	4.7	5.3	5.3	7.0	7.0	5.4
Vesper	7.0	7.7	46.7	4.0	4.3	4.7	5.7	4.7	6.0	7.0	5.2
SR 7200	7.0	8.3	48.3	4.0	4.0	4.3	4.7	5.0	6.0	7.0	5.0
CV	9.8	9.7	11.1	12.0	13.9	10.1	10.7	13.3	9.7	9.9	6.2
LSD	1.6	1.3	13.0	1.2	1.6	0.9	1.2	1.5	1.2	1.2	0.6

1999 Non-Irrigated Fairway Height Kentucky Bluegrass Cultivar Trial

Nick Christians and Luke Dant

The fairway height Kentucky bluegrass trial was established in September 1999 to evaluate a number of the new 'low mow' bluegrasses at a mowing height of 0.5 to 0.75 inches under non-irrigated conditions. The area receives 3 lbs. N/1000 ft^2/year and is treated with preemergence herbicides in the spring and broadleaf weed controls in the fall. No fungicides are used on the area. Dry conditions through most of the season eliminated differences among the cultivars during 2004.

The visual quality was evaluated monthly in 2004 from April through September (Table 1). The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. The yearly average of the monthly data for each cultivar was calculated and is listed in the last column (Mean). The first cultivar listed in Table 1 had the highest average visual quality rating for the entire 2004 season. The cultivars are listed in descending order by average quality. The last row states the LSD (least significant difference), which is a statistical measurement of how widely the datum in each column must vary before they are considered to be different from one another.

Table 1. Non-Irrigated Kentucy Bluegrass Trial 2004

Cultivar	**Quality April**	**Quality May**	**Quality June**	**Quality July**	**Quality August**	**Quality September**	**Mean Quality**
Award	4	6	6	6	6	6	6
Midnight	4	6	6	5	7	6	6
Total Eclipse	4	6	5	6	6	6	6
Absolute	4	6	5	5	6	5	5
Rambo	5	4	5	6	5	6	5
Nublue	5	6	4	5	6	6	5
Bluechip	5	4	5	5	6	6	5
****Sure-Shot Mix**	4	5	5	5	6	6	5
Nuglade	4	5	6	5	5	5	5
Bluemoon	5	4	5	5	6	5	5
Rugby II	4	5	5	5	5	6	5
***Sodgrower II**	5	4	4	5	5	5	5
Limosine	5	4	5	4	4	5	4
Kenblue	5	3	4	4	4	5	4
Park	5	3	4	5	4	4	4
LSD	1.3	1.4	NS	NS	1.4	1.8	1.0

*Sodgrower II Mix is composed of Bluechip, Nustar, Rambo, and Rugby II.

**Sure-Shot Mix is composed of Nuglade, Bluemoon, Award, Rugby II, and Rambo.

Shade Adaptation Study

Nick E. Christians and Luke Dant

The shade adaptation study was established in the fall of 1987 to evaluate the performance of 35 species and cultivars of grasses. The species include chewings fescue (C.F.), creeping red fescue (C.R.F.), hard fescue (H.F.), tall fescue (T.F.), Kentucky bluegrass (KBG), and rough bluegrass (*Poa trivialis*).

The trials are located under the canopy of a mature stand of Siberian elm trees (*Ulmus pumila*) at the Iowa State University Horticulture Research Station north of Ames, Iowa. Grasses are mowed at a 2-inch height and receive 2 lb N/1000ft^2/year. No weed control has been required on the area, but the grass has been irrigated during extended droughts.

The visual quality was evaluated monthly in 2003 from May through October (Table 1). The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. The yearly average of the monthly data for each cultivar was calculated and is listed in the last column (Mean). The first cultivar listed in Table 1 had the highest average visual quality rating for the entire 2004 season. The cultivars are listed in descending order by average quality. The last row states the LSD (least significant difference), which is a statistical measurement of how widely the datum in each column must vary before they are considered to be different from one another.

Table 1. Shade trial 2004

Cultivar	Quality April	Quality May	Quality June	Quality July	Quality August	Quality September	Quality October	Mean Quality
BAR Fo 81-225 (H.F.)	6	8	8	8	8	8	7	9
Victor (C.F.)	7	7	7	7	7	8	8	9
ST-2 (SR3000) (H.F.)	6	7	8	8	7	8	8	9
Waldina (H.F.)	6	6	8	8	7	8	7	9
Biljart (H.F.)	6	7	7	7	7	8	7	8
Atlanta (C.F.)	6	7	7	7	7	8	7	8
Shadow (C.F.)	6	6	7	7	8	8	8	8
Mary (C.F.)	6	8	6	7	7	8	7	8
Banner (C.F.)	6	8	7	6	7	7	7	8
Agram (C.F.)	6	7	7	6	8	8	7	8
Ensylva (C.R.F.)	6	6	6	7	7	8	8	8
Jamestown (C.F.)	6	7	7	7	7	8	6	8
Waldorf (C.F.)	5	7	6	7	7	8	7	8
Pennlawn (C.R.F.)	6	7	6	6	7	8	7	8
Reliant (H.F.)	5	7	6	6	7	7	7	7
Spartan (H.F.)	4	6	7	6	7	7	7	7
Wintergreen (C.F.)	6	5	6	6	5	7	6	7
Estica (C.R.F.)	4	5	6	6	6	7	6	7
Highlight (C.F.)	4	6	6	6	5	6	6	7
Rebel (T.F.)	4	5	5	5	6	6	7	6
Koket (C.F.)	5	5	5	5	5	6	6	6
Scaldis (H.F.)	4	5	5	5	5	6	5	6
Rebel II (T.F.)	4	5	5	5	5	6	7	6
Falcon (T.F.)	4	5	3	5	5	5	5	5
Arid (T.F.)	3	4	4	4	4	6	6	5
Bonanza (T.F.)	4	4	4	3	4	5	5	5
Apache (T.F.)	3	3	3	4	5	4	6	5
Ram I (K.B.)	3	4	3	3	3	3	3	4
Sabre (Poa trivialis)	2	4	3	4	3	3	3	4
Midnight (K.B.)	2	3	3	3	3	3	4	4
Nassau (K.B.)	2	3	2	3	2	3	3	3
Bristol (K.B.)	2	3	2	2	2	2	3	3
Coventry (K.B.)	2	2	2	3	2	3	3	3
Glade (K.B.)	2	2	3	2	2	2	3	3
Chateau (K.B.)	2	2	2	2	2	2	2	2
LSD 0.05	1.5	1.9	1.7	1.9	2.0	1.8	1.7	1.6

T.F. = Tall Fescue
C.F. = Chewings Fescue
H.F. = Hard Fescue
C.R.F. = Creeping Red Fescue

Ornamental Grasses Project 2000-2002

Nick Christians and Rodney St. John

Purpose:
The purpose of the ornamental grass project is to evaluate 34 ornamental grasses for their adaptation to Iowa conditions. The study is located south of the turfgrass research building. Grasses 1 and 2 were established in 1989. Grasses 3-5, 11-15, 17-18, 20-21, and 33 were established in 2000. The remaining grasses were established in June of 2001.

Each plot on this site has a 4 x 5 ft spacing. The grasses are located on the south side of the maintenance building at the Turf Research Farm. The grasses descend in height from number one in the center, to 34 on each of the ends. The 34 grasses are replicated twice on the two sides of the arc (Figure 1). The grasses are either cut down or burnt down each spring.

Choosing the species:
Ornamental grasses have numerous characteristics, each that could make a difference in which species is chosen for a particular landscape. For the plots at the Horticulture Research Station, the new species have general characteristics of being bunch type, non-aggressive, varying in color, form and shape, in addition to being able to grow in zones 4 and/or 5.

The grasses will remain in this location for several years. They will be evaluated on their winter survival and overall adaptation to local conditions.

Figure 1. Plot map and layout of the Ornamental Grasses Project.

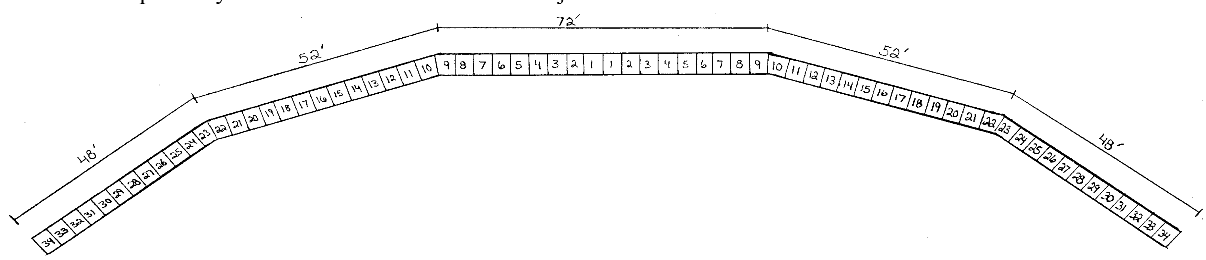


Table 1. Species, common name and expected growing height of the 34 grasses used in the Ornamental Grasses Project.

	Genus Species	Common Name	Expected Growing Height
1	Miscanthus floridulus 'Giganteus'	Giant Chinese Silver Grass	12-15'
2	Miscanthus sinensis	Japanese Silver Grass	8'
3	Miscanthus sinensis 'Strictus'	Porcupine Grass	8'
4	Panicum virgatum 'Cloud Nine'	Switch Grass	8'
5	Miscanthus sinensis 'Graziella'	Japanese Silver Grass	5-6'
6	Miscanthus sinensis 'Silberfeder'	Silver Feather	6-8'
7	Molina caerulea ssp. arundinacea 'Transparent'	Tall Moor Grass	5-7'
8	Molina caerulea ssp. arundinacea 'Skyracer'	Tall Moor Grass	7-8'
9	Molina caerulea ssp. arundinacea 'Windspiel'	Tall Moor Grass	6-7'
10	Molina litorialis 'Fontaene'	Tall Moor Grass	6'
11	Calamagrostis x acutiflora 'Karl Foerster'	Feather Reed Grass	4-5'
12	Miscanthus sinensis 'Variegatus'	Japanese Silver Grass	8'
13	Miscanthus sinensis 'Silberspinne'	Japanese Silver Grass	4-5'
14	Panicum virgatum 'Prairie Sky'	Switch Grass	6'
15	Panicum virgatum 'Heavy Metal'	Switch Grass	3-4'
16	Panicum virgatum	Switch Grass	5'
17	Miscanthus sinensis 'Purpurascens'	Japanese Silver Grass	3-4'
18	Sorghastrum nutans	Indian Grass	3-5'
19	Andropogon gerardii	Big bluestem	5'
20	Calamagrostis arundinacea 'Brachyticha'	Korean Feather Reed Grass	3'
21	Panicum virgatum 'Haense Herms'	Red Switch Grass	4'
22	Panicum virgatum 'Shenandoah'	Red Switch Grass	4'
23	Panicum virgatum 'Rotstrahlbusch'	Red Switch Grass	5'
24	Spodiopogon sibiricus	Siberian graybeard	4'
25	Bouteloua curtipendula	Side-oats grama	3'
26	Molina caerulea 'Karl Foester'	Variegated Purple Moor Grass	6-7'
27	Schizachyrium scoparium 'The Blues'	Little bluestem	2-3'
28	Deschampsia cespitosa 'Bronzeschleier'	Tufted Hair Grass	3'
29	Deschampsia cespitosa 'Goldstaub'	Tufted Hair Grass	2-3'
30	Helictotrichon sempervirens 'Saphiresprudel'	Blue-oat Grass	2-3'
31	Festuca mairei	Atlas Mountain Fescue	2-2.5'
32	Molina litoralis 'Bergfreud'	Tall Moor Grass	5-6'
33	Festuca glauca 'Superba'	Blue Fescue	1-2'
34	Festuca glauca 'Elijah Blue'	Blue Fescue	8"

2004 Low Input Sustainable Turfgrass Trial: A Regional Cooperative Research Project

Chris Blume, Shui-zhang Fei, Dave Minner and Nick Christians

Objectives: To identify alternative species adapted to this region with minimum input and obtain information on best management practice for each species.

Experimental methods A total of 13 species will be used for this trial. The cultivar, species name, and seeding rate are described as follows:

A: 'RoadCrest' Crested Wheatgrass 5 lbs / 1000 ft^2
B: 'LMC-1122' Meadow Fescue (*Festuca elatior*) 7 lbs / 1000ft^2
C: 'Spike' Tufted Hairgrass (*Descampsia caespitosa*) 1 lb /1000 ft^2
D: 'Blacksheep' Sheep fescue (*Festuca ovina*) 7 lbs/1000ft^2
E: 'Berkshire' Hard fescue (*Festuca longifolia*) 6 lbs/1000 ft^2
F: 'LMC-5000' Praire Junegrass (*Koeleria cristata*) 2 lbs/1000 ft^2
G: 'Fults' Alkaligrass (*Puccinellia distans*) 1.5 lbs /1000 ft^2
H: 'HB 342' hybrid bluegrass (Kentucky bluegrass X Texas bluegrass) 2 lbs/1000 ft^2
I: 'Dura Blue' Hybrid bluegrass (Kentucky bluegrass X Texas bluegrass) 2 lbs/1000 ft^2
J: 'ShadeStar' Crested dogs tail (*Cynosurus cristatus*) 1.0 lb/1000 ft^2
K: 'Bad river' Blue grama 3 lb/ 1000 ft^2
L: 'SR7150' Colonial bentgrass 1 lb /1000 ft^2
M: 'Grande II' tall fescue 7 lbs /1000 ft^2

The trial was established on September 7, 2004 with an entry plot size of 3 x 5 feet. Efforts were made to ensure successful establishment including the use of a starter fertilizer (P_2O_5 at 98kg per ha and 49 kg N per ha) and irrigation. Trimec® Classic was applied in April 2005 to control broadleaf weeds. No preemergent herbicides were applied. Three mowing heights at no mow, 2 inch and 4 inch are applied to each species and will be randomized within each of the three blocks as 5 x 39-feet strips perpendicular to and across all entries. Mowing frequency will be once every month during the growing season except for the no mow treatment.

Data collection This is the first year of the trial. No data has been collected yet. We will collect data on persistence and uniformity which will used as the two primary criteria to determine quality for each plot. Data will be taken monthly during the growing season. Different ratings will be applied toward no mow, 2" and 4" mowing heights as they represent different situations. Other data including density, percent coverage and percent of other species will be taken during the month of May, July and September every year. Data pooled from the 11 participating universities will be published.

2004 Crabgrass Control Trial

Luke Dant and Nick E. Christians

The purpose of this study was to evaluate the efficacy of several preemergence and postemergence herbicides for control of crabgrass. The study was conducted at the Iowa State University Research Facility on 'Ram 1' Kentucky bluegrass. To ensure uniformity, the plot area was seeded with crabgrass on April 26, 2004.

All liquid treatments were applied using a carbon dioxide backpack sprayer with #8002 flat fan TeeJet nozzles at 30-40 psi and diluted to a total spray volume of 3 gal per 1000 ft^2. Granular materials were applied using 'shaker dispensers' in order to provide uniform application. The initial preemergence application took place on April 27, 2004. On June 8, the 1-to-2-leaf-stage, the 1-to-3-leaf-stage, the early-post, and the 6-weeks-after-initial-treatment applications were made. The 4-to-6-leaf-stage application took place on July 10. Tillering crabgrass was treated on Aug. 3.

Turf quality was evaluated weekly during the summer and no damage to the bluegrass was observed from any of the treatments. On Aug. 13 and Sept. 10, the number of crabgrass plants in each plot were recorded.

Data were analyzed using Statistical Analysis System (SAS) and the Analysis of Variance procedure (ANOVA). Treatment effects were tested using the Least Significant Difference (LSD) test.

Heavy rains during and following the germination of crabgrass in May and June resulted in an extended period of flooding on the west end of the plots. This apparently affected establishment of the natural population and the seeded crabgrass, and very little germination occurred on the west one half of the study area. All three of the controls were in the flooded area which resulted in a lack of significant differences among treatments and the control.

While some differences occurred among treatments, the artifact caused by the flooding makes interpretation of the data difficult. Treatments and results are listed in Table 1.

Table. 1. Number of crabgrass plants per plot for the 2004 Crabgrass control trial.

Treatment		Application timing	Rate *a.i./A*		Rate *product/A*		Crabgrass number	
							Aug. 13	Sept. 10
1[Z]	**Untreated Control**	N/A	N/A		N/A		2	2
2	**Pendulum 3.3 EC**	Preemergence	2	lb	77.58	oz	48	48
3	**Pendulum 3.3 EC**	Preemergence	1	lb	38.79	oz	58	52
	Pendulum 3.3 EC	6 WAIT[y]	1	lb	38.79	oz		
4	**Pendulum 3.8 CS**	Preemergence	2	lb	67.37	oz	0	0
5	**Pendulum 3.8 CS**	Preemergence	1	lb	33.68	oz	0	0
	Pendulum 3.8 CS	6 WAIT	1	lb	33.68	oz		
6	**Oxadiazon I 2G**	Preemergence	3	lb	150.00	lb	0	0
7	**Oxadiazon II 2G**	Preemergence	3	lb	150.00	lb	6	3
8	**Oxadiazon III 2G**	Preemergence	3	lb	150.00	lb	0	0
9	**Oxadiazon I 2G**	1-2 leaf stage	3	lb	150.00	lb	10	4
10	**Oxadiazon II 2G**	1-2 leaf stage	3	lb	150.00	lb	0	1
11	**Oxadiazon III 2G**	1-2 leaf stage	3	lb	150.00	lb	67	61
12	**Ronstar 2G**	Preemergence	3	lb	150.00	lb	1	5
13	**Ronstar 2G**	1-2 leaf stage	3	lb	150.00	lb	10	6
14	**Ronstar 50 WSP**	Preemergence	3	lb	6.00	lb	1	0
15	**Betasan 4E**	Preemergence	20	lb	320.00	oz	0	1
16	**GWN-3031**	Preemergence	20	lb	320.00	oz	0	0
17	**GWN-3055**	Preemergence	20	lb	320.00	oz	0	2
18	**Barricade 4 FL**	Preemergence	0.65	lb	20.80	oz	29	24
19	**Mesotrione 4SC-A[x]**	Preemergence	0.25	lb	8.00	oz	13	7
20	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.125	lb	4.00	oz	40	39
21	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.187	lb	6.00	oz	12	12
22	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.25	lb	8.00	oz	25	23
23	**Mesotrione 4SC-A[x]**	4-6 leaf stage	0.187	lb	6.00	oz	0	0
24	**Mesotrione 4SC-A[x]**	4-6 leaf stage	0.25	lb	8.00	oz	0	0
25	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.1875	lb	6.00	oz	0	0
	Mesotrione 4SC-A[x]	4-6 leaf stage	0.187	lb	6.00	oz		
26	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.25	lb	8.00	oz	0	0
	Mesotrione 4SC-A[x]	4-6 leaf stage	0.25	lb	8.00	oz		
27	**Mesotrione 4SC-A[x]**	Tillering	0.187	lb	6.00	oz	2	2
28	**Mesotrione 4SC-A[x]**	Tillering	0.25	lb	8.00	oz	41	5
29	**Mesotrione 4SC-A[x]**	Preemergence	0.187	lb	5.98	oz	0	0
	Barricade 4 FL	Preemergence	0.65	lb	20.80	oz		
30	**Barricade 4 FL**	1-3 leaf stage	0.65	lb	20.80	oz	17	15
31	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.187	lb	5.98	oz	1	1
	Barricade 4 FL	1-3 leaf stage	0.65	lb	20.80	oz		
32	**Mesotrione 4SC-A[x]**	1-3 leaf stage	0.25	lb	8.00	oz	0	1
	Barricade 4 FL	1-3 leaf stage	0.65	lb	20.80	oz		

(Table 1. Cont.)

Treatment		Application timing	Rate *a.i./A*		Rate *product/A*		Crabgrass number	
							Aug. 13	Sept. 10
33	**Mesotrione 4SC-A**[x]	1-3 leaf stage	0.187	lb	5.98	oz	0	0
	Barricade 4 FL	1-3 leaf stage	0.65	lb	20.80	oz		
	Mesotrione 4SC-A[x]	4-6 leaf stage	0.187	lb	5.98	oz		
	Barricade 4 FL	4-6 leaf stage	0.65	lb	20.80	oz		
34	**Mesotrione 4SC-A**[x]	1-3 leaf stage	0.25	lb	8.00	oz	0	0
	Barricade 4 FL	1-3 leaf stage	0.65	lb	20.80	oz		
	Mesotrione 4SC-A[x]	4-6 leaf stage	0.25	lb	8.00	oz		
	Barricade 4 FL	4-6 leaf stage	0.65	lb	20.80	oz		
35	**Barricade 4 FL**	1-3 leaf stage	0.65	lb	20.80	oz	0	0
	Mesotrione 4SC-A[x]	4-6 leaf stage	0.25	lb	8.00	oz		
	Barricade 4 FL	4-6 leaf stage	0.65	lb	20.80	oz		
36	**A14524A 0.06%**	Preemergence	0.14	lb	225.00	lb	23	16
37	**A14525A 0.08%**	Preemergence	0.18	lb	225.00	lb	0	1
38	**A14526A 0.25%**	Preemergence	0.56	lb	225.00	lb	0	0
39	**Dimension Ultra 40 WP**	Preemergence	0.25	lb	0.63	lb	1	2
	Dimension Ultra 40 WP	Early post	0.25	lb	0.63	lb		
40	**Dimension Ultra 40 WP**	Preemergence	0.50	lb	1.25	lb	18	16
41	**Andersons Dimension**	Preemergence	0.15	lb	95.84	lb	0	0
42	**Andersons Dimension**	Preemergence	0.25	lb	152.48	lb	2	2
$LSD_{0.05}$							NS[w]	NS

[z] Treatments 2-5 were screened for the BASF Corporation, 6-14 for Bayer Environmental Sciences, 15-17 for the Gowan Company, 18-38 for Syngenta Crop Protection, Inc., and 39 and 40 for Dow AgroSciences, respectively.
[y] Weeks after initial treatment.
[x] Denotes that the non-ionic surfactant X-77 was used at a rate of 0.25% volume by volume.
[w] Means are not significantly different at the 0.05 level.

Mesotrione Kills Creeping Bentgrass in Kentucky Bluegrass

Marcus A. Jones and Nick E. Christians

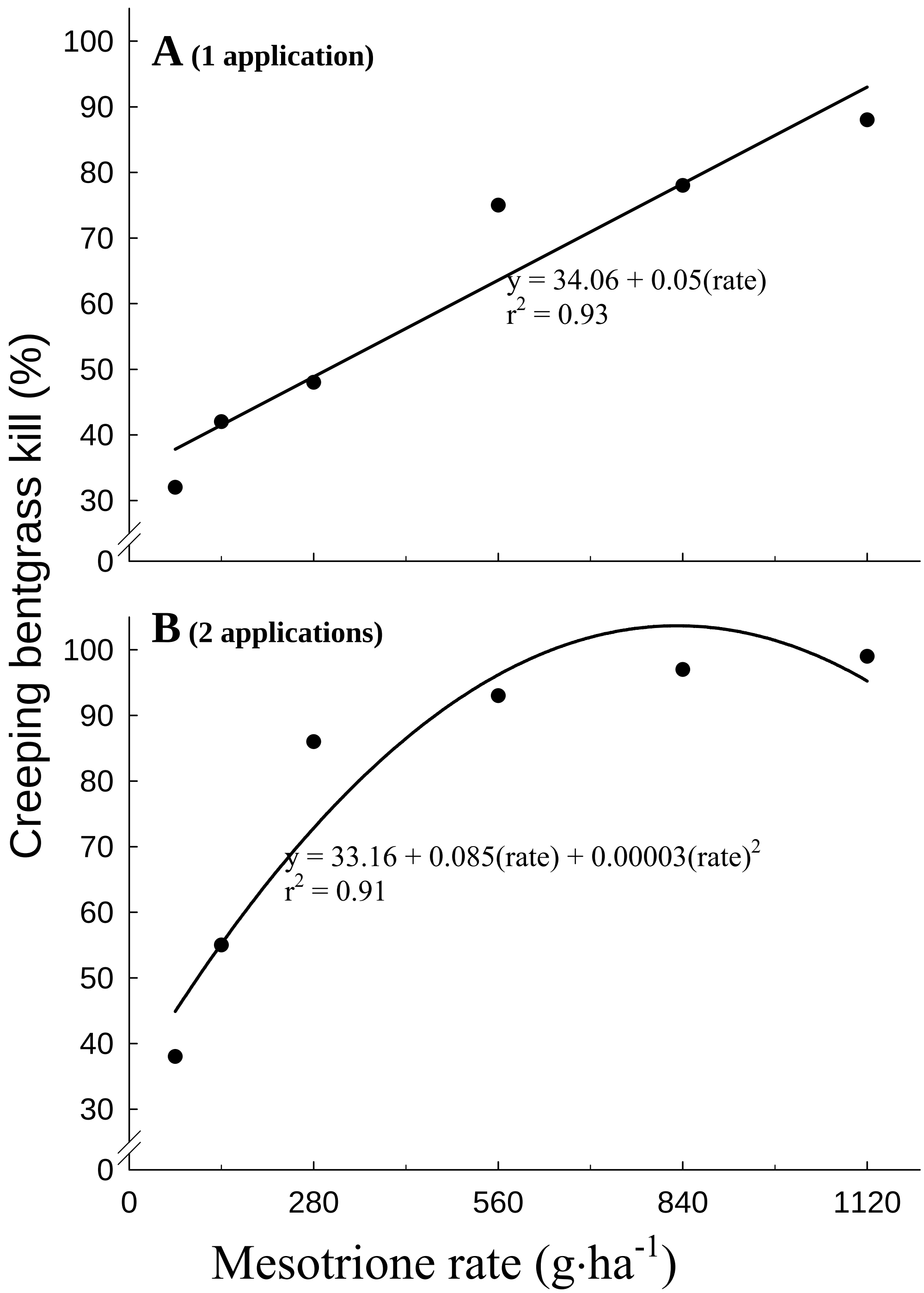
Introduction
Creeping bentgrass creates a dense, high-quality playing surface on golf courses, but often encroaches adjacent Kentucky bluegrass areas. Callisto, an herbicide produced and marketed by Syngenta containing the active ingredient mesotrione, provides preemergence and postemergence control of broadleaf and annual grassy weeds. Preliminary field trials show that mesotrione kills creeping bentgrass, but more information is needed regarding application protocol. Our research objective was to determine the affect of 1.) mesotrione rate and 2.) the number of applications on percent removal of creeping bentgrass from Kentucky bluegrass/bentgrass mixtures while monitoring overall turfgrass quality.

Materials and Methods
Research was conducted at the Iowa State University Horticulture Research Station. Turfgrass was a mixture of 'Pencross' creeping bentgrass and an unknown cultivar of Kentucky bluegrass. Experimental design was a randomized complete block with three replications. Each plot measured 5 x 5 feet. Plots were irrigated daily and mowed at a height of 1.5 inches three times per week. On May 5 mesotrione was applied at 0, 0.0625, 0.125, 0.25, 0.5, 0.75, and 1.0 lb ai./A. An untreated plot served as a control. On June 17 six plots in each block received a second application at the same rates. During each application, Mesotrione was mixed with a non-ionic surfactant at 0.25% volume to volume ratio.

Results and Discussion
One Application
One application of mesotrione killed 32% to 88% of the creeping bentgrass in Kentucky bluegrass (Fig. 1A). Applying mesotrione at 0.0625, 0.125 and 0.25 lb ai/A killed less than 50% of the creeping bentgrass. Conversely, applying mesotrione at 0.5, 0.75, and 1.0 lb ai/A resulted in 75% to 88% creeping bentgrass kill. Further analysis show that single applications of mesotrione at 0.5 lb ai/A were equally effective compared with rates of 0.75 and 1.0 lb ai/A. Currently, the label rate for maximum single applications of mesotrione is 0.3 lb ai/A. But, our research demonstrates that a single application of 0.3 lb ai/A would only kill 51% creeping bentgrass (Fig. 1A).

Two Applications
Two applications of mesotrione at increasing rates of 0.0625 to 1.0 lb ai/A each, killed 38% to 99% of the creeping bentgrass in Kentucky bluegrass (Fig. 1B). Two applications of mesotrione at 0.0625 and 0.125 lb ai/A each, provided 38% and 55% creeping bentgrass kill, respectively. Two applications at rates of 0.25 lb ai/A and higher, provided greater than 86% creeping bentgrass kill with the highest rate resulting in 99% kill. Further analysis show that two applications of mesotrione at 0.25 lb ai/A each, were equally effective compared with rates of 0.5, 0.75, and 1.0 lb ai/A. Two applications of mesotrione at a rate of 0.25 lb ai/A each, killed 86% of the creeping bentgrass in Kentucky bluegrass (Fig. 1B). This rate of two split applications of 0.25lb ai/A each meets label use requirements while still providing effective control of creeping bentgrass in Kentucky bluegrass.

Fig. 1. Percentage creeping bentgrass kill in Kentucky bluegrass in plots receiving one (A) or two (B) applications of mesotrione at 0.0625, 0.125, 0.25, 0.5, 0.75, and 1.0 lb ai/A. The first application was applied 5 May 2004 and plots receiving a second application were treated again on 17 June 2004. Percentage creeping bentgrass kill was determined 5 Aug. 2004 using a modified grid.



Overall Turfgrass Quality

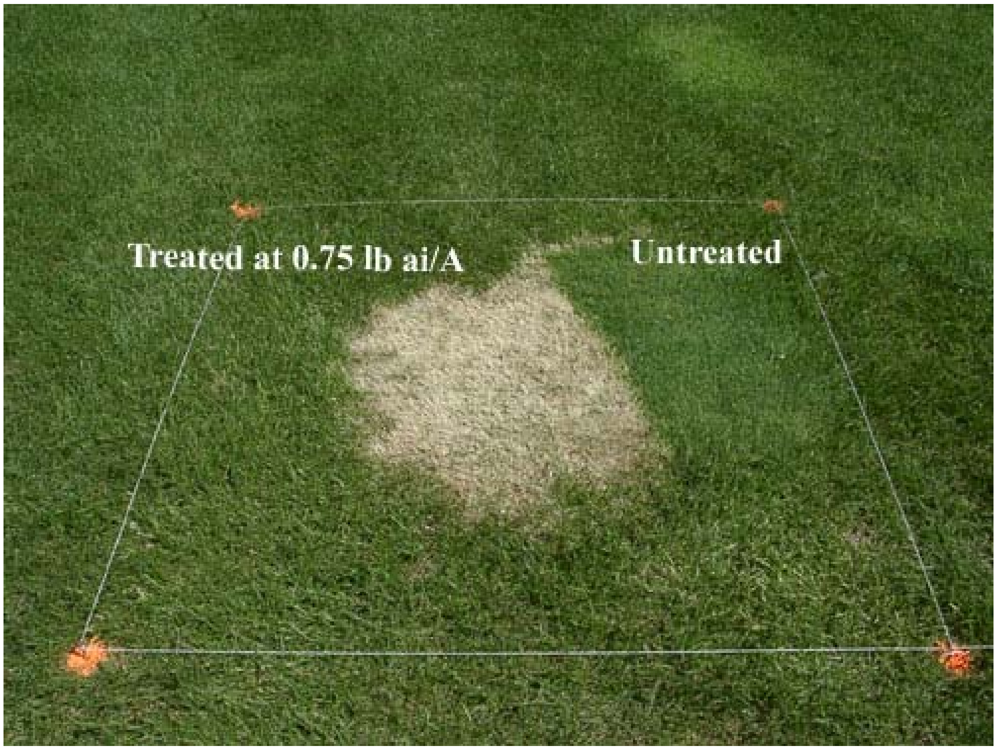
One and two applications of mesotrione at a rate of 0.25 lb ai/A and greater, reduced overall turfgrass quality 44% to 56% two weeks after final application but fully recovered six weeks later. However, plots receiving two applications of mesotrione at 0.25 lb ai/A each, recovered to acceptable levels one week after final application (data not shown). Reductions in overall turfgrass quality resulted from the lack of plant density once creeping bentgrass died. In areas where creeping bentgrass comprises a large percentage of mixtures, removal would create gaps in the canopy inviting weeds to colonize. Seeding Kentucky bluegrass, fescue species or perennial ryegrass rather than simply allowing the established Kentucky bluegrass to fill this void may improve overall turfgrass quality faster. Further work is required to determine if mesotrione possesses preemergence activity on various cool-season turfgrass seeds.

Table 1. Mesotrione rate and number of applications affect overall turfgrass quality. The first application was applied May 5 and plots receiving two applications were treated again on June 17 2004. Plots were irrigated daily and fertilized with urea (46-0-0) at 1.0 lb N/1000 ft^2 on May 24 2004. Values represent means of three replications.

	One application						**Two applications**				
	Time after application (weeks)						**Time after final application (weeks)**				
Rate (lbs ai/A)	**2**	**3**	**4**	**5**	**6**	**7**	**2**	**4**	**6**	**8**	**10**
	Overall quality[z]						**Overall quality**				
Control	9a[y]	9a	9a	9a	9a	9a	9a	9a	9a	9a	9a
0.0625	8ab	8a	9a	9a	9a	9a	9a	9a	9a	9a	9a
0.125	7b	8a	9a	9a	9a	9a	7ab	9a	9a	9a	9a
0.25	5c	6b	8ab	8b	9a	9a	5bc	8a	9a	9a	9a
0.5	5c	6b	6bc	8b	9a	9a	5bc	7b	8b	9a	9a
0.75	4d	5bc	5cd	7c	8b	9a	4bc	7b	8b	9a	9a
1.0	4d	4c	4d	5d	6c	8a	4c	5c	5c	7b	9a

[z]Overall quality based on color, uniformity, and plant density was assessed visually on a 1 to 9 scale with 1 = poorest, 6 = least acceptable, and 9 = best.
[y]Means within column followed by the same letter are not different according to Fishers $LSD_{0.05}$.

Close-up of creeping bentgrass damage receiving a single application of mesotrione at 0.75 lb ai/A. Kentucky bluegrass (center) was unaffected by the application.



Field plot demonstrating characteristic bleaching of plant tissue. Left half of creeping bentgrass patch received mesotrione at 0.75 lb ai/A. Right half was untreated. Adjacent Kentucky bluegrass was unaffected by the application.

Selective Removal of Creeping Bentgrass from Kentucky Bluegrass with Sulfosulfuron

Marcus A. Jones and Nick E. Christians

Introduction

Sulfosulfuron is a sulfonylurea herbicide marketed by Monsanto that provides control of annual and perennial broadleaves and grasses in wheat and non crop areas. Recent studies demonstrate that sulfosulfuron exhibits herbicidal activity on annual bluegrass and tall fescue, but Kentucky bluegrass and perennial ryegrass are tolerant of the herbicide at low application rates. The goal of this study is to determine if Certainty® has the capability of selectively removing creeping bentgrass from Kentucky Bluegrass. Our three objectives are:

1) Determine the best time of application that provides for selective postemergence control of creeping bentgrass in Kentucky bluegrass,
2) Determine the rate of application for selective postemergence control of creeping bentgrass in Kentucky bluegrass, and
3) Observe detrimental effects to the Kentucky bluegrass from the herbicide applications.

Materials and Methods

The trial was initiated during the fall of 2004. Research was conducted at Coldwater Golf Links in Ames, IA on a mixed stand of L-93 creeping bentgrass and Sure Shot Kentucky bluegrass maintained at a height of one inch. Sure Shot is a Kentucky bluegrass blend containing Nuglade, Bluemoon, Award, Rugby II, and Rambo cultivars.

The randomized complete block trial was replicated three times and received weekly applications of sulfosulfuron applied with a non-ionic surfactant beginning the fourth week of September and concluding the third week of November (Table 1). Weekly turfgrass quality data was recorded on a scale of 1 to 9 (1 = Worst, 6 = Acceptable, 9 = Best) and grid counts were performed to determine percentage creeping bentgrass kill. Data were analyzed using the Statistical Analysis System Software and the Analysis of Variance procedure. Fisher's LSD (α=0.05) was used to determine treatment effects.

Results and Discussion

Sulfosulfuron failed to provide effective postemergence control of creeping bentgrass at 0.25 and 0.5 oz/A (Table 1). Reductions in creeping bentgrass coverage were observed, but we believe these reductions were due to winter injury and not sulfosulfuron treatments as percentage bentgrass kill was reduced 19% in untreated controls. In addition, the 0.5 oz/A rate did not prove more effective compared with the 0.25 oz/A rate (Table 1). Turfgrass quality was unaffected by sulfosulfuron applications. Fall applications of sulfosulfuron at 0.25 and 0.5 oz/A did not control creeping bentgrass in Kentucky bluegrass in this trial.

Table 1. Influence of sulfosulfuron rate and timing on creeping bentgrass control. Percentage reduction was determined by using a modified grid. Grids were performed directly prior to initiation of treatments and again the following spring in order to quantify creeping bentgrass kill. Values represent means of three replications

Treatment	Timing	Rate (oz/A)	C. bentgrass reduction (%)
1	**Control**	Control	19
2	**4th week Sept.**	0.25	10
3		0.5	9
4	**5th week Sept.**	0.25	15
5		0.5	+6
6	**1st week Oct.**	0.25	12
7		0.5	21
8	**2nd week Oct.**	0.25	12
9		0.5	+5
10	**3rd week Oct.**	0.25	0
11		0.5	+4
12	**4th week Oct.**	0.25	11
13		0.5	9
14	**1st week Nov.**	0.25	+3
15		0.5	1
16	**2nd week Nov.**	0.25	+2
17		0.5	+5
18	**3rd week Nov.**	0.25	+3
19		0.5	10
LSD			25

Control of Glyphosate-resistant Creeping Bentgrass with Postemergence Herbicides

L.A. Dant and N.E. Christians

Creeping bentgrass (*Agrostis stolonifera* L.) is the primary turfgrass used on golf course putting greens and fairways in the temperate region of the United States. A cultivar that is resistant to glyphosate has recently been developed by the Scotts Company in partnership with the Monsanto Company. Establishment of golf course turf to glyphosate-resistant creeping bentgrass would improve weed control, in particular control of annual bluegrass (*Poa annua* L.). Creeping bentgrass is a stoloniferous grass that has the potential to move beyond golf course putting greens and fairways into areas where it is undesirable. Research was conducted at Iowa State University to evaluate herbicides for the control and removal of glyphosate-resistant creeping bentgrass from areas where it is undesirable

Materials and Methods

We removed plugs of glyphosate-resistant creeping bentgrass and 'Penncross' creeping bentgrass, measuring 4.25 inches in diameter, from an established native-soil putting green on 7 Nov. 2004. Plugs were placed in 5-inch diameter pots and allowed to acclimate to greenhouse conditions. Treatments included ten herbicides applied according to label directions (Table 1) and an untreated control. The study was a completely randomized design with four replications. Herbicides were applied to glyphosate-resistant creeping bentgrass and 'Penncross' creeping bentgrass on 28 Jan. 2005, in a spray booth using a total spray volume of 20 gallons per acre. Turf was fertilized and irrigated for optimal growth. Mowing occurred on a weekly basis before initiation of treatments and turf was maintained at a height of 0.5 inches.

Data collection and analysis

Turfgrass quality was recorded on a weekly basis using a scale of 1 to 9 with 1 = worst, 6 = acceptable, and 9 = excellent. Dry clipping weight was measured 14 and 42 days after treatment (DAT). Upon termination of the study (56 DAT), percent kill was documented. Data were analyzed by using the General Linear Model procedure of the Statistical Analysis System (SAS, 1999-2001). Mean comparisons for turfgrass quality, dry clipping weight, and percent kill were made using an F-protected least significant test. Contrasts were used to compare means for interactions of cultivar and herbicide. All tests of significance were made at the $P \leq 0.05$ level.

Results

All herbicides reduced turfgrass quality of glyphosate-resistant creeping bentgrass and 'Penncross' creeping bentgrass below levels of the untreated control 28 DAT with the exception of glyphosate applied to glyphosate-resistant bentgrass (Tables 2 and 3). Glufosinate reduced turfgrass quality of both cultivars to the worst quality rating (1) 14 days after treatment, however, the grass began to recover 28 DAT. Glyphosate applied to 'Penncross' creeping bentgrass reduced quality to a 1 at 14 DAT, but the grass began to recover 28 DAT and reached a quality rating of 3 by 56 DAT (Table 3). Both cultivars treated with imazapyr received the worst quality rating at 35 DAT and this was the only treatment to receive the worst rating at 56 DAT (Tables 2 and 3).

Percentage kill was the greatest when turfgrass was treated with imazapyr; 99% and 100% for glyphosate-resistant and 'Penncross' creeping bentgrass, respectively (Table 4). Glufosinate resulted in kill ≥ 75% for both cultivars and glyphosate killed 89% of 'Penncross' creeping bentgrass, but had no affect on bentgrass resistant to the herbicide (Table 4). All other herbicides provided varying control of both cultivars.

All herbicides reduced dry clipping weight of 'Penncross' creeping bentgrass below that of the control, 14 DAT (Table 5). This was also true for glyphosate-resistant creeping bentgrass with the exception of mesotrione and glyphosate. Imazapyr was the only herbicide that resulted in no clipping yield for both cultivars, 42 DAT (Table 5).

All of the herbicides provided similar control of both cultivars with the exception of quizalofop and glyphosate. Kill of glyphosate-resistant bentgrass treated with quizalofop was 65% compared with only 21% kill of 'Penncross' creeping bentgrass (Table 4). Glyphosate killed 89% of 'Penncross' creeping bentgrass, but glyphosate-resistant bentgrass was unaffected (Table 4).

Discussion

Imazapyr was the only herbicide evaluated that provided control ≥ 99% of both bentgrass cultivars. We feel that several of the herbicides evaluated, specifically fluazifop-P, glufosinate, and quizalofop, would provide complete control if two or more applications were made. Contrary to popular belief, we found that glyphosate did not completely control bentgrass susceptible to the herbicide. The label of Roundup Pro® (glyphosate) states that it only offers "partial control" of creeping bentgrass (Monsanto Corporation, 2003). We found that most of the herbicides resulted in control that was relatively similar between cultivars. This suggests that transformation of bentgrass does not confer resistance to other herbicides.

In conclusion, imazapyr killed creeping bentgrass in one application and would be an excellent alternative to glyphosate. Research conducted at Iowa State University has also shown that mesotrione provides effective control of creeping bentgrass in the field, but is ineffective in greenhouse studies. Future research should be conducted to evaluate these herbicides in the field. All of the herbicides evaluated have potential to control bentgrass with multiple applications, and this should be the target of future research. Although glyphosate-resistant creeping bentgrass may move into areas where it is undesirable, alternative herbicides are available that will provide control of bentgrass at levels similar to that of glyphosate.

Table 1. Herbicides evaluated for control of glyphosate-resistant and 'Penncross' creeping bentgrass. All herbicides were applied per label directions.

Trade Name	Active ingredient	Rate	Adjuvant	Rate
		—— lb·acre^{-1} ——		— volume/volume —
Untreated control	---	---	---	---
Fusilade DX	Fluazifop-P	0.38	NIS	0.25%
Revolver	Foramsulfuron	0.04	---	---
Finale	Glufosinate	1.5	Ammonium Sulfate	17 lb per 100 gal
Roundup Pro	Glyphosate	1.5	---	---
Raptor	Imazamox	0.05	NIS	0.25%
Arsenal	Imazapyr	0.75	NIS[z]	0.25%
Callisto	Mesotrione	0.3	NIS	0.25%
Assure II	Quizalofop	0.08	NIS	0.25%
Poast Plus	Sethoxydim	0.28	COC[y]	32 oz·acre^{-1}
Outrider	Sulfosulfuron	0.09	NIS	0.25%

[Z]Non-ionic surfactant
[y]Crop oil concentrate

Table 2. Turfgrass quality of glyphosate-resistant creeping bentgrass treated with several herbicides. Turfgrass quality was rated on 1-9 scale with 1 = worst, 6 = acceptable, and 9 = excellent. Values are means from four replications.

Active Ingredient	**Time after treatment (days)**							
	7	**14**	**21**	**28**	**35**	**42**	**49**	**56**
	Turfgrass quality							
Untreated control	9	9	8	9	8	6	7	6
Fluazifop-P	6	5	3	3	3	2	3	4
Foramsulfuron	5	5	4	4	3	4	4	4
Glufosinate	1	1	1	2	2	2	2	3
Glyphosate	9	9	8	9	7	6	6	5
Imazamox	6	5	5	5	4	6	6	6
Imazapyr	5	4	3	2	1	2	1	1
Mesotrione	8	7	4	4	3	3	4	5
Quizalofop	6	5	4	3	3	4	3	3
Sethoxydim	5	4	4	3	4	4	5	4
Sulfosulfuron	7	8	6	7	6	5	6	6
$LSD_{0.05}$	1	1	1	1	1	2	1	1

Table 3. Turfgrass quality of 'Penncross' creeping bentgrass treated with several herbicides. Turfgrass quality was rated on 1-9 scale with 1 = worst, 6 = acceptable, and 9 = excellent. Values are means from four replications.

Active Ingredient	Time after treatment (days)							
	7	14	21	28	35	42	49	56
	Turfgrass quality							
Untreated control	9	9	9	8	9	8	8	7
Fluazifop-P	6	4	3	3	3	3	4	4
Foramsulfuron	6	5	5	5	4	5	5	4
Glufosinate	1	1	1	2	2	2	2	3
Glyphosate	2	1	1	2	2	2	2	3
Imazamox	5	5	4	4	4	5	5	6
Imazapyr	5	4	3	2	1	2	1	1
Mesotrione	9	5	3	3	4	4	5	5
Quizalofop	5	4	3	3	3	3	4	5
Sethoxydim	5	4	3	4	4	4	4	4
Sulfosulfuron	6	8	8	6	5	7	6	5
$LSD_{0.05}$	1	1	1	1	1	2	1	1

Table 4. Percentage kill of glyphosate-resistant and 'Penncross' creeping bentgrass treated with several herbicides. Percentage kill was recorded 56 days after treatment. Values are means from four replications.

Active ingredient	Glyphosate-resistant creeping bentgrass	'Penncross' creeping bentgrass
	Percentage kill	
	%	
Untreated control	0	4
Fluazifop-P	59	44
Foramsulfuron	20	36
Glufosinate	79	75
Glyphosate	0	89
Imazamox	16	26
Imazapyr	99	100
Mesotrione	9	11
Quizalofop	65	21
Sethoxydim	23	23
Sulfosulfuron	10	8
$LSD_{0.05}$	20	19

Table 5. Clipping dry weight of glyphosate-resistant and 'Penncross' creeping bentgrass treated with several herbicides. Turf was maintained at 13 mm. Clippings were collected for each pot, dried, and weighed. Values are means from four replications.

Active ingredient	Glyphosate-resistant creeping bentgrass		'Penncross' creeping bentgrass	
	Time after treatment (days)			
	14	42	14	42
	Clipping dry weight			
	mg·pot^{-1}			
Untreated control	79	81	94	147
Fluazifop-P	14	23	24	104
Foramsulfuron	15	22	15	63
Glufosinate	4	33	8	35
Glyphosate	94	105	15	25
Imazamox	10	53	15	57
Imazapyr	11	0	23	0
Mesotrione	59	90	54	99
Quizalofop	15	30	15	66
Sethoxydim	6	70	15	72
Sulfosulfuron	31	146	13	68
$LSD_{0.05}$	31	42	17	54

Fig. 1. Glyphosate-resistant and ‘Penncross’ creeping bentgrass 56 days after treatment with imazapyr.

Fig. 2. Glyphosate-resistant and ‘Penncross’ creeping bentgrass 56 days after treatment with glyphosate.

Identification and Characterization of a CBF Gene in Perennial Ryegrass (*Lolium perenne* L.)

Yanwen Xiong and Shui-Zhang Fei

Introduction

Perennial ryegrass is widely used as both turf and forage in temperate regions. Perennial ryegrass cannot survive severe winters, which is a major limitation for its distribution. Plants from temperate regions can increase freezing tolerance after an exposure to non-freezing low temperatures for a period time. This process is called cold acclimation. Cold acclimation is at least partly due to gene expression induced by low temperatures. Many cold inducible genes have been identified and characterized in Arabidopsis, barley, wheat and other crops. These cold inducible genes all have a C-repeat (CRT)/dehydration response element (DRE) in their promoter regions. In model plant Arabidopsis, a family of transcription factors that bind to CRT/DRE promoter region has been identified and designated as CBF (CRT/DRE Binding Factor) genes. CBF is a small family from which CBF1, CBF2, CBF3 have been isolated and identified in Arabidopsis. Overexpression of CBF1 and CBF3 led to constitutive expression of cold-inducible genes and enhanced freezing tolerance in non-cold acclimated Arabidopsis. This cold-stress signal transduction pathway has been reported to be conserved in flowering plants. CBF genes have also been identified and characterized in rice, maize, barley, and Brassica, in addition to Arabidopsis. The objective of this study was to identify and characterize CBF-like genes in perennial ryegrass with the hope that we can improve freezing tolerance of perennial ryegrass by transgenic technology in the future.

Materials and methods

Degenerate primers were designed based on the AP2 domain and C-terminal region conserved in all CBF genes known in monocot plant species. RNA was isolated from the perennial ryegrass cultivar ‘Caddyshack’ that was cold-treated by using Trizol reagent. RT-PCR was performed on the isolated RNA by using the degenerate primers to obtain partial length of a CBF-like gene and 5’ and 3’ RACE (Rapid amplification of cDNA end) were used to obtain the complete 5’and 3’ end of the CBF-like gene. Southern and northern blots were used to determine the copy number and the expression pattern of the CBF-like genes in various stress treatments. Mega3 program was used to conduct phylogenetic analysis.

Results

A CBF-like gene was isolated by using RT-PCR and 5’and 3’RACE in perennial ryegrass cultivar ‘Caddyshack’. Phylogenetic analysis indicated that perennial ryegrass CBF-like gene was clustered with a group of CBF3 genes from rice, maize, and barley. We, therefore, designated the perennial ryegrass CBF-like gene as LpCBF3 gene and deposited it to GeneBank with an accession number of AY970831. The expression pattern of LpCBF3 was similar to those of other reported CBF genes that function in ABA-independent cold stress signal transduction pathway. We are currently working on functional analysis of the LpCBF3 gene by transferring the gene into Arabidopsis. Expression pattern of downstream target genes and freezing tolerance testing of transgenic plants will be analyzed.

Mapping of Quantitative Trait Loci (QTL) for Winter Hardiness in Perennial Ryegrass

Yanwen Xiong, Shui-zhang Fei and Reed Barker

Introduction

Perennial ryegrass (Lolium perenne L) is an important turf species. Perennial ryegrass has a fast establishment rate, strong seedling vigor, good tolerance to both traffic and low mowing, which makes it a good choice for use on golf course fairways and athletic fields. However, perennial ryegrass has poor ability to survive in severe winters, which limits its use in the far north of the United States including Iowa. An important breeding objective for perennial ryegrass is to improve its winter hardiness. Winter hardiness is a complex quantitative trait that is controlled by multiple genes with each having minor genetic effect. In addition, the expression of such genes is often affected by the environment, which makes it difficult to identify such genes. With the development of DNA marker techniques, it is now possible to locate these genes (quantitative trait loci, QTLs) that are associated with winter hardiness. There are abundant DNA marker variations present in natural population; some of these markers are in the same chromosome as the genes responsible for winter hardiness. These markers often transmit together with the winter hardiness genes into their progenies. The DNA markers are stable and relatively easy to identify compared to winter hardiness genes that are influenced by environment and difficult to identify with classic genetics. The long-term goal of this project is to facilitate germplasm improvement of perennial ryegrass with enhanced winter hardiness through marker-assisted selection (MAS). The specific objective of this research was to identify QTLs that are associated with winter hardiness in perennial ryegrass.

Materials and methods

A segregating population of 174 genotypes was created by crossing a perennial ryegrass cultivar 'Manhattan' which has good winter hardiness with an annual ryegrass cultivar 'Floregon' which is very sensitive to winter killing. Four clones of each genotype were planted in the field within each replication in an α lattice design with three replications. The distance between individual clones of a genotype is 30 cm, and the distance between each genotype is 60 cm. The distance between rows is 90 cm. Fall regrowth was measured as the vertical height of regrowth in centimeters on 14 November after the last mowing. Freezing tolerance was assessed by measuring ion leakage. Winter survival was evaluated at the end of April using a scale of l - 5 with 1 being completely dead and 5 being no injury.

Results

Nine QTLs were identified for fall growth, freezing tolerance, and winter survival from both female and male maps. Four QTLs were identified for winter survival from both female and male maps; two QTLs were identified for fall growth measured in year 2003 and year 2004, respectively.

Mowing Frequency Affects Creeping Bentgrass Health

Mark J. Howieson and Nick E. Christians

Frequent mowing is necessary to maintain uniform playing surfaces for sports turf areas. However, mowing wounds grass plants, creating openings that facilitate water loss and that are susceptible to entry of disease-causing organisms. Plants respond to wounding by increasing production of hydrogen peroxide. This is the same chemical used as a disinfectant to treat cuts and scrapes. Hydrogen peroxide regularly is produced by plants in low concentrations as a byproduct of photosynthesis and other metabolic reactions; however, production of hydrogen peroxide increases substantially after wounding.

Hydrogen peroxide plays an important role in many responses to wounding. Hydrogen peroxide acts as a signal to kill damaged tissue near cut leaf tips. This is similar to formation of scabs on our own bodies. Scabs form a cover to stop blood loss and provide a barrier to infection. In plants, hydrogen peroxide-mediated cell death near the cut leaf tip limits water loss and entry of disease-causing fungi. Mowing removes leaf tissue used for photosynthesis and food production; therefore, grasses must temporarily limit growth to conserve energy. Hydrogen peroxide also acts as a signal to slow cell division and induces accumulation of plant hormones that reduce growth and allows grasses to better adapt to limited energy production.

High concentrations of hydrogen peroxide are toxic to plant cells, and ultimately will result in cell death if not removed. Plants have developed enzymes that detoxify hydrogen peroxide to limit cell damage. Catalase is an important hydrogen peroxide detoxification enzyme. Unfortunately, the activity of catalase is reduced in severely wounded tissue, which may result in accumulation of hydrogen peroxide and extensive damage or even death.

Grasses often are double-cut to improve the uniformity and visual appearance of the playing surface. However, multiple-cuttings likely are more stressful to the plant than single-cuttings and may limit the vigor and recuperative potential of mown grasses. The objective of this study was to determine the activity of catalase and photosynthetic efficiency over time in double-cut, single-cut, rolled, and uncut grasses.

Results and discussion

The activity of catalase consistently was lowest in grasses that were double-cut and highest in uncut grasses (Fig 1). Catalase activity also was reduced in single-cut grasses, although the magnitude was not as great as the reduction observed in double-cut grasses. The largest reduction of catalase enzyme activity in both single- and double-cut grasses occurred 12 hours after mowing. Coupled with a decrease of catalase enzyme activity in mown grasses is an increase in production of hydrogen peroxide. This may result in increased levels of hydrogen peroxide and the associated reduction in plant growth and initiation of cell death. The additive stress of multiple cuttings may contribute to slower growth and vigor of grasses in the clean-up pass or in overlap areas between successive mower passes or cutting units.

Photosynthetic Efficiency

Photosynthetic yield is a measurement of the light use efficiency of a plant, i.e., the percentage of absorbed light energy that is used to form chemical bonds and not fluoresced or released as heat. A large photosynthetic yield value indicates low levels of stress, whereas a smaller value indicates that photosynthetic components have been damaged and that the plant is under stress. Photosynthetic yield was highest in uncut and rolled grasses, whereas photosynthetic yield consistently was lowest in double-cut grasses (Fig 2). Reduced photosynthetic yield in double-cut grasses is likely the result of high concentrations of hydrogen peroxide caused by increased production in wounded tissue and decreased removal because of limited catalase activity. Photosynthetic yield also was reduced in single-cut grasses, although the duration and magnitude was not as great as the reduction observed in double-cut grasses.

Take home message

Multiple-cuttings damage grasses more than a single-cut or rolling. Although double-cutting can be used to create better playing surface uniformity and playability, caution should used especially during adverse environmental conditions. Grasses that have been double-cut may be less vigorous in growth and more susceptible to other stresses.

Materials and methods

Eighty-four pots of 'L-93' creeping bentgrass (*Agrostis stolonifera* L.) were established on sand and grown in a growth chamber with PAR of 500 µmol m^{-2} s^{-1} for a 16 hour photoperiod (0600-2200). Temperatures were 70/60 ºF (day/night). Sand was fertilized weekly with a modified Hoagland's solution. Grass was mowed three times weekly at a height of 1.3 cm (0.5 in) with an electric walk-behind greens mower (Toro, Minneapolis, MN).

Treatments were applied on the third day after the previous mowing. Leaf tissue was collected 0, 3, 6, 9, 12, 15, and 24 hours after application of treatments. Enzymes were extracted with a potassium-phosphate buffer (pH 7.0). Catalase activity was determined as described previously by Change and Maehly. Photosynthetic yield was measured by using a chlorophyll fluorometer (Walz, Germany).
The study was in a completely randomized design with three replications per treatment. Data were analyzed by using the MIXED procedure of SAS (Cary, NC).

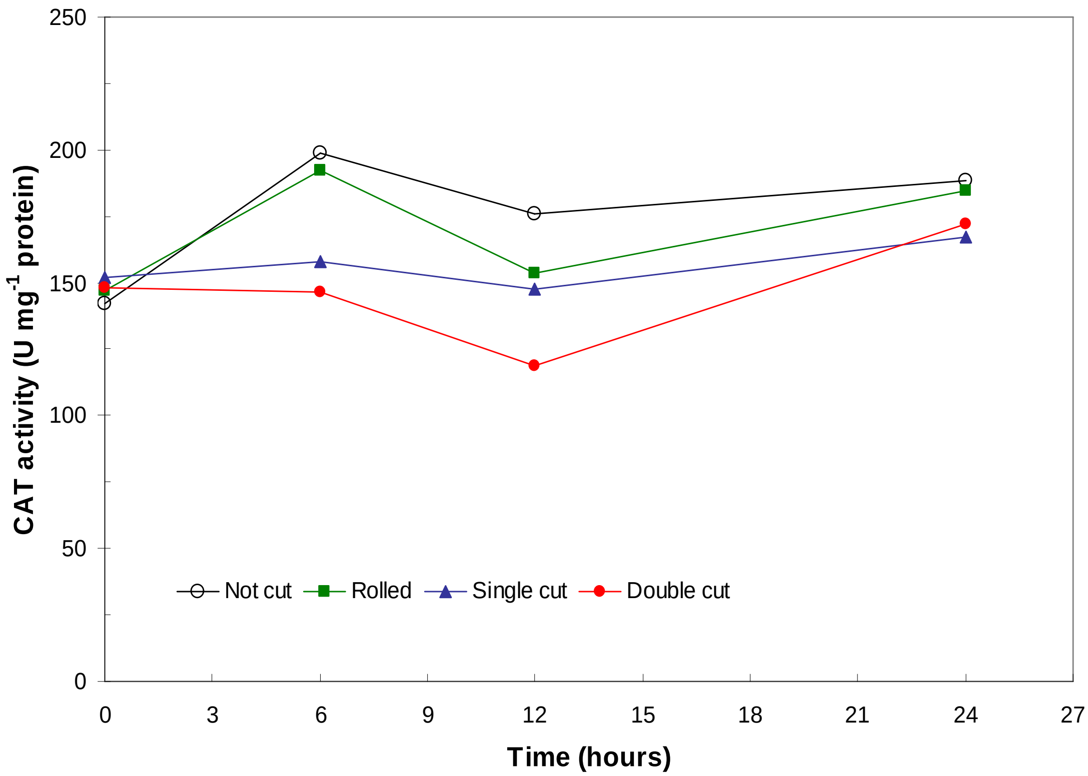


Figure 1. Catalase activity of uncut, rolled, single-cut, and double-cut creeping bentgrass over time after mowing. Plants, when wounded, increase production of hydrogen peroxide that is toxic to plant cells. Catalase is an enzyme that detoxifies hydrogen peroxide. Decreased activity of catalase in single- and double-cut grasses may result in accumulation of hydrogen peroxide.

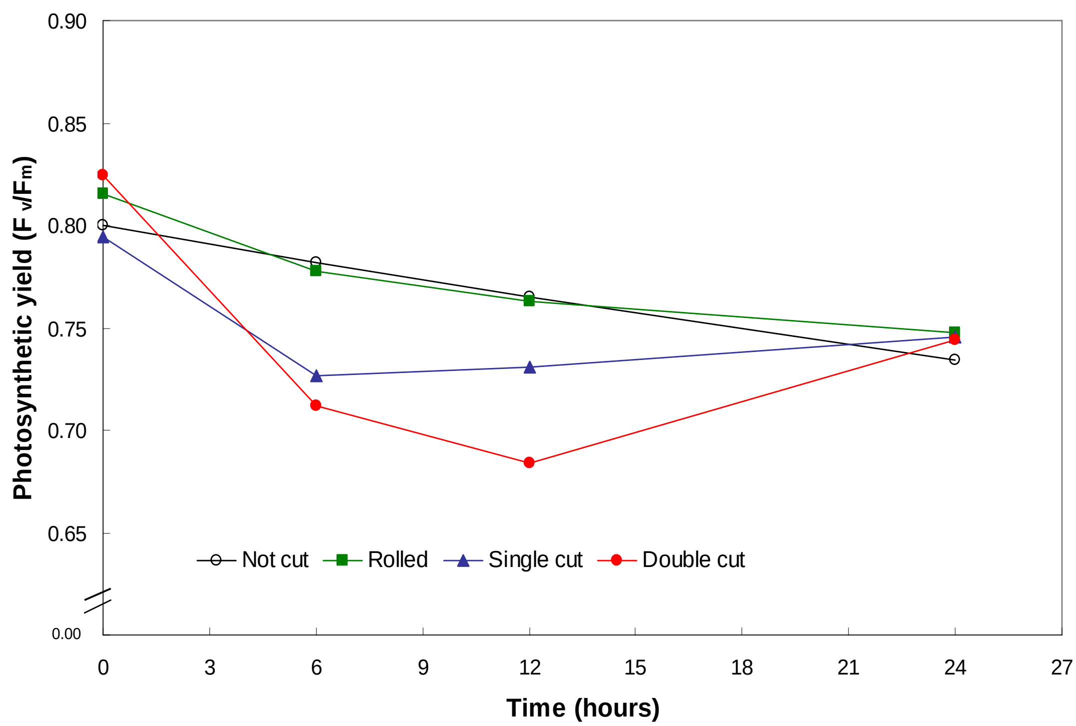


Figure 2. Photosynthetic yield of uncut, rolled, single-cut, and double-cut creeping bentgrass over time after mowing. Photosynthetic yield is a measure of stress.
Smaller values indicate reduced efficiency of photosynthesis and greater stress.

Evaluation of Fungicides for Control of Dollar Spot in Creeping Bentgrass - 2003.

Mark L. Gleason and Sara J. Helland

Trials were conducted at the Iowa State University Horticulture Station in Ames, Iowa. Creeping bentgrass was maintained at 0.16-inch cutting height. Fungicides, selected for activity against brown patch, were applied using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal per 1000 sq ft. The experimental design was a randomized complete block with four replications. All plots measured 4 ft x 5 ft. Spray applications were initiated on 30 Jun. This was followed by re-applications at recommended intervals until 20 Aug. Visual estimates were made of percent disease severity for dollar spot at approximately 10-day intervals starting on 27 Jul. Data were analyzed using the GLM procedure in SAS, and mean separations were determined using Fisher's protected LSD at $P \leq 0.05$.

Disease pressure was low to moderate due to dry conditions throughout July. Most of the tested products suppressed dollar spot significantly ($P<0.05$) in comparison to the unsprayed check, with the exception of Endorse. This product provided control no better than the unsprayed check. No phytotoxicity symptoms were observed during the trial.

Dollar spot trial – 2003
Iowa State University Horticulture (Penncross creeping bentgrass)

Plot size: 20 ft^2 (4 ft x 5 ft); 4 plots per treatment

Trt #	*Company*	*Product*	*Rate/1000 ft^2*	*Interval (days)*	*Dollar spot (%)* 27 Jul	*6 Aug*	*15 Aug*	*23 Aug*
1	**Check**	**-----------**	-------	------	4.1	7.5	10.0	15.7
2	**BASF**	**Emerald 70WG**	0.13 oz	14	0.0	0.0 c	0.0	3.1
3	**BASF**	**Emerald 70WG**	0.18 oz	21	0.0	0.0 c	0.0	3.7
4	**BASF**	**Insignia 20WG**	0.9 oz	14	0.0	0.0 c	0.5	2.2
5	**BASF**	**Emerald 70WG ROTATE Insignia 20WG and [1]**	0.13 oz + 0.9 oz	14	0.0	0.1	0.9	3.6
6	**BASF**	**Propiconazole Pro 1.3 MC**	1.0 fl oz	14	0.0	0.0	0.1	1.5
7	**Cleary**	**Endorse 2.5WP**	4 oz	14	1.7	5.2	10.7	16.7
8	**Cleary**	**Spectro 90WDG**	4 oz	14	0.0	0.0	0.2	2.0
9	**Bayer**	**26GT 2SC**	4 fl oz	14	0.0	0.0	0.0	5.5
10	**Bayer**	**Bayleton 50DF**	0.5 oz	14	0.0	2.5	0.6	1.4
	LSD (0.05)				6.2	3.7	3.7	1.6

[1] Product applications were rotated on a 14-day interval (Emerald 30 Jun and 28 Jul; Insignia 14 Jul and 11 Aug).

Evaluation of Fungicides for Control of Brown Patch and Dollar Spot in Creeping Bentgrass – 2004

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Trials were conducted at Veenker Memorial Golf Course in Ames, Iowa. ‘Washington’ creeping bentgrass was maintained at 0.16-inch cutting height. Fungicides selected for activity against brown patch were applied using a backpack sprayer at 30 psi and a dilution rate of 5 gal per 1000 sq ft. The experimental design was a randomized complete block with four replications. All plots measured 4 ft x 5 ft. Spray applications were initiated on 4 Jun, except for curative treatments, which were initiated on 2 Jul. These were followed by re-applications at recommended intervals until 13 Aug.

For brown patch, visual estimates of disease severity were made at approximately 10-day intervals starting on 15 Jul with a qualitative scale of 0-5, where 0 = no disease; 1 = 1-5%; 2 = 6-10%; 3 = 11-25%; 4 = 26-50%; 5 = >50% plot symptomatic. For dollar spot, visual estimates of disease severity (% dollar spot) were made at approximately 7-day intervals starting on 23 Jun. Data were analyzed using the GLM procedure in SAS and mean separations were determined using Fisher’s protected LSD at $P \leq 0.05$.

Because of cool temperatures, disease pressure was low to moderate for brown patch and severe for dollar spot. Most of the tested products suppressed brown patch and dollar spot significantly ($P \leq 0.05$) in comparison to the unsprayed check. No phytotoxicity symptoms were observed during the trial.

Table 1. BROWN PATCH TRIAL, Veenker Memorial Golf Course, Ames IA (creeping bentgrass) – 2004
Plot size: 20 ft^2 (4 ft x 5 ft); 4 plots per treatment

			Brown patch severity (1-5 scale)			
Product	***Rate/100ft²***	***Interval (days)***	***15 Jul***	***28 Jul***	***10 Aug***	***19 Aug***
Unsprayed check	---	---	1.75 a-c	2.25 a-d	1.50 a	0.25 bc
3336 F	4 fl oz	14	0.00 d	0.00 f	0.00 e	0.00 c
3336 F + Spotrete WDG	4 fl oz + 5 oz	14	0.00 d	0.50 ef	0.00 e	0.00 c
Spectro 90WDG	4 oz	14	0.00 d	1.00 c-f	0.00 e	0.00 c
Endorse 2.5WP	4 oz	14	0.25 d	0.50 ef	0.00 e	0.00 c
Cleary EXP 0214	4 oz	Once (4 June)	0.00 d	0.00 d	0.25 de	0.00 c
Super GT 3SC	2.67 fl oz	14	0.25 d	0.25 ef	0.00 e	0.00 c
26GT 2SC	4 fl oz	14	0.00 d	0.00 f	0.00 e	0.00 c
Bayleton DF	0.5 oz	14	0.00 d	0.00 f	0.00 e	0.00 c
Bayleton DF[1]	0.5 oz	14	0.50 cd	0.25 ef	0.00 e	0.00 c
Compass 50WG	0.1 oz	14	0.00 d	0.75 d-f	0.25 de	0.00 c
Compass 50WG[1]	0.1 oz	14	1.25 a-d	1.50 a-f	0.25 de	0.50 a-c
Compass 50WG	0.2 oz	14	0.00 d	0.00 f	0.00 e	0.00 c
Compass 50WG + Bayleton DF	0.1 oz + 0.5 oz	14	0.00 d	0.00 f	0.00 e	0.00 c
Compass 50WG + Bayleton DF[1]	0.1 oz + 0.5 oz	14	1.25 a-d	1.75 a-e	0.00 e	0.00 c
Compass 50WG + Bayleton DF	0.2 oz + 1 oz	14	0.25 d	0.50 ef	0.00 e	0.00 c
Compass 50WG + Bayleton DF[1]	0.2 oz + 1 oz	14	0.75 cd	0.50 ef	0.00 e	0.25 bc
Banner MAXX 1.24 MEC + Daconi Ultrex 82.5WDG	1 fl oz + 3.25 oz	14	0.00 d	0.25 ef	0.00 e	0.00 c
Bayer EXP 0357 0.157 GR	5 lb	14	0.00 d	0.75 d-f	0.00 e	0.00 c
Bayer EXP 0357 0.157 GR	10 lb	14	0.00 d	1.25 b-f	0.00 e	0.00 c
Emerald 70WG	0.13 oz	14	0.00 d	0.00 f	0.00 e	0.00 c
Emerald 70WG[1]	0.13 oz	14	0.00 b-d	0.75 d-f	0.25 de	0.25 bc
Insignia 20WG	0.5 oz	14	0.00 d	0.00 f	0.25 de	0.00 c
Insignia 20WG	0.9 oz	14	0.00 d	0.00 f	0.00 e	0.00 c
Insignia 20WG[1]	0.9 oz	14	0.25 d	0.25 ef	0.00 e	0.00 c
Insignia 20WG	0.9 oz	28	0.00 d	0.00 f	0.00 e	0.00 c
Daconil Ultrex 82.5WDG	3.25 oz	7	0.00 d	0.50 ef	0.00 e	0.00 c
Daconil Ultrex 82.5WDG	3.25 oz	28	1.00 b-d	3.00 a	0.75 b-d	0.00 c
Ecoguard BioFungicide WS	20 fl oz	7	0.75 cd	0.25 ef	0.00 e	0.00 c
Ecoguard BioFungicide WS	20 fl oz	14	0.00 d	0.25 ef	0.00 e	0.00 c
Ecoguard BioFungicide WS + Daconil Ultrex 82.5 WDG	20 fl oz + 3.25 oz	14	0.00 d	0.75 d-f	0.00 e	0.00 c
Ecoguard BioFungicide WS + Daconil Ultrex 82.5 WDG	20 fl oz + 2.45 oz	14	0.75 cd	1.25 b-f	0.00 e	0.00 c
Ecoguard BioFungicide WS + Daconil Ultrex 82.5 WDG	20 fl oz + 1.63 oz	14	0.25 d	1.50 a-f	0.75 b-d	0.00 c
Ecoguard BioFungicide WS ROTATE Daconil Ultrex 82.5 WDG[2]	20 fl oz + 3.25 oz	14	1.00 b-d	1.75 a-e	0.50 c-e	0.00 c
Ecoguard BioFungicide WS ROTATE Banner MAXX 1.24MEC[2]	20 fl oz + 1 fl oz	14	0.75 cd	0.75 d-f	0.00 e	0.00 c
Ecoguard BioFungicide WS ROTATE Compass 50WG[y]	20 fl oz + 0.2 oz	14	0.25 d	0.75 d-f	0.00 e	0.00 c
Ecoguard BioFungicide WP 140	5 oz	7	1.00 b-d	0.75 d-f	0.00 e	0.00 c
Ecoguard BioFungicide WP 140	5 oz	14	1.75 a-c	2.25 a-d	0.25 de	0.00 c
Ecoguard BioFungicide WP 145	1 oz	7	0.25 d	1.25 b-f	1.00 a-c	0.75 ab
Ecoguard BioFungicide WP 145	1 oz	14	2.50 ab	3.00 a	1.25 ab	0.75 ab
LSD (0.05)[3]			1.40	1.69	0.75	0.60

[1]Application of products was initiated on 2 Jul.
[2]Product applications were rotated on a 14-day interval (First product 4 Jun, 2 Jul and 30 Jul; Second product 18 Jun, 16 Jul and 13 Aug).
[3]Means marked by the same letter are not significantly different according to Fisher's protected LSD at P≤0.05.

Table 2. DOLLAR SPOT TRIAL, Veenker Memorial Golf Course, Ames IA (creeping bentgrass) – 2004
Plot size: 20 ft^2 (4 ft x 5 ft); 4 plots per treatment

			Dollar spot severity (%)			
Product	***Rate/100ft²***	***Interval (days)***	***7 Jul***	***21 Jul***	***4 Aug***	***18 Aug***
Unsprayed check	---	---	5.5 b-h	17.5 b-i	24.0 ab	25.1 ab
3336 F	4 fl oz	14	0.1 i	0.1 k	0.0 k	0.1 j
3336 F + Spotrete WDG	4 fl oz + 5 oz	14	0.0 i	0.0 k	0.0 k	0.0 j
Spectro 90WDG	4 oz	14	0.0 i	0.0 k	0.0 k	0.2 j
Endorse 2.5WP	4 oz	14	0.0 i	5.0 h-k	5.8 f-k	7.6 f-j
Cleary EXP 0214	4 oz	Once (4 June)	4.0 c-i	20.8 b-f	36.2 a	29.0 ab
Super GT 3SC	2.67 fl oz	14	0.0 i	2.1 jk	0.5 jk	0.1 j
26GT 2SC	4 fl oz	14	0.1 i	3.5 i-k	1.5 jk	0.1 j
Bayleton DF	0.5 oz	14	0.0 i	0.0 k	0.0 k	0.0 j
Bayleton DF[1]	0.5 oz	14	2.3 g-i	2.6 jk	1.0 jk	0.4 ij
Compass 50WG	0.1 oz	14	0.4 hi	4.5 h-k	4.9 f-k	4.1 g-j
Compass 50WG[1]	0.1 oz	14	11.3 a	29.5 a-c	25.0 ab	23.1 ab
Compass 50WG	0.2 oz	14	2.3 g-i	12.0 e-k	11.0 d-i	12.4 c-g
Compass 50WG + Bayleton DF	0.1 oz + 0.5 oz	14	0.0 i	0.0 k	0.1 k	0.1 j
Compass 50WG + Bayleton DF[1]	0.1 oz + 0.5 oz	14	3.3 d-i	6.0 g-k	4.0 h-k	1.6 h-j
Compass 50WG + Bayleton DF	0.2 oz + 1 oz	14	0.0 i	0.0 k	0.5 jk	0.1 j
Compass 50WG + Bayleton DF[1]	0.2 oz + 1 oz	14	6.5 a-g	7.0 f-k	2.5 i-k	1.2 h-j
Banner MAXX 1.24 MEC + Daconi Ultrex 82.5WDG	1 fl oz + 3.25 oz	14	1.0 hi	0.1 k	0.0 k	0.0 j
Bayer EXP 0357 0.157 GR	5 lb	14	8.3 a-e	28.3 a-d	17.0 b-g	4.6 g-k
Bayer EXP 0357 0.157 GR	10 lb	14	3.0 e-i	11.0 e-k	9.5 g-m	1.1 i-k
Emerald 70WG	0.13 oz	14	0.8 hi	0.1 k	0.0 k	0.0 j
Emerald 70WG[1]	0.13 oz	14	5.5 b-h	8.5 f-k	2.8 h-k	0.5 ij
Insignia 20WG	0.5 oz	14	0.3 hi	1.6 jk	3.1 h-k	2.9 g-j
Insignia 20WG	0.9 oz	14	2.5 f-i	15.5 c-j	14.0 c-f	7.1 f-j
Insignia 20WG[1]	0.9 oz	14	6.5 a-g	30.3 ab	24.3 ab	33.3 a
Insignia 20WG	0.9 oz	28	3.3 d-i	25.0 a-e	21.3 a-c	25.0 ab
Daconil Ultrex 82.5WDG	3.25 oz	7	0.0 i	0.0 k	0.0 k	0.0 j
Daconil Ultrex 82.5WDG	3.25 oz	28	2.0 g-i	18.8 b-h	17.0 b-e	5.4 f-j
Ecoguard BioFungicide WS	20 fl oz	7	3.9 c-i	8.8 f-k	1.9 i-k	1.4 h-j
Ecoguard BioFungicide WS	20 fl oz	14	1.9 g-i	3.6 i-k	4.0 h-k	3.6 g-j
Ecoguard BioFungicide WS + Daconil Ultrex 82.5 WDG	20 fl oz + 3.25 oz	14	0.0 i	1.3 jk	0.1 k	0.0 j
Ecoguard BioFungicide WS + Daconil Ultrex 82.5 WDG	20 fl oz + 2.45 oz	14	2.3 g-i	6.3 g-k	3.8 h-k	1.2 h-j
Ecoguard BioFungicide WS + Daconil Ultrex 82.5 WDG	20 fl oz + 1.63 oz	14	1.4 g-i	7.8 f-k	5.9 f-k	2.2 g-j
Ecoguard BioFungicide WS ROTATE Daconil Ultrex 82.5 WDG[2]	20 fl oz + 3.25 oz	14	1.8 g-i	9.8 f-k	5.5 f-k	3.0 g-j
Ecoguard BioFungicide WS ROTATE Banner MAXX 1.24MEC[2]	20 fl oz + 1 fl oz	14	2.8 f-i	8.8 f-k	4.8 g-k	0.9 ij
Ecoguard BioFungicide WS ROTATE Compass 50WG[y]	20 fl oz + 0.2 oz	14	8.8 a-c	26.5 a-d	16.0 b-e	9.9 e-j
Ecoguard BioFungicide WP 140	5 oz	7	1.0 hi	3.8 i-k	2.9 h-k	1.4 h-j
Ecoguard BioFungicide WP 140	5 oz	14	4.0 c-i	14.0 d-k	11.8 d-h	8.0 f-j
Ecoguard BioFungicide WP 145	1 oz	7	4.8 b-i	21.3 a-f	13.8 c-g	6.8 f-j
Ecoguard BioFungicide WP 145	1 oz	14	10.0 ab	35.5 a	26.5 a	22.1 bc
LSD (0.05)[3]			5.3	14.5	9.8	10.5

[1]Application of products was initiated on 2 Jul.
[2]Product applications were rotated on a 14-day interval (First product 4 Jun, 2 Jul and 30 Jul; Second product 18 Jun, 16 Jul and 13 Aug).
[3]Means marked by the same letter are not significantly different according to Fisher's protected LSD at P≤0.05.

Fungicide Application and Winter Injury on Creeping Bentgrass

D.D. Minner and F.J. Valverde

Fungicides are routinely applied for control of snow mold diseases on putting greens in Iowa. Phytotoxicity from winter applied products that result in delayed spring green up has been suspected by some Golf Course Superintendents. Fungicides, wetting agents, plant growth regulators, turf colorants, anti-desiccants, growth covers, and sand topdressing are all factors to consider during winter injury evaluation.

Objective
The purpose of this trial was to determine if any of a broad range of winter applied products contribute to winter turf injury.

Methods
This study was conducted on creeping bentgrass (Agrostis stolonifera L.) at the Horticulture Research Farm in Ames and at Veenker Memorial Golf course, Iowa State University, Ames, Iowa. Two field trials were conducted simultaneously during winter and spring of 2003-2004 and three trials were conducted simultaneously during winter and spring of 2004-2005. The experimental design was a randomized complete block. There were 4 replications, and a variable number of treatments in each trial as described in tables 1 and 2. Both trials in 2003 were covered with an Evergreen tarp during the winter. In 2004-2005 one trial was covered with an Evergreen tarp, another with Green Jacket tarp, and one was left uncovered. Chemicals were applied on December 7, 2003 and December 8, 2004 with a CO2 back pack sprayer delivering 3 gallons/1000 sq.ft. Since there was some phytotoxicity observed in the 2003-2004 trial with products containing Banner Maxx, Daconil, and Medallion, those product batches were kept and reapplied the following year to be compared with new formulation batches. All chemicals and mixtures were prepared two days before spraying and mixed constantly during application. Winter protection covers were placed on 10 December in both years and prior to the first substantial snow event of the season. Visual ratings were taken on 24 March, 5 April and 3 May 2004 and on 23 March, 25 April and 18 May of 2005. Color ratings were based on a scale of 1-9 with 9 = dark green, 1 = bleached tan and 6 being the least acceptable green color.
Anova and LSD tests were performed on the data.

Table 1. Treatment description and application rates for products applied in 2003.

Treatment	Description	Rate	
		Oz./1000ft^2	*ml-g/25ft^2
1	Control		
2	Water application	384	285
3	Banner Maxx	3.0	2.18
	Daconil Weather Stick	5.5	3.99
4	Banner Maxx	2.0	1.45
	Medallion	0.5	0.36
5	Banner Maxx	3.0	2.18
	Medallion	0.5	0.36
6	Banner Maxx	2.0	1.45
	Medallion	0.5	0.36
	Daconil Weather Stick	5.5	3.99
7	Primer select	4.0	2.90
8	Leaf shield	2.0	1.45
9	Aca 1820	6.0	4.35
10	Regreen	12.0	8.7
11	Regreen	24.0	17.4
12	Regreen	12.0	8.70
	Banner Maxx	3.0	2.18
	Daconil Weather Stick	5.5	3.99
13	Greenlawnger	32.0	25
14	Evergrenn cover	n/a	n/a
15	Sand Topdress	1/8"	1 gal/plot
16	Impermeable cover	n/a	n/a
17	Waterings (3/season)	10240/ea.	7800/ea.
18	PCNB granular	120	85
19	PCNB WP	8.0	5.80
20	PCNB F	16.0	11.6

* Units are either milliliter or grams/25 sq.ft. depending on liquid or dry formulation.

Table 2. Treatment description and application rates for products applied in 2004.

Treatment	Description	Rate	
		Oz./1000 ft^2	*ml-g/25 ft^2
1	Control		
2	2004 Banner Maxx	3.0	1.74
	2004 Daconil Weather Stick	5.5	3.19
3	2004 Daconil Weather Stick	5.5	3.19
	2004 Medallion	0.5	0.29
4	2004 Banner Maxx	3.0	1.74
	2004 Medallion	0.5	0.29
5	2004 Banner Maxx	2.0	1.16
	2004 Medallion	0.5	0.29
	2004 Daconil Weather Stick	5.5	3.19
6	Leaf Shield	2.0	1.16
7	Regreen	12.0	6.96
8	Regreen	24.0	13.92
9	Regreen	12.0	6.96
	2004 Banner Maxx	3.0	1.74
	2004 Daconil Weather Stick	5.5	3.19
10	Greenlawnger	300-1000ml	20.0
11	Sand (toddress 1/8")		1 gal/plot
12	PCNB (granular)	7.5 lb	68
13	PCNB (WP)	8.0	4.64
14	PCNB (F)	16.0	9.28
15	2003 Banner Maxx	4.0	2.32
16	2003 Medallion	0.5	0.29
17	2003 Daconil Weather Stick	5.5	3.19
18	2004 Banner Maxx	4.0	2.32
19	2004 Medallion	0.5	0.29
20	2004 Daconil Weather Stick	5.5	3.99

* Units are either milliliter or grams/25 sq.ft. depending on liquid or dry formulation

Table 3. Turfgrass color ratings in 2004 for products applied at two research locations in 2003.

Treatment	Description	Color ratings					
		Veenker Golf Course			Horticulture farm		
		24-Mar	5-Apr	3-May	24-Mar	5-Apr	3-May
1	**Control**	4.0	5.7	7.5	4.2	5.4	7.5
2	**Water application**	4.7	7.0	7.3	4.8	5.8	6.8
3	**Banner Maxx Daconil Weather Stick**	1.3	4.0	7.5	2.0	3.2	7.0
4	**Banner Maxx Medallion**	1.3	5.0	7.0	2.4	3.0	7.2
5	**Banner Maxx Medallion**	1.3	4.7	7.3	1.8	2.8	6.9
6	**Banner Maxx Medallion Daconil Weather Stick**	1.0	4.0	7.5	1.8	3.2	7.1
7	**Primer select**	4.3	6.0	7.7	5.0	5.8	7.4
8	**Leaf shield**	5.3	6.0	7.3	4.2	4.2	7.2
9	**Aca 1820**	3.3	6.3	7.5	3.6	4.8	7.4
10	**Regreen**	9.0	9.0	7.0	9.0	9.0	8.0
11	**Regreen**	9.0	9.0	7.0	9.0	8.0	8.0
12	**Regreen Banner Maxx Daconil Weather Stick**	9.0	9.0	7.5	9.0	9.0	8.0
13	**Greenlawnger**	9.0	9.0	7.7	9.0	8.0	7.8
14	**Evergrenn cover**	6.7	7.0	7.3	8.0	7.6	7.4
15	**Sand Topdress**	5.0	6.0	7.3	6.0	6.4	7.8
16	**Impermeable cover**	8.0	7.7	7.7	8.0	6.4	7.5
17	**Waterings (3/season)**	4.3	6.0	7.3	5.0	6.0	7.3
18	**PCNB granular**	3.7	7.0	7.3	4.8	5.2	7.6
19	**PCNB WP**	3.7	6.3	7.8	4.6	4.8	7.2
20	**PCNB F**	1.0	6.3	7.5	3.0	4.6	7.2
	LSD $_{0.05}$	1.4	1.4	0.6	1.1	2.1	0.5

Table 4. Turfgrass color ratings in 2005 for products applied in 2004 and left uncovered.

Treatment	Description	Color		
		23-Mar	25-Apr	18-May
1	Control	2.0	7.0	8.5
2	2004 Banner Maxx 2004 Daconil Weather Stick	2.0	7.0	8.5
3	2004 Daconil Weather Stick 2004 Medallion	2.0	6.3	8.2
4	2004 Banner Maxx 2004 Medallion	1.8	6.7	8.5
5	2004 Banner Maxx 2004 Medallion 2004 Daconil Weather Stick	1.8	6.7	8.2
6	Leaf Shield	2.0	7.0	8.7
7	Regreen	7.0	8.5	8.5
8	Regreen	7.0	8.5	8.5
9	Regreen 2004 Banner Maxx 2004 Daconil Weather Stick	7.0	8.5	8.5
10	Greenlawnger	7.0	8.5	8.7
11	Sand (toddress 1/8")	2.0	6.8	8.3
12	PCNB (granular)	2.0	6.0	8.2
13	PCNB (WP)	2.0	6.7	8.3
14	PCNB (F)	1.2	6.3	8.3
15	2003 Banner Maxx	1.7	6.3	8.3
16	2003 Medallion	2.0	6.7	8.3
17	2003 Daconil Weather Stick	2.0	6.7	8.3
18	2004 Banner Maxx	2.0	7.0	8.3
19	2004 Medallion	2.0	6.5	8.3
20	2004 Daconil Weather Stick	2.0	6.8	8.3
	$LSD_{.0.05}$	0.3	0.8	NS

Table 5. Turfgrass color ratings in 2005 for products applied in 2004 and covered with two different winter protection covers.

Treatment	Description	Color					
		Green Jacket Cover			Evergreen Cover		
		23-Mar	25-Apr	18-May	23-Mar	25-Apr	18-May
1	**Control**	6.0	7.0	8.5	7.8	7.0	8.5
2	**2004 Banner Maxx**	5.8	7.0	8.5	7.7	7.0	8.7
	2004 Daconil Weather Stick						
3	**2004 Daconil Weather Stick**	6.2	7.0	8.3	7.8	7.0	8.5
	2004 Medallion						
4	**2004 Banner Maxx**	5.0	7.0	8.3	7.5	7.0	8.5
	2004 Medallion						
12	**PCNB (granular)**	6.0	6.2	8.2	7.8	6.2	8.3
13	**PCNB (WP)**	6.0	6.8	8.3	7.0	6.8	8.3
14	**PCNB (F)**	4.0	6.5	8.3	5.7	6.2	8.2
15	**2003 Banner Maxx**	5.2	7.3	8.5	7.0	7.2	8.5
16	**2003 Medallion**	6.0	7.0	8.5	7.3	7.0	8.5
17	**2003 Daconil Weather Stick**	6.3	7.2	8.3	7.7	7.0	8.5
18	**2004 Banner Maxx**	5.2	7.0	8.5	7.7	7.2	8.7
19	**2004 Medallion**	5.5	7.0	8.5	7.7	7.0	8.5
20	**2004 Daconil Weather Stick**	5.0	7.0	8.3	7.7	7.0	8.5
	LSD $_{0.05}$	1.2	0.6	NS	0.7	0.3	NS

Results

In the 2003-2004 study, most of the turf injury was associated with PCNB or fungicide mixtures containing Banner Maxx or Medallion (Table 2). Color dye treatments and protective cover treatments were better than the control during the first two evaluations. At that time the colored dye was apparent on the grass blades and provided a striking darker contrast to the surrounding plots. By the last evaluation the dyes had faded and the grass had been mowed enough to expose new tissue; thus, color ratings had no interference from dye color at that time. The last evaluation on 3 May at the Horticulture Farm location showed that the Regreen treatment had better turf color even after the dye had worn away and was no longer visible. Color differences in May were not observed between Regreen and the control in the 2004-2005 study.

Three separate sets of the product treatments were repeated in 2004-2005, however, one set received no cover, one received Evergreen cover, and one received Green Jacket cover.

During the second year, none of the treatments having turf injury in 2003-2004 showed discoloration in 2004-2005, except for PCNB. On 23 March 2005, PCNB F had more turf discoloration than the control (Tables 4 and 5). By 25 April the injury caused by PCNB F persisted only in the non-covered and Evergreen covered areas. PCNB F also caused turf phytotoxicity in the 2003-2004 study. The PCNB granular product showed no turf injury during the March evaluation but by 25 April 2005 PCNB granular showed injury in covered or non-covered situations. In the second year Banner Maxx, Daconil, and Medallion showed no signs of bleaching or phytotoxicity. Variations in results from year to year and under different covers, suggest that other conditions such as temperature, moisture, and maybe precipitation during winter and spring may affect the response observed on creeping bentgrass. However, the fungicide PCNB was the only product that showed signs of phytotoxicity in both years of the study.

This project was initiated with funding by the Siouxland Golf Course Superintendents Association.

Evaluation of Merit for Preventative and Curative Bluegrass Billbug Control

Marcus A. Jones and Nick E. Christians

Introduction
Bluegrass billbug (Sphenophorus parvulus) is a serious pest of cool-season turfgrasses in the United States. Adults deposit their eggs into small holes chewed in the stem. Injury occurs after the larvae burrow throughout the stem eventually making their way to the crown to feed. Often misdiagnosed, the symptoms usually appear mid to late summer as the turf is under moisture stress. Chemical control is normally achieved by treating the adults early in the spring or later in the season once the larvae have moved into the soil. The objective of this study was to evaluate different rates of merit for preventative and curative control of bluegrass billbug.

Methods
A field trial was established during the spring of 2004 at the Iowa State University Horticulture Research Station near Gilbert, IA. Plots measuring 5 x 5 feet were located on Kentucky bluegrass mowed at 2.5 inches. The randomized complete block trial contained four replications and seven treatments (Table 1). A curative application of merit was made May 1 followed by preventive applications May 26th or July 1st. Plots were sampled August 3rd and billbug populations were determined on a square foot basis.

Table 1. Protocol used to determine efficacy of insecticide treatments targeting bluegrass billbug in Kentucky bluegrass turf.

Trt	Product	Formulation	Rate (lb ai/A)	Application Timing
1	**Control**	-	-	-
2	**Merit**	75WP	0.3	May 1
3	**Merit**	75WP	0.4	May 1
4	**Tempo SC Ultra**	10WP	0.094	May 26
5	**Merit**	75WP	0.25	June 1
6	**Merit**	75WP	0.3	June 1
7	**Merit**	75WP	0.4	June 1

Results
Heavy spring rains during the time adult billbugs were laying eggs resulted in reduced larvae populations when plots were sampled. Bluegrass billbug injury was not observed during this trial, and only two billbugs were observed in untreated control plots. Therefore, differences between treated and untreated controls could not be determined.

Controlling White Grub Species with Merit and Competitive Insecticides

Marcus A. Jones and Nick E. Christians

Introduction
White grubs are the most destructive of insects causing widespread damage to a number of turfgrasses in the cool-season region. Direct injury occurs when larvae feed on roots near the soil surface. Damage from most species usually appears in late summer and early fall. Various management techniques exist ranging from cultural and biological controls to insecticide treatments. The objective of this research was to assess the performance of merit and competitive insecticides for control of white grubs.

Methods
A field trial was established during the spring of 2004 at the Iowa State University Horticulture Research Station near Gilbert, IA. Each plot measured 5 x 5 feet and contained a mixture of creeping bentgrass and Kentucky bluegrass. The area was mowed at 1.5 inches and was irrigated daily. The randomized complete block trial contained five replications and nine treatments (Table 1).

Table 1. Treatment specification used to control white grub species in a creeping bentgrass/Kentucky bluegrass mixture.

Trt	Product	Formulation	Rate (lbs ai/A)	Application Timing
1	**Control**	-	-	-
2	**Merit**	750 g ai/kg WP	0.3	June 26
3	**Merit**	750 g ai/kg WP	0.4	June 26
4	**Merit**	5 g ai/kg	0.3	June 26
5	**Merit Fertilizer A**	2g ai/kg	0.3	June 26
6	**Mach 2**	2 lb ai/gal SC	2	June 26
7	**Mach 2 Fertilizer**	13.3 g ai/kg	2	June 26
8	**Centric**	400 g ai/kg WG	0.125	June 26
9	**Centric**	400 g ai/kg WG	0.2	June 26

On June 26, 2004 all treatments were applied. Liquid treatments were applied using a carbon dioxide backpack sprayer with #8002 flat fan TeeJet nozzles at 30-40 psi and diluted to a total spray volume of 3 gallons per 1000 square feet. Granular materials were applied using 'shaker dispensers' in order to provide uniform application. The experiment was terminated September 9, 2004. A sod cutter was used to cut a strip across each block. The sod was folded back and grub counts were recorded and converted to an area of one square foot. Data were analyzed using the Statistical Analysis System Software and the Analysis of Variance procedure. Fisher's LSD (α=0.05) was used to determine treatment effects.

Results
White grubs were not present in the untreated plot of the fifth block. Therefore, data were analyzed two times, once while including the full dataset and again while excluding the fifth block. Differences were observed between treated and untreated plots (Table 2). However, no differences were observed among insecticide treatments (Table 2).

Table 2. White grub populations in creeping bentgrass/Kentucky bluegrass plots receiving various insecticides. Treatments were applied June 26, 2004 and white grub populations were determined September 9, 2004. Values represent means of four or five replications respectively.

Trt	Product	Rate (lbs ai/A)	Mean (All 5 blocks)	Mean (5th block removed)
1	**Control**	-	2.0	2.5
2	**Merit**	0.3	0.4	0.5
3	**Merit**	0.4	0.0	0.0
4	**Merit**	0.3	0.0	0.0
5	**Merit Fert. A**	0.3	0.0	0.0
6	**Mach 2**	2	0.0	0.0
7	**Mach 2 Fert.**	2	0.0	0.0
8	**Centric**	0.125	0.4	0.5
9	**Centric**	0.2	0.0	0.0
	LSD 0.05		1.0	1.2

The Response of Kentucky Bluegrass Turf to Varying Nitrogen Sources

Christopher J. Blume and Nick Christians

Introduction:

The objectives of the 2004 nitrogen (N) source study were to compare the turf response and N release rates of various experimental fertilizer products that are being proposed for marketing in 2005 to a number of industry standards, such as Milorganite, Sustane, Nature Safe, Corn Gluten Meal, and Renaissance. An untreated control was also added for comparison. The research was conducted at the Iowa State University turfgrass research area north of Ames, Iowa on 'Nassau' Kentucky bluegrass turf.

Materials and Methods:

The study included 21 different N fertilizer treatments obtained from varying companies involved in packaging fertilizer materials for the turf industry and a control (Table 1). The study was conducted as a randomized complete block design with 3 replications. With 22 treatments and 3 replications, there were a total of 66 plots. Each of the 'Nassau' Kentucky bluegrass plots measured 5x5ft ($25ft^2$). Following an initial mowing at 1.7 inches, all of the fertilizers were applied at a rate of 1 lb N/$1000ft^2$. The first application date was May 21st, 2004. A broadleaf herbicide application of Trimec®was applied May 27th at a rate of 1.2 fluid oz/$1000ft^2$. The plots were again mown at a uniform height one week after fertilizers were applied. Clipping data collection began one week following that mowing on June 3. Clippings were harvested separately from each plot at a mowing height of 1.7 inches. One mowing 'strip' was taken from each plot. The width of the collection strip was 19 ½ inches using a McClain reel mower with a catch basket. This resulted in clippings being collected from $8.125ft^2$ of plot area. After all clippings were taken for a particular date, the remaining area on the plots was mowed to a uniform height of 1.7 inches and the clippings were collected and then discarded in order to avoid any nitrogen being put back into the soil. Following collection, the clippings were placed in an oven and allowed to dry for a minimum of 3 days at 67° C. They were then weighed and the data were reported on the basis of grams of dry weight tissue/25 ft^2 plot (Table 2).

On June 22nd, phosphorus was applied at a rate of 1 lb P /$1000ft^2$ to the entire area. The next day, June 23rd, 1 lb/$1000ft^2$ of potassium was applied to the entire area and watered in. This was done to eliminate possible differences caused by variations of these elements in the fertilizer products.

Visual quality ratings based on color, density, and overall appearance were taken weekly on a scale of 9-1, with 9 being the highest quality and 1 being the lowest quality. A rating of 6 or higher was considered acceptable turf quality. The second application of N fertilizers was applied on July 8th and the third application of fertilizers was on September 9th. Both of these treatments were made uniformly at a rate of 1 lb N/1000 ft^2.

Clippings were taken a total of 20 times. Every two weeks, weighed clippings were combined together and then ground through a Wiley mill with a twenty mesh screen. Since there were 20 collection dates, there were 10 dates of ground clippings. Once the clippings were ground, 0.1 grams of tissue was weighed, added to Kjeldahl tubes, and processed through the Micro-Kjeldahl procedure using a Lachat BD-46 block digester. The liquid solution resulting from the digestion process was then analyzed with a Lachat nitrogen analysis apparatus in accordance to the Salicylate Method for ammonium determination. The results of the procedure produced dry-weight percentages of N for each tissue sample (Table 3).

Results and Discussion:

Weekly quality data for June 3 to November 6 are listed in Table 1. We have not attempted to make graphic representations of the comparative data because of the large numbers of treatments. Representatives of each company involved in the project are encouraged to make any graphic representations of the data of their product(s) versus the standards of their choice that they like.

Weekly clipping data are listed in Table 2. Clippings provide a more objective measurement of turf response than do the subjective quality ratings. The value of this data will be a demonstration of how the grass responded to each product versus the untreated control. It also shows how quickly the grass responded to the various treatments and how long that response lasted. Again, comparisons of the new proposed products to industry standards will provide useful information.

Table 3 includes data on the uptake of nitrogen by the grass on a % dry tissue basis in response to each treatment over the entire season. Again, we grouped clippings from two week time periods for N analysis. This data gives additional objective measurements that can be used to compare individual products to the control and to other industry standards.

Table 4 includes end of season nutrients, both macro and micro. These nutrients were measured using ICAP procedures and include all other essential elements with the exception of iron and chlorine, which require different testing methods. These nutrients were measured using only the final two weeks worth of clippings.

Table 1. Quality data from Kentucky bluegrass plots treated with varying nitrogen sources during the 2004 season, 9= highest quality and 1= lowest quality.

Treatment	6/3	6/10	6/17	6/25	6/30	7/7	7/15	7/22	7/28	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/24	10/2	10/17	11/6
Control	5.7	6.0	6.0	6.7	6.0	5.7	5.3	5.3	5.0	6.0	5.3	5.7	5.7	6.3	6.0	6.0	6.0	6.0	6.0	5.0
Renaissance 8-2-6	7.0	7.0	6.7	7.0	6.0	6.0	7.0	7.0	7.7	8.7	7.3	7.7	7.7	7.0	7.7	8.3	8.7	7.7	7.0	6.0
Milorganite 6-2-0	6.3	7.0	6.7	7.0	6.0	6.0	6.3	6.3	7.3	8.0	7.7	7.0	7.0	7.0	7.0	8.0	8.0	7.3	7.0	6.0
Nature Safe 10-2-8	5.7	7.0	6.3	7.0	6.0	6.0	6.7	6.7	7.7	8.0	7.7	7.3	7.3	6.7	7.3	7.7	8.0	7.7	7.0	6.0
Leovex 8-0-7	6.0	7.0	7.0	7.7	6.3	6.3	6.3	6.3	7.7	8.7	8.0	7.3	7.3	7.0	7.0	7.0	8.0	8.0	7.0	6.0
Secure Safe 9-0-0	6.0	6.7	6.7	7.0	6.0	6.0	6.3	6.3	7.3	8.3	8.0	8.0	8.0	7.0	7.0	8.3	8.3	8.3	7.0	6.0
Soylpro 9-2-3	6.3	7.0	6.7	6.3	6.0	6.0	6.3	6.3	6.7	7.7	7.0	7.0	7.0	7.0	7.3	7.7	7.7	7.3	7.0	6.0
SoyGreen 11-1-2	6.3	7.0	6.3	6.7	6.0	6.0	7.0	7.0	7.3	7.7	7.0	7.7	7.7	7.0	8.0	8.7	8.0	7.7	7.0	6.0
Sustane 5-2-4	5.7	6.0	6.0	6.3	6.0	6.0	6.0	6.0	7.0	7.7	7.3	7.0	7.0	7.0	6.7	7.0	7.3	7.3	7.0	6.0
Sustane 8-2-4	6.3	7.0	6.7	7.0	6.0	6.0	6.7	6.7	7.0	8.0	7.3	7.3	7.3	7.0	7.3	8.0	8.7	8.0	7.0	6.0
Sustane 5-2-4 + Fe	6.3	7.0	6.3	6.7	6.0	6.0	7.0	8.0	7.0	7.7	7.0	7.0	7.0	7.0	7.3	8.0	7.7	7.3	7.0	6.0
Ladybug 8-2-4	6.0	7.3	6.7	7.0	6.3	6.3	6.3	6.3	7.0	8.0	7.0	7.0	7.0	7.0	7.3	8.0	8.0	7.7	7.0	6.0
Four All Seasons 9-1.2-1.55	5.3	6.3	6.7	6.7	6.0	6.0	6.0	6.0	7.3	8.0	7.3	7.3	7.3	7.0	8.0	8.0	7.7	8.0	7.0	6.0
Organisoil 3% N	5.7	6.3	6.0	6.0	6.0	6.0	6.0	6.0	6.3	7.0	6.7	6.3	6.3	6.0	6.3	6.7	7.0	6.7	6.0	5.0
Worm casts 0.754%	6.0	6.3	5.7	6.0	6.0	6.0	6.7	6.7	6.7	7.0	6.3	6.3	6.3	6.0	6.7	6.3	6.7	6.3	6.0	5.0
Aaron Tech 1.2%	5.3	7.0	6.3	7.0	6.0	6.0	5.0	5.0	7.0	7.7	7.3	7.7	7.7	7.0	6.0	8.0	8.3	8.0	7.0	6.0
Rootein 8-2-2	6.3	7.0	6.7	6.7	6.0	6.0	7.7	8.0	7.0	7.7	7.3	7.0	7.0	7.0	7.7	8.3	7.7	7.3	7.0	6.0
Rootein 12-5-3	7.0	7.7	7.0	7.0	6.3	6.3	8.0	8.7	7.0	7.7	7.3	7.3	7.3	7.0	9.0	9.0	8.3	7.7	7.0	6.0
Rootein 17-6-2	7.3	8.7	7.7	7.7	6.3	6.3	8.3	8.7	8.3	8.0	8.3	8.0	7.0	7.0	8.7	9.0	8.7	8.3	7.0	6.0
Perfectly Nat. 9-1-4	7.0	7.7	7.0	7.0	6.3	6.3	7.7	8.7	7.3	8.7	7.3	7.3	7.3	7.0	8.0	8.3	7.7	7.3	7.0	6.0
Perfectly Nat. 10-0-8	6.3	7.3	7.0	7.0	6.0	6.0	7.7	8.3	7.3	7.7	7.3	7.0	7.0	7.0	7.7	9.0	8.0	8.0	7.0	6.0
Perfectly Nat. 12-0-4	7.0	7.7	7.0	7.0	6.3	6.3	7.7	8.7	7.0	7.3	7.3	7.7	7.7	7.0	8.3	9.0	8.0	7.7	7.0	6.0
LSD 0.05	**NS**	**0.8**	**0.9**	**0.9**	**NS**	**NS**	**1.0**	**0.9**	**1.2**	**1.1**	**0.9**	**0.7**	**0.7**	**0.3**	**0.7**	**0.8**	**0.9**	**0.9**	**0.9**	**0.9**

Table 2. Clipping data from Kentucky bluegrass plots treated with varying nitrogen sources during the 2004 season.

	Date of Clipping Collection																			
Treatment	**6/3**	**6/10**	**6/17**	**6/25**	**6/30**	**7/7**	**7/15**	**7/22**	**7/28**	**8/5**	**8/12**	**8/19**	**8/26**	**9/2**	**9/9**	**9/16**	**9/24**	**10/2**	**10/17**	**11/6**
	Grams of tissue																			
Control	34.0	19.6	11.2	12.3	5.3	10.2	10.8	9.7	7.5	23.0	6.3	8.5	8.7	12.7	10.0	8.4	9.0	7.0	5.7	4.0
Renaissance 8-2-6	44.2	30.2	22.3	19.8	8.8	15.9	21.7	34.8	18.9	58.1	19.3	17.6	21.6	29.2	26.5	39.1	27.5	19.9	14.1	12.4
Milorganite 6-2-0	37.5	19.7	15.2	14.2	6.4	11.2	14.9	16.6	13.0	40.0	12.4	13.3	20.0	22.4	25.2	29.1	21.6	13.5	11.3	11.4
Nature Safe 10-2-8	39.1	26.2	17.5	20.0	8.5	17.0	18.8	24.3	18.5	56.8	18.8	18.2	24.2	28.3	23.6	27.5	24.7	17.3	12.2	11.2
Leovex 8-0-7	44.2	26.1	26.5	24.3	11.1	16.8	19.7	20.7	17.5	53.9	22.4	25.0	26.1	27.4	23.6	25.3	22.0	18.6	16.7	17.9
Secure Safe 9-0-0	35.8	28.8	24.8	23.7	13.1	20.7	20.5	21.0	13.4	41.3	25.5	24.2	28.4	28.4	24.6	27.1	25.3	21.0	19.0	15.5
Soylpro 9-2-3	46.4	23.8	18.1	14.7	7.6	11.7	16.5	19.6	13.8	42.4	13.7	14.7	15.6	22.2	21.6	23.7	20.5	13.6	11.2	9.8
SoyGreen 11-1-2	50.9	30.0	18.1	9.8	7.8	15.0	26.7	31.3	14.9	45.8	16.7	16.1	18.5	19.7	25.5	37.5	28.6	14.2	12.2	10.4
Sustane 5-2-4	49.4	26.4	18.1	17.5	8.1	12.6	14.6	17.6	12.6	38.7	14.7	11.9	13.7	19.5	17.7	20.6	18.1	13.5	11.0	9.2
Sustane 8-2-4	45.3	25.0	20.1	18.2	12.3	16.8	20.6	20.7	18.1	55.7	17.9	17.2	19.6	27.0	24.5	30.2	30.4	19.2	14.6	12.9
Sustane 5-2-4 + Fe	44.8	21.3	16.5	16.9	7.5	12.6	23.1	22.6	15.5	47.8	14.2	14.1	17.2	20.9	23.7	29.7	22.3	14.1	11.6	10.6
Ladybug 8-2-4	46.9	27.8	22.2	19.1	9.4	17.0	16.3	23.2	17.9	55.0	16.7	15.3	17.7	22.9	20.7	25.3	24.5	14.6	12.0	11.1
Four All seasons 9-1.2-1.55	48.5	28.9	18.1	16.9	7.3	14.5	15.6	14.5	13.3	41.0	13.5	15.7	20.1	22.0	18.3	23.7	24.2	14.1	11.9	10.8
Organisoil 3N	35.2	20.9	11.8	11.4	5.6	11.2	10.4	9.6	8.3	25.7	8.0	8.2	10.6	17.3	12.0	16.9	15.7	9.9	9.4	6.4
Worm Castings 0.754	41.7	18.7	15.1	12.5	6.4	11.3	12.7	12.8	10.7	32.9	10.0	10.1	12.6	17.1	16.6	16.1	15.6	10.0	9.0	6.8
Aaron Tech Solution 1.2% N	64.2	37.4	22.0	21.0	8.1	13.8	27.0	37.5	19.8	61.0	16.3	16.3	20.9	25.3	35.9	44.7	31.1	18.3	12.1	9.0
Rootein 8-2-2	48.9	26.0	16.9	16.7	7.9	12.6	26.3	26.4	12.1	37.2	15.8	17.6	18.9	22.6	33.4	37.8	28.8	16.9	12.9	9.7
Rootein 12-5-3	67.6	38.9	23.1	20.5	10.0	13.3	31.7	30.3	13.8	42.5	15.3	14.0	16.5	19.5	36.8	46.9	29.1	18.3	14.4	11.5
Rootein 17-6-2	72.8	50.9	26.6	25.8	12.5	19.9	49.2	44.8	27.4	84.2	20.6	20.0	19.6	23.4	42.1	57.4	32.4	18.4	15.2	11.5
Perfectly Natural 9-1-4	50.0	29.6	19.6	18.8	7.7	14.3	31.5	31.2	15.4	47.4	18.2	16.2	21.8	24.9	34.1	42.4	27.9	16.1	12.6	11.5
Perfectly Natural 10-0-8	46.4	27.4	18.9	16.3	8.3	15.5	34.8	35.6	21.6	66.5	18.1	18.4	20.9	22.7	33.8	41.9	30.3	17.6	14.0	12.7
Perfectly Natural 12-0-4	58.1	35.7	23.1	20.2	8.5	14.7	34.2	38.0	20.8	63.9	18.5	20.0	23.5	24.9	36.1	45.4	29.4	18.7	14.2	11.4
LSD	**13.5**	**10.7**	**5.3**	**5.8**	**2.6**	**4.6**	**7.3**	**7.6**	**7.0**	**21.7**	**4.3**	**4.3**	**5.4**	**5.4**	**6.9**	**11.8**	**7.9**	**6.1**	**5.8**	**6.0**

Table 3. Percentage nitrogen content in the tissue of grasses treated with varying nitrogen sources.

Treatment	6/3 & 6/1	6/17 & 6/25	6/30 & 7/7	7/15 & 7/22	7/28 & 8/5	8/12 & 8/19	8/26 & 9/2	9/9 & 9/16	9/24 & 10/2	10/17 & 11/6
	-----	-----	-----	-----	Percentage N	-----	-----	-----	-----	-----
Control	2.4	2.1	2.7	3.1	2.9	3.0	3.6	3.5	3.3	2.9
Renaissance 8-2-6	3.0	2.3	2.8	3.9	3.4	3.3	3.9	4.2	3.8	3.2
Milorganite 6-2-0	2.8	2.3	2.9	3.6	3.4	3.4	3.8	4.2	3.7	3.2
Nature Safe 10-2-8	2.8	2.3	2.9	3.8	3.5	3.3	3.8	4.1	3.8	3.2
Leovex 8-0-7	2.6	2.5	3.1	3.5	3.7	3.5	3.9	4.0	3.9	3.4
Secure Safe 9-0-0	3.1	2.5	3.2	3.6	3.9	3.7	4.1	4.3	4.2	3.5
Soylpro 9-2-3	2.5	2.2	2.9	3.7	3.3	3.4	3.9	4.1	3.7	3.1
SoyGreen 11-1-2	3.2	2.3	3.1	4.1	3.5	3.4	3.9	4.5	3.9	3.2
Sustane 5-2-4	2.6	2.1	2.8	3.4	3.3	3.3	3.8	4.0	3.6	3.1
Sustane 8-2-4	2.8	2.3	3.1	3.7	3.4	3.4	4.0	4.3	3.9	3.3
Sustane 5-2-4 + Fe	2.6	2.2	3.1	3.7	3.2	3.3	3.7	4.3	3.8	3.1
Ladybug 8-2-4	2.9	2.3	3.1	3.8	3.5	3.5	4.0	4.3	4.0	3.3
Four All Seasons 9-1.2-1.55	2.9	2.4	3.1	3.7	3.5	3.5	3.9	4.3	4.1	3.3
Organisoil 3% N	2.5	2.1	2.9	3.2	3.0	3.2	3.6	4.1	3.8	3.1
Worm casts 0.754%	2.5	2.2	3.0	3.4	3.1	3.4	3.7	3.9	3.5	3.0
Aaron Tech 1.2%	3.4	2.4	3.1	4.6	3.6	3.5	4.0	4.8	4.3	3.3
Rootein 8-2-2	2.9	2.4	3.1	3.9	3.4	3.6	4.0	4.6	4.0	3.1
Rootein 12-5-3	3.2	2.3	3.1	4.0	3.3	3.4	4.1	4.7	4.1	3.2
Rootein 17-6-2	3.6	2.5	3.2	4.6	3.7	3.5	4.1	5.0	4.4	3.3
Perfectly Nat. 9-1-4	3.2	2.4	3.1	4.2	3.5	3.5	3.9	4.6	4.1	3.3
Perfectly Nat. 10-0-8	2.9	2.4	2.9	4.2	3.3	3.4	3.6	4.5	3.8	3.2
Perfectly Nat. 12-0-4	3.3	2.4	3.0	4.4	3.7	3.7	3.9	4.8	4.1	3.3
LSD 0.06	**0.3**	**0.3**	**0.3**	**0.2**	**0.3**	**0.3**	**0.2**	**0.3**	**0.3**	**0.2**

Table 4. 2004 Organic Nitrogen Fertilizer ICAP Readings (ppm)

	Boron	Calcium	Copper	Potassium	Magnesium	Manganese	Molybdenum	Sodium	Phosphorus	Sulfur	Zinc
Control	4.2	5500.0	4.9	14466.7	2456.7	9.0	0.6	72.5	3396.7	1656.7	24.0
Renaissance 8-2-6	4.4	5078.3	4.1	14416.7	2343.3	9.2	0.5	53.1	3336.7	1460.0	23.6
Milorganite 6-2-0	4.0	5085.0	4.9	13833.3	2361.7	7.9	0.8	55.9	3360.0	1470.0	24.5
Nature Safe 10-2-8	4.1	5300.0	4.7	13933.3	2358.3	10.1	0.5	59.2	3226.7	1523.3	23.9
Leovex 8-0-7	4.2	5181.7	4.4	15083.3	2231.7	10.9	0.5	65.5	3268.3	1365.0	23.3
Secure Safe 9-0-0	3.3	4916.7	4.7	14800.0	2138.3	10.4	0.5	51.1	3245.0	1420.0	21.5
Soylpro 9-2-3	4.1	4966.7	4.7	14200.0	2308.3	8.8	0.5	62.8	3296.7	1441.7	24.2
SoyGreen 11-1-2	3.5	4888.3	4.5	14616.7	2285.0	8.9	0.7	64.8	3273.3	1450.0	22.3
Sustane 5-2-4	4.6	4765.0	4.6	14266.7	2183.3	8.4	0.7	61.7	3391.7	1448.3	24.1
Sustane 8-2-4	3.5	4673.3	4.6	14166.7	2266.7	8.9	0.5	55.7	3423.3	1418.3	24.4
Sustane 5-2-4 + Fe	5.4	4900.0	4.5	14166.7	2383.3	7.6	0.8	54.1	3343.3	1530.0	24.3
Ladybug 8-2-4	4.1	4701.7	4.4	14150.0	2371.7	8.2	0.5	57.8	3385.0	1440.0	24.7
Four 9-1.2-1.55	3.8	5080.0	5.1	14066.7	2376.7	9.1	0.6	52.2	3281.7	1523.3	24.5
Organisoil 3% N	3.9	4913.3	4.6	14400.0	2086.7	8.7	0.6	68.3	3281.7	1413.3	23.5
Worm casts 0.754%	3.8	4888.3	4.2	14000.0	2166.7	8.1	1.2	56.4	3221.7	1473.3	23.2
Aaron Tech 1.2%	3.2	4478.3	4.3	13733.3	2151.7	8.7	0.5	74.7	3133.3	1418.3	23.2
Rootein 8-2-2	4.4	5468.3	4.1	13950.0	2335.0	9.2	0.5	58.3	3248.3	1411.7	22.3
Rootein 12-5-3	3.5	6150.0	4.3	14300.0	2246.7	10.1	0.6	55.5	3343.3	1391.7	22.9
Rootein 17-6-2	3.3	5316.7	4.6	14733.3	2325.0	9.4	0.5	65.8	3310.0	1545.0	21.1
Perfectly Nat. 9-1-4	4.3	4893.3	4.9	15316.7	2128.3	9.8	0.5	71.2	3258.3	1468.3	22.5
Perfectly Nat. 10-0-8	4.5	5093.3	4.7	15066.7	2218.3	9.2	0.5	68.8	3333.3	1491.7	23.6
Perfectly Nat. 12-0-4	3.5	4790.0	4.3	14183.3	2320.0	9.2	0.5	68.5	3213.3	1563.3	23.8
LSD	**1.2**	**NS**	**NS**	**1920.7**	**310.3**	**2.2**	**0.2**	**NS**	**NS**	**NS**	**2.7**

Cation Ratios And Soil Testing Methods For Sand-Based Golf Course Greens

Rodney St. John and Nick Christians

This research is focused on basic cation nutrition of sand-based greens. Specifically, we are looking at soil testing techniques for measuring exchangeable basic cations and cation exchange capacity (CEC), and we are also looking at Basic Cation Saturation Ratios (BCSR) for creeping bentgrass. Most of our progress this past year was made evaluating soil testing techniques.

Soil Testing Procedures:
Some soil testing methods dissolve calcium carbonate and/or gypsum; thus, reporting high readings for exchangeable calcium, which may lead to erroneous interpretations of CEC and basic cation ratios. On soils with large proportions of clay and organic matter, this dissolution problem usually has a small affect on the results, but in the high-sand, low-organic-matter, calcareous root zones used for turf, the dissolution of calcium carbonate can greatly influence the results. There are two ways to approach this problem of dissolution. The first solution can be to prevent the calcium carbonate or gypsum from dissolving during the soil testing procedure. Ways to prevent the dissolution include raising the pH and/or lowering the salt concentration of the extracting solution, or by choosing different extraction solutions that have less reactivity with $CaCO_3$ or $CaSO_4$. The second answer to dissolution is to be aware that dissolution is occurring and correct for this amount. One correction method measures the carbonate and sulphate concentration in the soil extracts and relates those concentrations to dissolved $CaCO_3$ and $CaSO_4$, respectively (Suarez, 1996). The concentrations of dissolved $CaCO_3$ and $CaSO_4$ are related to calcium and are subtracted from the total calcium measured in the extract.

We started by raising the pH of the industry standard ammonium acetate pH 7 (NH_4OAc) procedure. Raising the pH of the ammonium acetate solution from 7.0 to 8.1 reduced the Ca concentration of the soil extracts an average of 33% (Table 1). We also evaluated a procedure that makes corrections for the dissolved $CaCO_3$ and/or $CaSO_4$. The technique uses ammonium chloride (NH_4Cl) as the extracting solution (Suarez, 1996). The NH_4Cl procedure measured an average 16% less Ca than the NH_4OAc pH 7.0 extraction procedure (Table 1).

We also evaluated the effect of calcium carbonate on several different soil test procedures by testing samples with increasing levels of $CaCO_3$. We mixed silica samples with either lab-grade $CaCO_3$ or a local calcareous sand. The results from 5 different soil test techniques are presented in Graphs 1 and 2. When using reagent grade $CaCO_3$, the dissolution of $CaCO_3$ plateaued for each extraction technique. The Mehlich 3 leveled off around 10-15% $CaCO_3$ content (Data not shown), whereas the NH_4OAc pH 8.1 and NH_4Cl methods leveled off around 0.5% and the NH_4OAc pH 7 leveled around 2%. Clearly the different techniques influence the solubility of $CaCO_3$. When using sand instead of lab grade $CaCO_3$, the Ca concentrations were not as high and did not plateau either. Not as much Ca was dissolved when using sand as the $CaCO_3$ source. The differences in Ca concentration between the two types of $CaCO_3$ sources could be attributed to particle size and purity. The lab grade $CaCO_3$ was a finely ground pure powder whereas the sand had a much larger particle size and the individual particles of $CaCO_3$ probably contained impurities, both of which probably caused a reduced dissolution rate. It is also possible that the sand we used did not actually have 11% $CaCO_3$ like we measured. We measured the calcium carbonate concentration of the calcareous sand by gravimetric loss upon treatment with acid. Perhaps the loss in weight we measured was due to more than just reaction of the $CaCO_3$ with acid. We are doing further evaluations of these procedures in the winter of 2004/2005.

We have been using DOWEX cation exchange resin to mimic sand. DOWEX is a sulfonated polystyrene/ DVB matrix resin that has a known cation exchange capacity. We intend to 'load' the resin with different ratios of cations and perform several soil tests with different techniques and hopefully determine which method extracts the correct ratio and concentration of cations. In our experiments to date, we apparently have not correctly prepared the DOWEX for analysis. The DOWEX was prepared for analysis by washing it with a weak HCl solution, equilibrating it with a solution containing Ca and Mg overnight, rinsing with distilled water, and air drying. The results from these experiments had very high levels of Ca and Mg compared to the calculated CEC of the DOWEX and also had very low pH. Therefore, we believe the DOWEX samples were not rinsed with enough distilled water to remove any free Ca/Mg solution and due to the low pH, the DOWEX samples were not properly equilibrated with the Ca/Mg solution to remove enough of the H ions from the exchange sites. We are doing more work to establish the correct preparation procedures for DOWEX analysis.

Basic Cation Saturation Ratio Theory
The BCSR theory states that proper and healthy growth is achieved when the basic cations exist within certain percentages of the cation exchange capacity (CEC). It states that calcium (Ca) should be 65-85% of the CEC, magnesium (Mg) should be 6-12%, and potassium (K) should be 2-5%. Recently we have seen an increased use of the BCSR theory with sand-based greens and athletic fields. The validity of applying this theory to sand-based greens is in question.

While research has been conducted applying the cation saturation theories to agronomic crops established on soils with large proportions of clay, silt and organic matter and relatively high cation exchange capacities, little research has been completed applying these methods to turfgrass established on sandy, low CEC media. The objective of this research is to determine the effectiveness and validity of the BCSR theory for use with sand-based turfgrass systems.

Future Plans:
We plan to finish the soil test experiments for exchangeable basic cations and for cation exchange capacity this year. We are continuing the studies designed to use exchange resins to mimic sands for soil test evaluation and correlation. Recently we visited with other soil

scientists around the US and have discovered some new techniques that we are planning to add to the experiment. We are still modifying the DOWEX protocol to improve its effectiveness for use in the soil test experiments.

We are working with a statistician to redesign the BCSR experiments in the greenhouse. We are hoping to use a 'mixture statistical design' to compare ratios of Ca, Mg, and K in a single study, rather than using three independent studies looking at Ca:Mg, Ca:K, and Mg:K. The basis of the 'mixture design' is to maximize results, while minimizing the number of treatments. We plan to have the greenhouse experiment started this winter and replicated in the spring.

References:

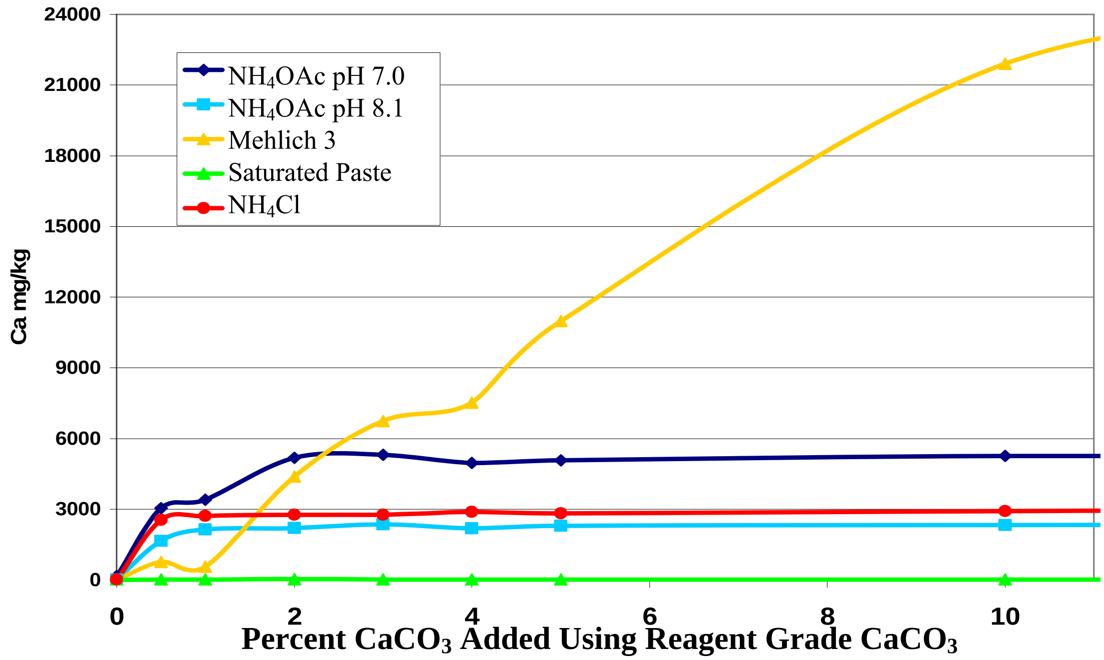
Suarez, D.L. 1996. Beryllium, magnesium, calcium, strontium, and barium. p. 575-601. *In* Sparks, D.L. (ed.) Methods of soil analysis: Chemical methods. Part 3. SSSA, Madison, WI.

Table 1. Average Ca concentration affected by soil test method of 19 soil samples with soil types ranging from sand to silt-loam.

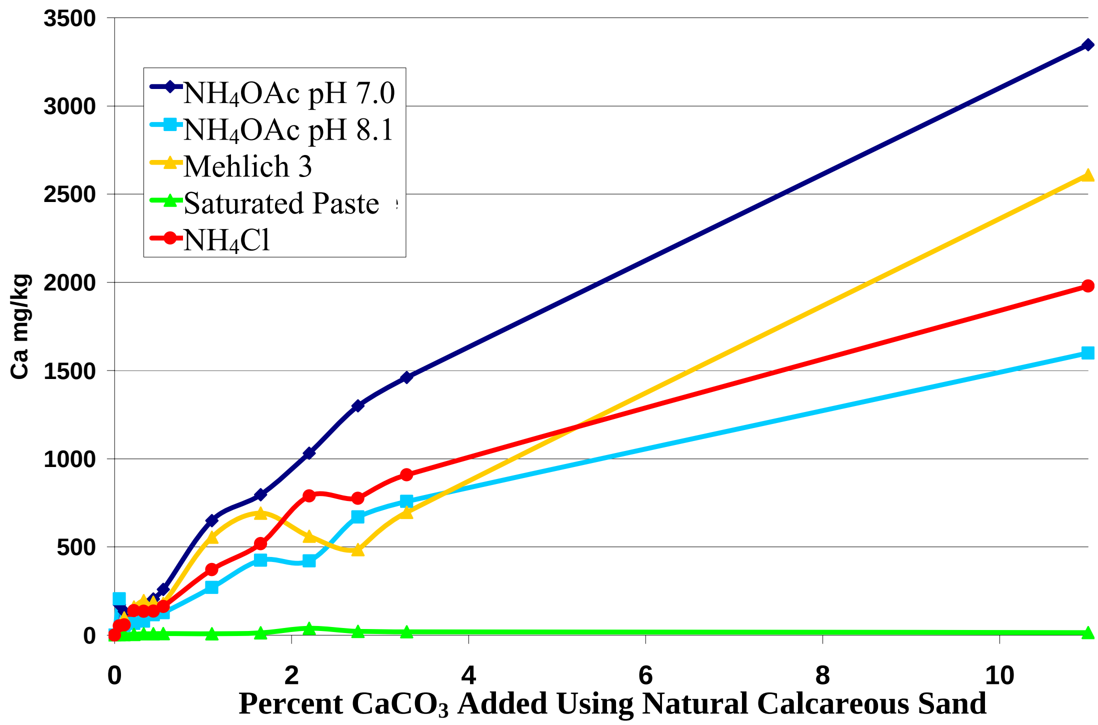
Method	**Ca** (mg/kg)
Mehlich 3	3100 a†
NH4OAc pH 7.0	2774 ab
NH4Cl	2328 c
NH4OAc pH 8.1	1853 d

†Means with the same letter are not significantly different according to Tukey's multiple comparison error rate. ($p \leq 0.05$)

Graph 1. Ca concentration from silica sand samples that had increasing levels of reagent grade $CaCO_3$.



Graph 2. Ca concentration from silica sand samples that had increasing levels $CaCO_3$ from local calcareous sand.



Nitrogen Source Trial – Precision Lab, Inc 2004

D.D. Minner and F. Valverde

Objective
To compare the benefit of a slow release form of nitrogen fertilizer to a relatively fast source such as urea in a USGA type green.

Methods
This study was conducted at the Horticulture Research Farm in Ames Iowa on a sand/peat USGA putting green. Nitrogen sources of urea, Nature's Time, and Nature Safe were applied monthly from May through Aug to the creeping bentgrass (*Agrostis stolonifera* L.) putting green (Table 1). Grass was mowed every other day at 3.9mm and watered as needed to prevent wilting. The experimental design was a randomized complete block with 3 treatments and 4 replications. Individual plots were 5ft by 5ft.

Table 1. Fertilizer rate and application time

	May 21	June 25	July 23	August 20
Nature's Time 7-2-5	1 lbs N/M	0.25 lbs N/M	0.25 lbs N/M	0.25 lbs N/M
Nature Safe 8-3-5	1 lbs N/M	0.25 lbs N/M	0.25 lbs N/M	0.25 lbs N/M
Urea Control	1 lbs N/M	0.25 lbs N/M	0.25 lbs N/M	0.25 lbs N/M

Visual ratings of turf color (scale 1-10; 6 least acceptable green) were recorded every 2 weeks. Clipping weight was collected 2 weeks after fertilizer application. Clippings were collected from a 4ft by 4ft square inside each treatment plot.

Results and Discussion

Statistically analyzed data appears in table 2. Turf color differences were observed on 4 of the 7 sampling dates from May through August. On three of the four sampling dates when turf color differences occurred there was no difference between Nature's Time and Nature Safe (Table 2). Urea produced a darker green color than Nature's Time and Nature Safe on all four of the sampling dates when differences occurred. The growth rate measured as clipping yield for Nature's Time and Nature Safe was similar to urea even though urea had a darker green color. The turf color and growth response of Nature's Time and Nature Safe are very similar with no discernable differences noted in this study.

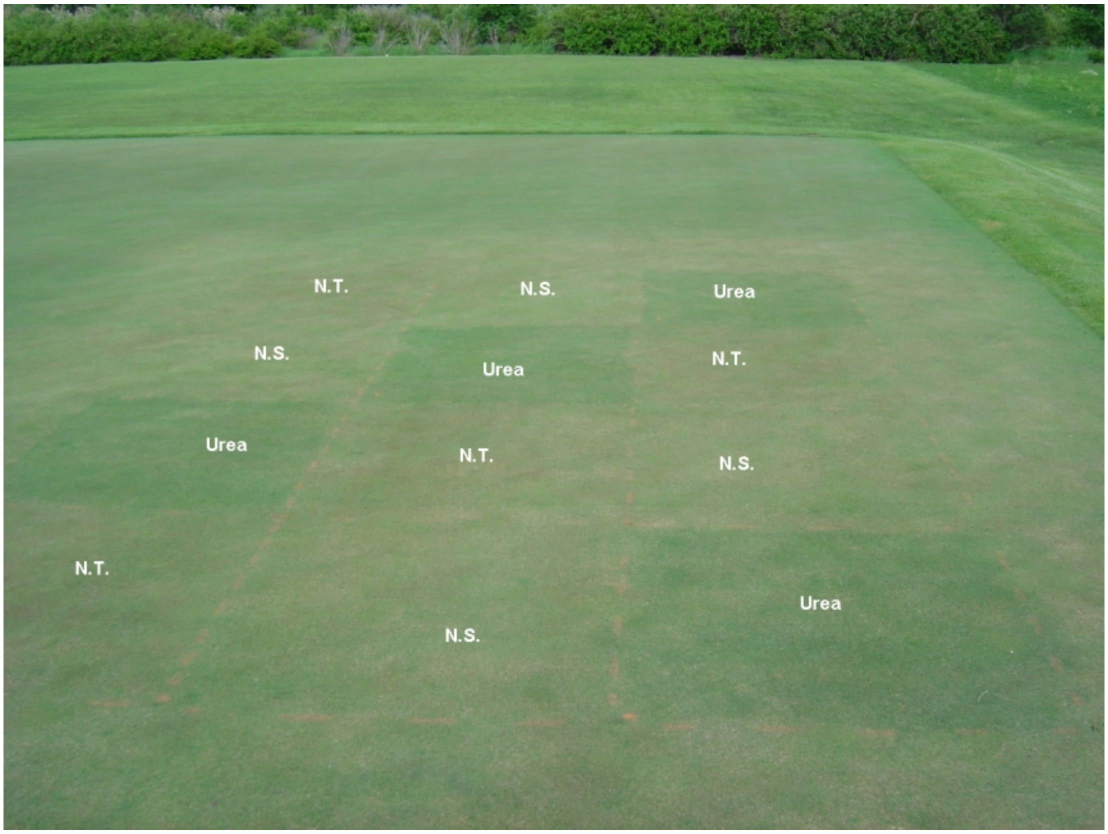
Table 2. Turf color and dry weight clipping yields during the summer of 2004 for nitrogen treatment.

		Color		
Color ratings observed	**Urea**	**N.Time**	**N. Safe**	**LSD $_{0.05}$**
11-Jun	8.50	7.25	7.50	**0.29**
25-Jun	8.38	8.00	8.00	**0.25**
9-Jul	8.50	8.50	8.50	**NS**
23-Jul	8.00	8.00	8.00	**NS**
6-Aug	9.00	8.00	8.38	**0.25**
20-Aug	8.63	8.13	8.13	**0.50**
7-Sep	8.75	8.63	8.50	**NS**

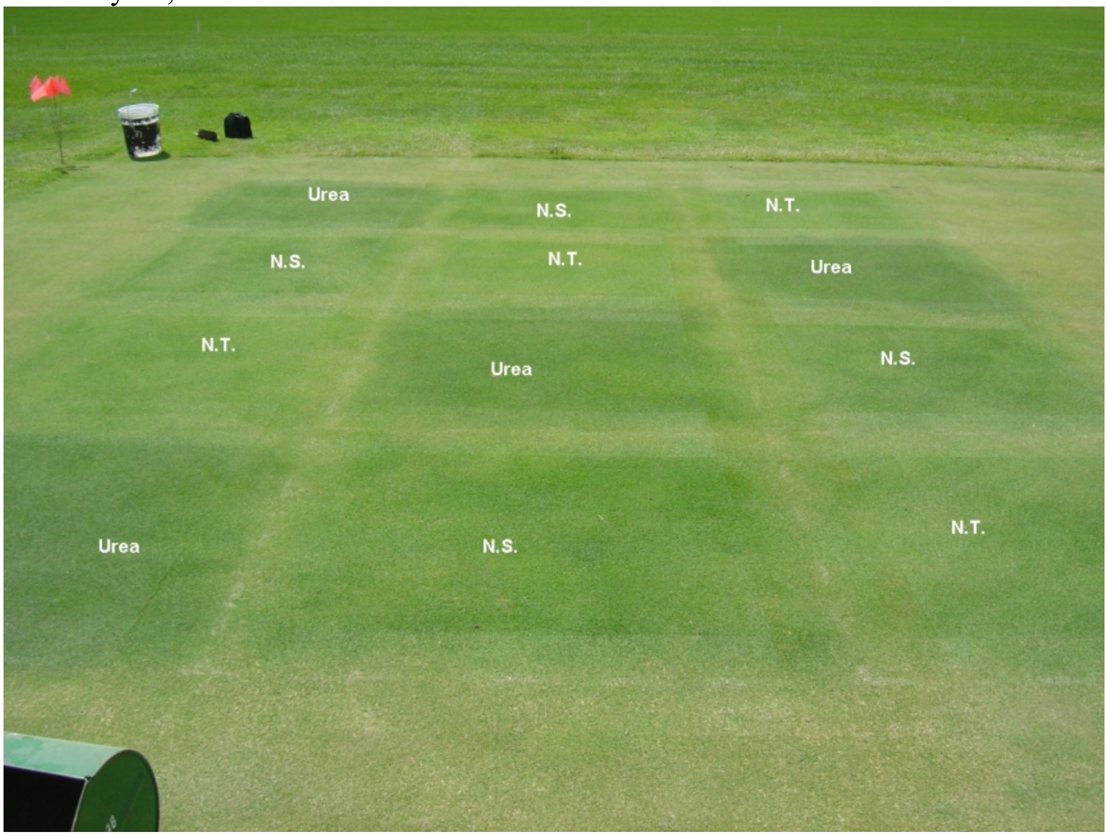
Dry weight (grams) in 16 ft^2

Clippings collected on:	**Urea**	**N.Time**	**N. Safe**	**LSD 0.05**
11-Jun	22.95	18.14	22.28	**NS**
9-Jul	21.59	21.00	20.54	**NS**
6-Aug	18.63	15.12	16.33	**NS**
7-Sep	26.42	29.00	24.53	**NS**

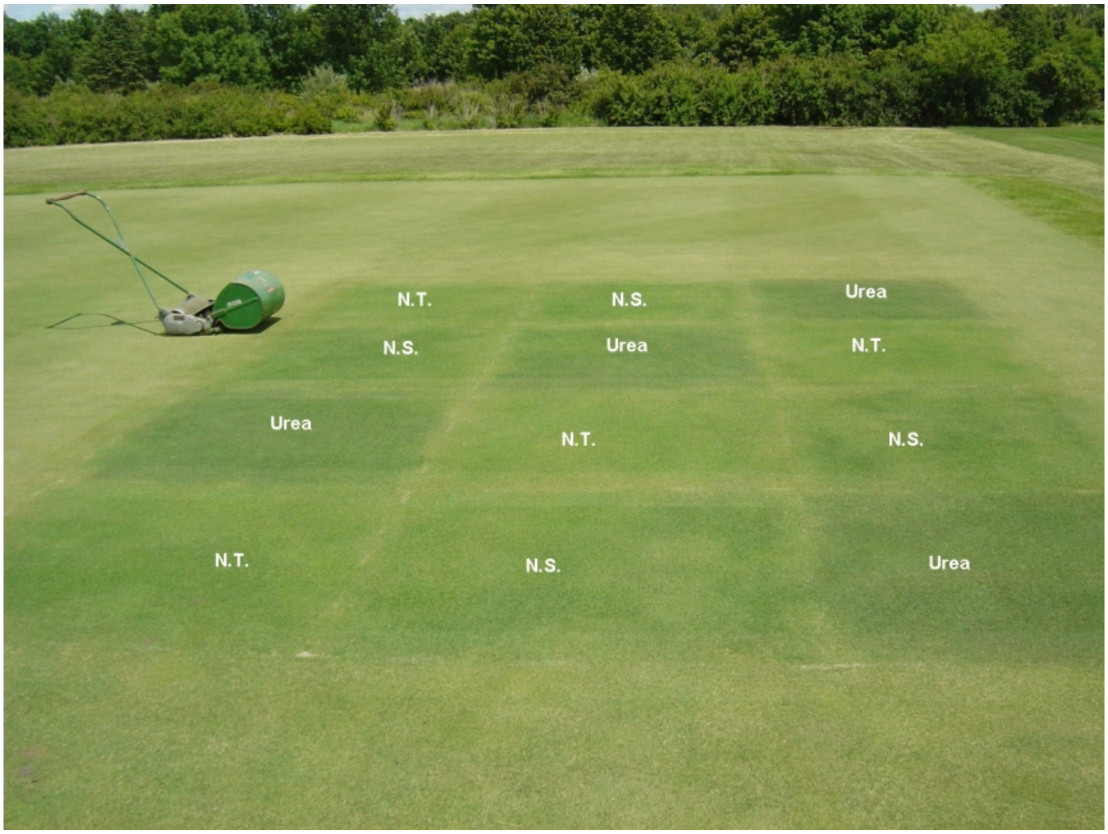
Slow release forms of fertilizer do not usually produce a very drastic visual difference, as was observed on this trial. However, it is a recommended source due to the low risk of damaging plant tissue and low N leaching rates when there is excess of rain or irrigation. When a fast recovery is necessary, fast release forms are preferred; however, special care has to be given to slow down N lost by water movement. If there is limited water movement and relatively good fertilization, differences between slow or fast release forms of N are not expected.



Picture taken May 26, 2004



Picture taken June 11, 2004



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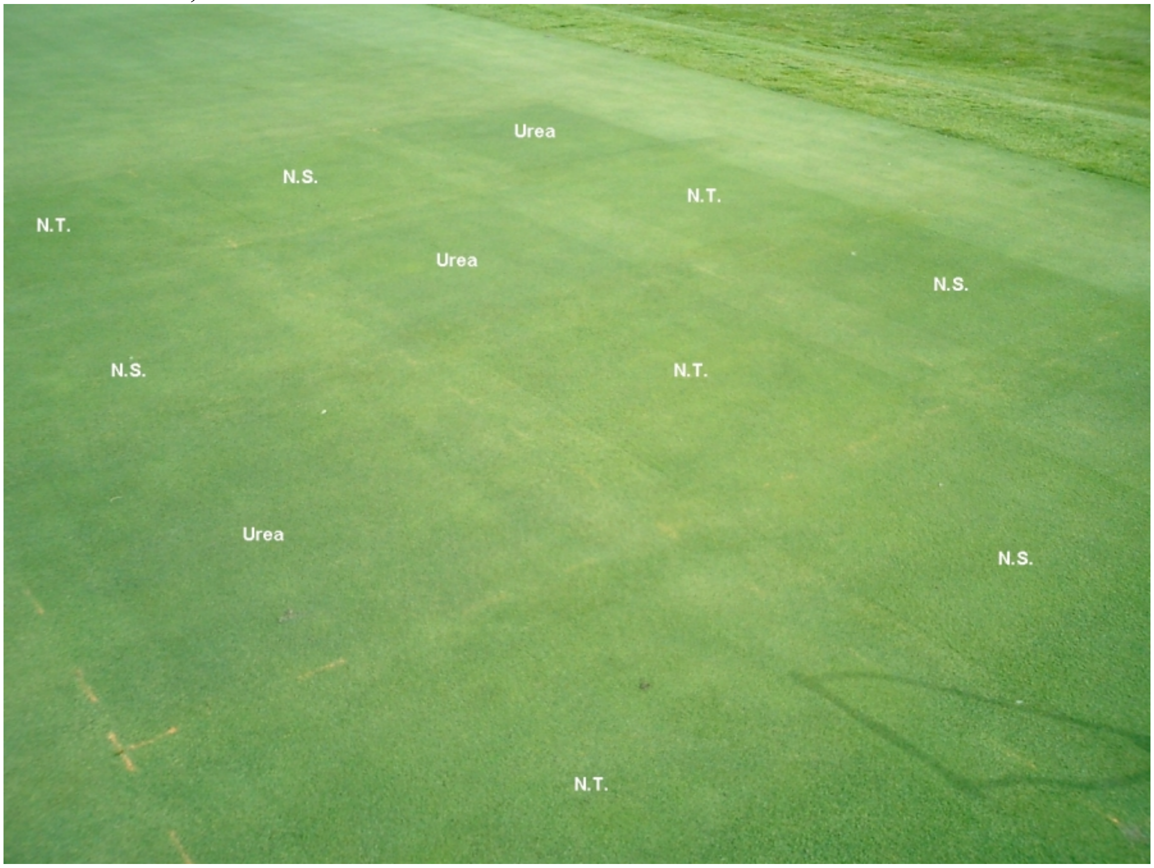

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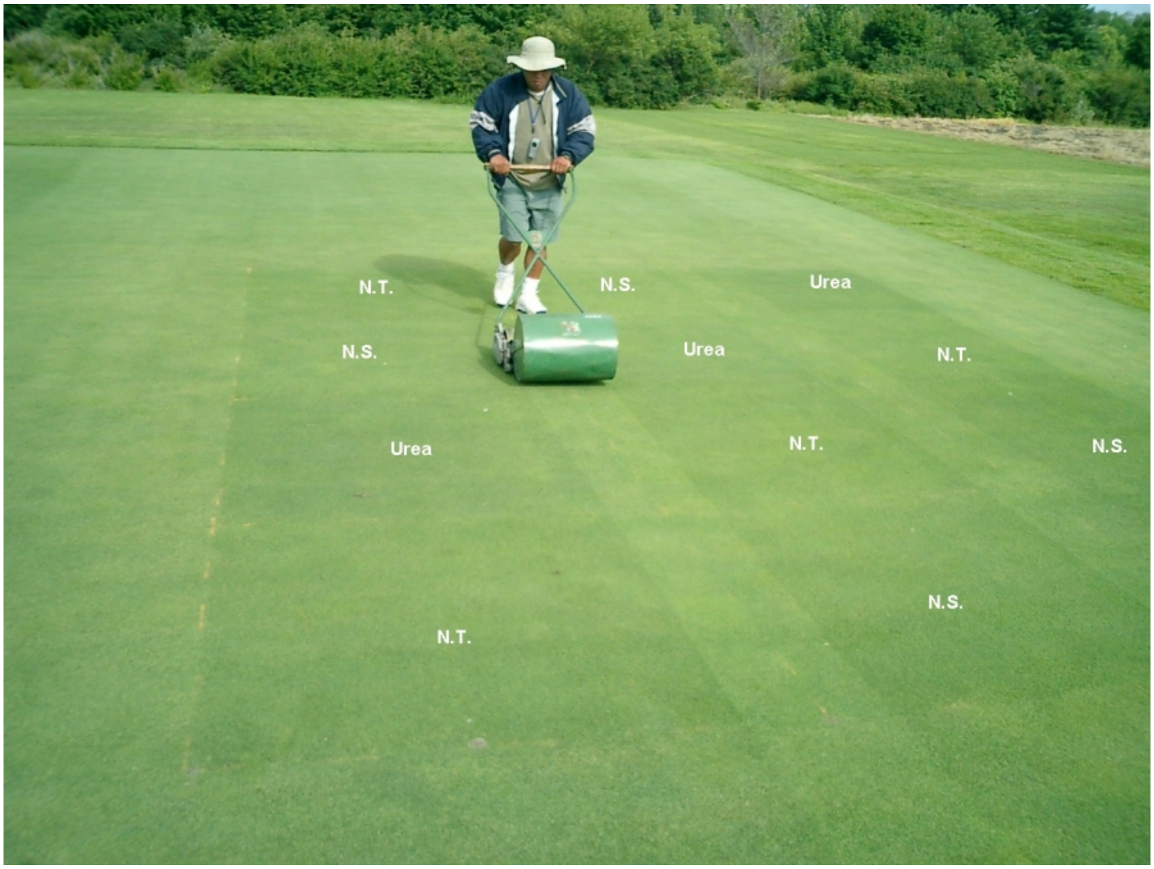

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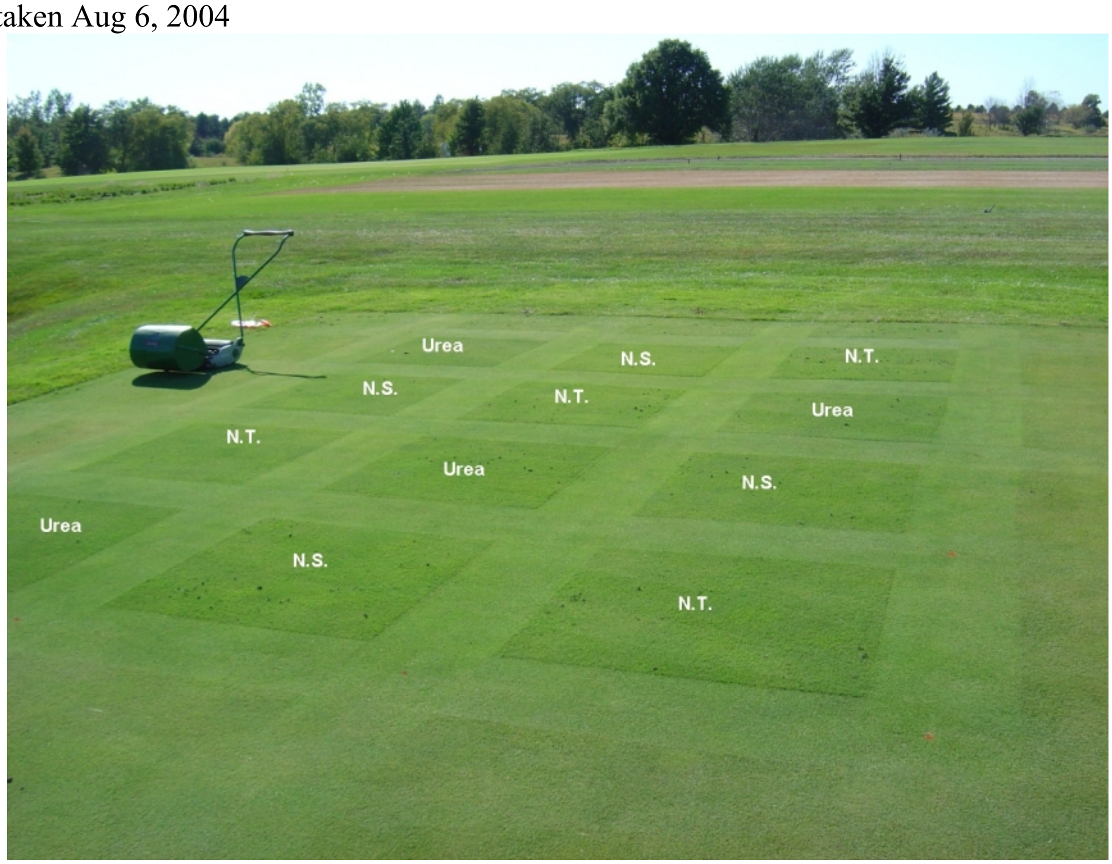

Picture taken September 7, 2004

Picture taken September 7, 2004

Evaluating the Influence of a Liquid Organic Polymer (Turf2Max®) on Soil Aggregation and Growth of Perennial Ryegrass

D.D. Minner and S.K. Lee

Introduction
A soil aggregate is defined as many soil particles held in a single mass or cluster, such as a clod, crumb, block, or prism (Brady and Weil, 2002). Pore space created by binding these particles together improves retention and exchange of air and water. Stability of soil aggregate refers to the ability of soil aggregates to resist disruption when outside forces are applied. Products that increase soil aggregation would benefit turfgrass growth on compacted soils with poor soil aeration. This study was initiated to determine if a liquid organic polymer mixture, Turf2Max®, has any influence on turfgrass quality or soil aggregation.

Materials and Methods
The study was conducted from December 22, 2003 to March 16, 2004 (76 day growing period) in the research greenhouse at the Iowa State University Horticulture Department, Ames, IA. Turf2Max® was applied to two soils. Local Iowa topsoil (Nicollet, fine-loamy, mixed, mesic Aquic Hapludoll) with 4.0% organic matter was screened and dried. Commercial baseball infield clay, QuickDry®, was used as the second soil. Material for both soils was processed through a hammer mill and soil that passed a 149 micron sieve was used in the green house study. Soil was placed in 2.5 by 2.5 inch plastic pots and treated with Turf2Max® liquid organic polymer solution. The Iowa-Soil required 100g of soil treated with 89 ml of Turf2Max®® and QuickDry® required 70g of porous clay material treated with 76.5 ml of Turf2Max® solution to fill each pot (Fig 1). Two conditions, with grass and without grass, were made to measure stability of soil aggregate. An additional set of treatment pots with grass were used for destructive sampling during root weight measurement. Pots were seeded with 'Catalina' Perennial ryegrass (*Lolium perenne* L.) at 7 lbs/1000 sqft on December 22, 2003. Fertilizer was applied 30 days after planting to supply 1.0 lb of N, P, and K/1000 sqft. One inch of water per week was applied to promote growth during the study.

Turfgrass color, quality, and density were visually estimated according to National Turfgrass Evaluation Program guidelines (http://www.ntep.org/pdf/ratings.pdf). Turf color was evaluated on a visual scale of 1-9 where, 1= completely straw brown, 6 = lowest acceptable color, and 9 = dark green. Turf quality was rated on a scale of 1-9 where, 1 = poorest, 6 = lowest acceptable quality, and 9 = best. Turf density was rated on a scale of 1-9 where 9 = maximum density. Turfgrass density is a visual estimate of living plants or tillers per unit area. Plant height was measured 46 days after seeding (DAS). Beginning 46 DAS, turf was mowed weekly at 5 cm and clippings were collected. On 16 Mar 2004, at the end of the study period, turfgrass was clipped at the soil level and combined with the weekly mowing samples to produce a total dry weight shoot yield for the 76 day growing period. The harvested grass foliage was oven-dried at 67ºC for 24 h and weighed. At the end of the study, root dry weight was determined by washing and oven-drying samples at 67ºC for 24 h. Because it was impossible to completely separate the roots from the soil, oven dried roots were ashed at 490 ºC for 8 h in a muffle furnace and then weighed to determine total organic matter. Aggregate stability was measure according to a modified method by Cambardella and Elliott (1993).

The experimental design was a randomized complete block with three replications and 12 treatments (Table 1). There were 3 rates of Turf2Max® liquid organic polymer (0, 2, and 4%), 2 soil sources (Iowa-soil and QuickDry® soil) and 2 grass conditions conditions (with and without grass) for a total of 12 treatments. The data were analyzed using PROC ANOVA of the SAS software, Version 8 of the SAS System for Windows (SAS Institute, 1999). Means were separated ($\alpha = 0.05$) by Fischer's protected LSD.

Results
The greenhouse study was initiated as a preliminary study to determine if there was any beneficial response from Turf2Max® treatment. Results of the preliminary findings were to serve as the basis for further study. There were no visible differences in turfgrass establishment or growth during the 76 day study period. Turfgrass density, color, quality, height, shoot growth, and root growth of the non-treated control was not significantly different from the Turf2Max® treated turfgrass during the 76 day study (Table 3 and Figs 24 and 25).

The aggregate particle size distribution and the aggregate mean weight diameter (MWD) are presented in Table 2. Mean weight diameter of soil aggregates is an indication of the stable fraction of the aggregates in the soil system. A higher mean weight diameter value indicates more stable aggregates. Treatment effects were significant for mean weight diameter. The Iowa-soil with grass had more stable aggregates when treated with 2% and 4% Turf2Max® (MWD 1.09 and 0.93, respectively) compared with the untreated control (MWD 0.62). Increasing Turf2Max® rate from 2% to 4% did not influence aggregate MWD. Without grass Turf2Max® had no influence on aggregate MWD.

This study represents only a single greenhouse screening for the Turf2Max® product and it therefore is not conclusive. The aggregate stability study needs to be repeated in the greenhouse and then substantiated under field conditions before any claims can be made about this product. Our preliminary observations indicated that under the conditions of a 76 day greenhouse study: 1) There was no visual improvement in turfgrass color, quality, or growth by using Turf2Max®. 2) It is possible that aggregate stability increases with use of Turf2Max®, and 3) more research is needed to substantiate these preliminary observations.

Table 1. Treatments showing 3 levels of Turf2Max®, 2 soil types, and 2 levels of grass cover.

Treatment #	**Treatment list**
1	Iowa soil and 0% Turf2Max® with grass
2	Iowa soil and 2% Turf2Max® with grass
3	Iowa soil and 4% Turf2Max® with grass
4	QuickDry® and 0% Turf2Max® with grass
5	QuickDry® and 2% Turf2Max® with grass
6	QuickDry® and 4% Turf2Max® with grass
7	Iowa soil and 0% Turf2Max® without grass
8	Iowa soil and 2% Turf2Max® without grass
9	Iowa soil and 4% Turf2Max® without grass
10	QuickDry® and 0% Turf2Max® without grass
11	QuickDry® and 2% Turf2Max® without grass
12	QuickDry® and 4% Turf2Max® without grass

Table 2. Summary ANOVA, aggregate size distribution, and aggregate mean weight diameter for Turf2Max® (T2M) treatments evaluated in a green house study conducted 22 Dec 2003 to 16 Mar 2004.

		Aggregate Particle Size Distribution						
		2mm	**250um**	**90um**	**53um**	**<53um**	**Macro aggregate**	**MWD†**
Source								
	Treatment	**	NS	NS	**	**	**	**
	Block	*	NS	NS	*	*	*	*
Treatment		%						— mm —
1	Iowa soil, 0% T2M + grass	24.2	5.9	42.4	10.0	14.9	30.1	0.62
2	Iowa soil, 2% T2M + grass	48.0	8.7	27.0	5.6	8.5	56.8	1.09
3	Iowa soil, 4% T2M + grass	38.1	12.0	29.9	7.3	10.9	45.3	0.95
4	QuickDry®, 0% T2M + grass	2.4	9.1	39.3	19.5	27.2	11.6	0.17
5	QuickDry®, 2% T2M + grass	1.6	6.7	39.7	17.8	31.5	8.4	0.14
6	QuickDry®, 4% T2M + grass	1.3	9.7	42.5	24.4	21.3	11.1	0.16
7	Iowa soil, 0% T2M	34.8	14.3	32.0	6.1	10.6	49.2	0.89
8	Iowa soil, 2% T2M	35.9	9.3	35.3	7.7	10.0	45.2	0.87
9	Iowa soil, 4% T2M	47.1	9.8	24.9	6.5	9.2	57.0	1.08
10	QuickDry®, 0% T2M	1.8	4.4	45.1	16.0	29.6	6.2	0.13
11	QuickDry®, 2% T2M	6.7	10.6	38.9	17.6	24.2	17.4	0.24
12	QuickDry®, 4% T2M	9.0	10.8	34.4	18.6	23.2	19.9	0.27
	$LSD_{0.05}$	19.3	NS	NS	6.5	9.7	17.9	0.32

* Significant at 0.05 probability level.
** Significant at 0.01 probability level.
† Mean weight diameter.

Table 3. Summary ANOVA, turfgrass height, total shoot dry weight, and root dry weight for Turf2Max® (T2M) treatments evaluated in a green house study conducted 22 Dec 2003 to 16 Mar 2004.

		Turfgrass density		Turfgrass color		Turfgrass quality		Turfgrass height	Total shoot dry weight	Root dry weight
		46 DAS†	76 DAS	46 DAS	76 DAS	46 DAS	76 DAS	46 DAS	76 DAS	76 DAS
Source										
Treatment		**	NS	**	NS	**	NS	*	NS	**
Block		NS	NS	NS	NS	NS	NS	NS	NS	NS
Treatment								— mm —	— mg —	— mg —
1	**Iowa soil, 0% T2M + grass**	7	8	7	8	7	8	90	722	485
2	**Iowa soil, 2% T2M + grass**	7	8	7	8	7	8	77	718	486
3	**Iowa soil, 4% T2M + grass**	7	8	7	8	7	8	90	817	593
4	**QuickDry®, 0% T2M + grass**	6	8	6	8	6	8	57	853	1006
5	**QuickDry®, 2% T2M + grass**	6	8	6	8	6	8	57	808	0910
6	**QuickDry®, 4% T2M + grass**	6	8	6	8	6	8	57	831	1163
	LSD $_{0.05}$		**NS**		**NS**		**NS**	**18**	**105**	**2499**

* Significant at 0.05 probability level.
** Significant at 0.01 probability level.
† Days after seeding.
NS Not significant.

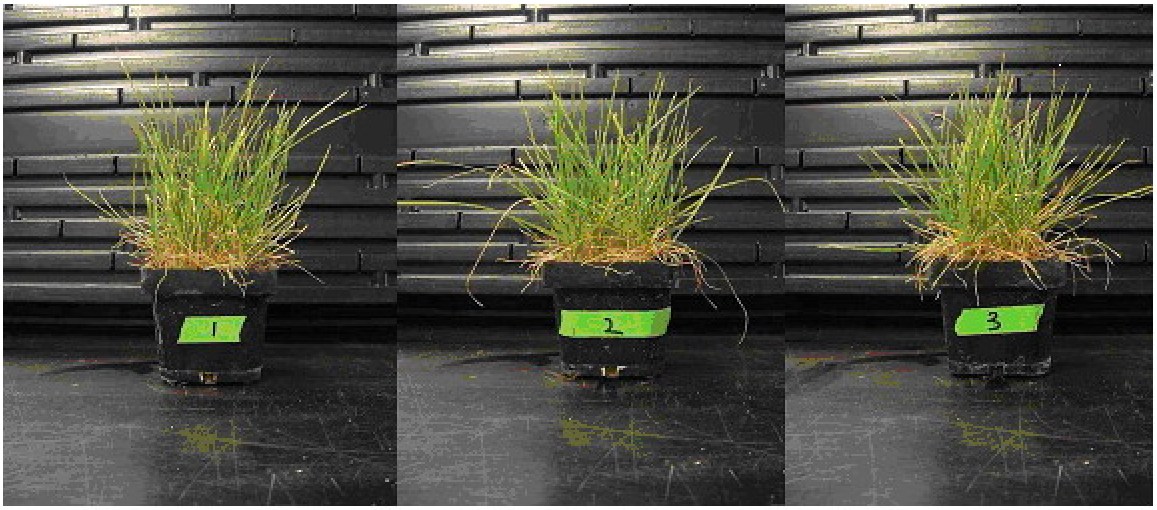

Figure 24. Visual aspect of treatment plots before aggregate determination. Treatments showing Iowa-soil plus grass treated with Turf2Max® at 0%(left), 2% (center) and 4% (right).

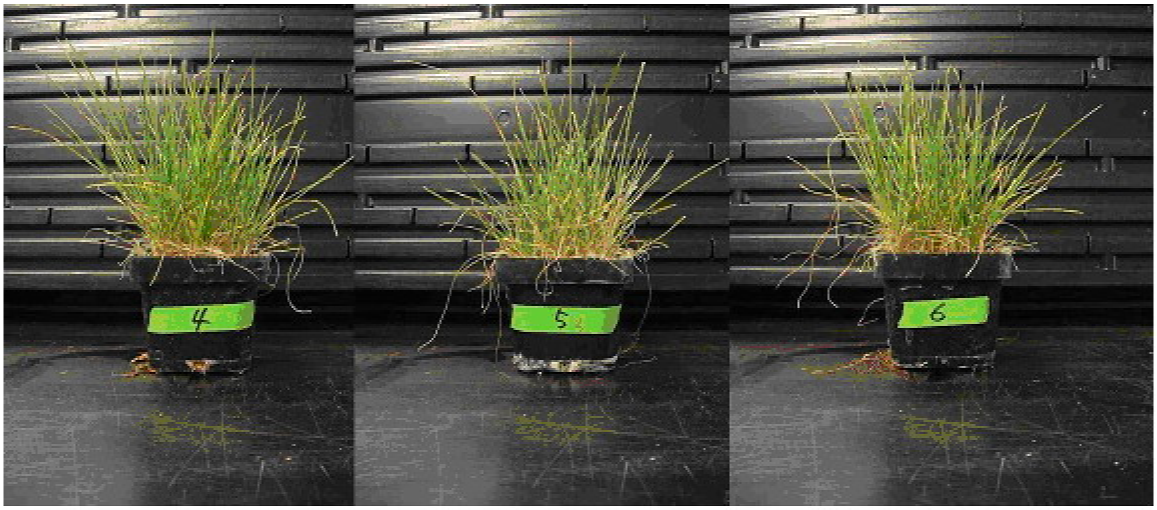

Figure 25. Visual aspect of treatment plots before aggregate determination. Treatments showing Quickdry porous clay plus grass treated with Turf2Max® at 0%(left), 2% (center) and 4% (right).

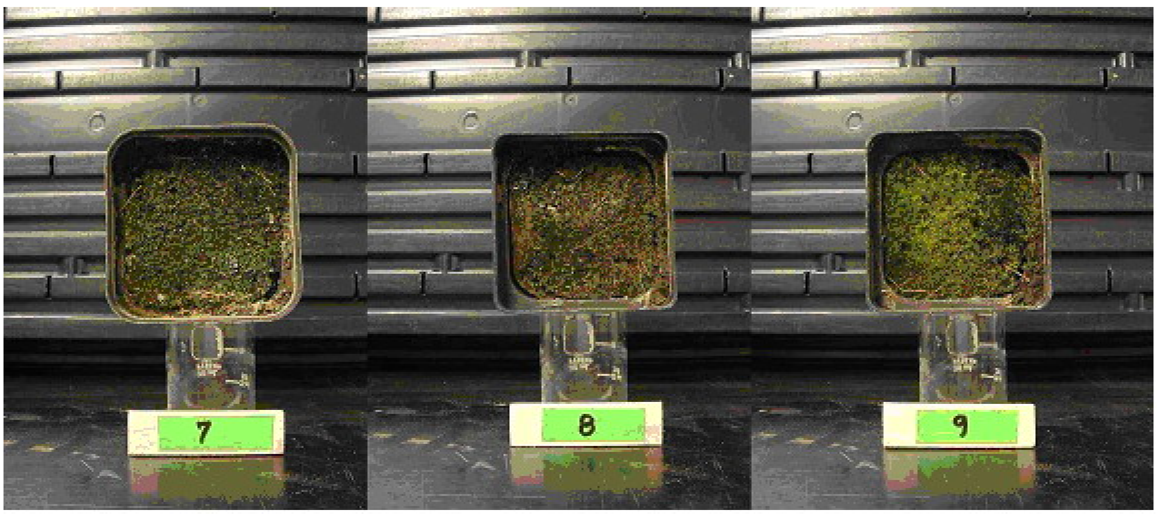

Figure 26. Visual aspect of treatment plots before aggregate determination. Iowa soil without grass at 0, 2 and 4% Turf2Max®.

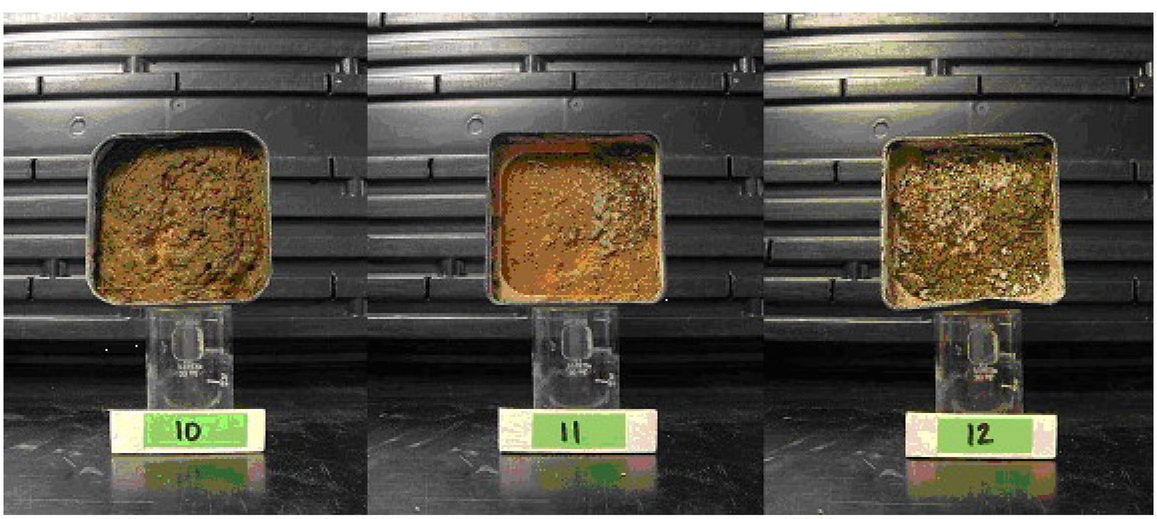

Figure 27. Visual aspect of treatment plots before aggregate determination. Quickdry without grass at 0, 2 and 4% Turf2Max®.

Figure 28. Root and tissue samples collected at the end of the greenhouse study on 16 Mar 2004. Pictured samples have been oven dried.

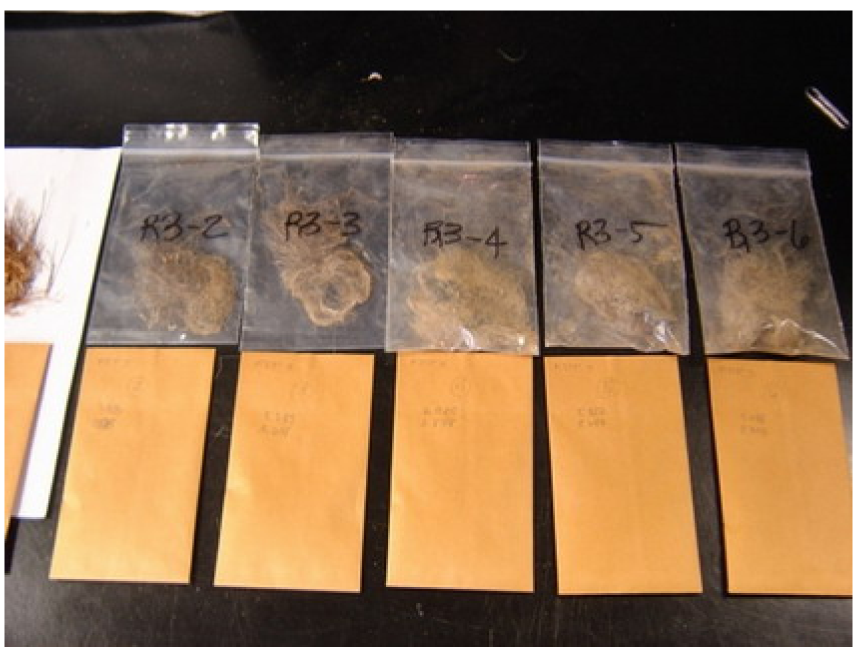

Figure 29. Root samples after washing and drying and before determining ash content in muffle furnace.

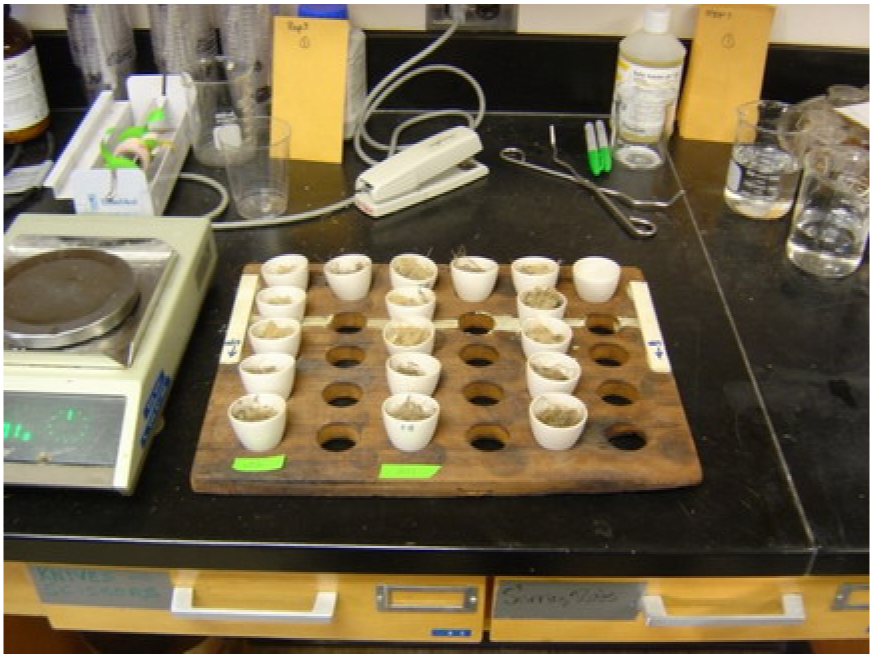

Figure 30. Weighing ash from root samples after muffle furnace treatment.

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Optimum Seeding Rates That Maximize Turf Cover When Established Under Traffic

D. D. Minner and F. J. Valverde

In a turfgrass system under continuous traffic stress, overseeding is a common practice to improve turfgrass cover in worn out areas. Seeding at the upper range for a recommended species is often suggested. Many sports turf managers seed at rates that often exceed the recommended range by a factor of two and sometimes three. The upper range for seeding rates is not clearly understood when traffic is applied during the seed establishment period.

Objective
The purpose of this research was to determine the optimum rates and schedules to overseed in a system under continuous traffic stress.

Methods
Two independent trials, one on Kentucky bluegrass KB (*Poa pratensis* L.) and the other on perennial ryegrass PR (*Lolium perenne* L.) were established on a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) soil with 4.0% organic matter at the Horticulture Research Farm in Ames, Iowa USA, on 3 Sep 2003 and were repeated on 1 Sep 2004.

Each trial was composed of 7 seeding rates and 2 seeding regimes. Seeding was done all at once during the first date (concentrated regime) or scattered in 7 sowings (disperse regime). Disperse seeding was performed exactly one week apart over a 7 week period to match final seeding rates of concentrated seeding. The experimental design was a randomized complete block with 4 replications. Treatments consisted of seeding rates of 1, 2, 3, 4, 5, 6 and 7 lb/1000 ft^2 for KB and 5, 10, 15, 20, 25, 30 and 35 lb/1000 ft^2 for PR. Traffic stress was initiated immediately after the first seeding in all plots. Traffic was applied weekly with a GA-SCW traffic simulator (Carrow et al., 2001) during a 10-week period. Four passes were made with the simulator every Friday for a total of 40 passes.

Turf cover was evaluated monthly, but only final data of autumn and spring of the first year are reported at this time. The data were analyzed using PROC ANOVA of the SAS software, Version 8 of the SAS System for Windows (SAS Institute, 1999). Means were separated ($\alpha = 0.05$) by Fischer's protected LSD.

Results
The impact of seeding rates on turf cover was more noticeable for perennial ryegrass than Kentucky bluegrass. The early concentrated seeding produced more turf cover for Kentucky bluegrass and perennial ryegrass than the dispersed seeding when observed at the end of the football season on 14 Nov 2003. Under concentrated seeding, Kentucky bluegrass turf cover increased as the seeding rates increased up to 5 lbs/1000 sq.ft. For perennial ryegrass, turf cover increased as seeding rates increased up to 25 lbs/1000 sq.ft. By the following summer, there was little difference between Kentucky bluegrass seeding rates. For perennial ryegrass, observations on 29 June still indicated that the 25 lbs/1000 sq.ft. seeding rate seems justified to maximize turf cover. More research needs to be conducted to determine the seeding rate impact on actual biomass/thatch/mat production.

Table 1. Percent cover of Kentucky Bluegrass plots at the end of the Fall 2003 and Spring of 2004.

Seeding rate (#)	Dispersed seeding	
	14-Nov	29-Jun
	%	
1	0.5	66.3
2	0.5	70.0
3	1.0	67.5
4	1.3	71.3
5	0.5	70.0
6	1.0	70.0
7	0.8	71.3
	Concentrated seeding	
	14-Nov	29-Jun
	%	
1	1.0	60.0
2	1.8	66.3
3	2.3	68.8
4	1.8	68.8
5	3.3	63.8
6	3.0	75.0
7	3.0	75.0
$Lsd_{0.05}$	0.7	3.6

Table 2. Percent cover of Perennial Ryegrass plots at the end of the Fall 2003 and Spring of 2004.

Seeding rate #	Dispersed seeding	
	14-Nov	29-Jun
	%	
5	22.5	71.3
10	32.5	77.5
15	40.0	81.3
20	43.8	83.8
25	63.5	91.3
30	63.8	93.8
35	65.0	90.0
	Concentrated seeding	
	14-Nov	29-Jun
	%	
5	33.8	75.0
10	43.8	78.8
15	55.0	85.0
20	65.0	86.3
25	76.0	90.0
30	83.8	92.5
35	83.8	93.8
$Lsd_{0.05}$	10.0	5.2

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Optimizing Seeding Dates for Autumn and Spring Renovation of Football Fields

D.D. Minner and F.J. Valverde

Intensely trafficked areas of athletic fields require routine seeding to reestablish grass and reduce the amount of exposed soil. It is important to maintain sufficient biomass/thatch/mat to reduce mud and compaction problems that develop when soil becomes exposed on the surface (Minner, 2004). Autumn, spring, and summer seeding schedules have been recommended for turf reestablishment (Minner, 2005). Dormant seeding is a practice that is often used when renovating football fields at the end of the playing season in November. Seeding in September usually germinates but the survivability of seedlings under traffic is not known. Seeding in October may or may not produce fall germinated plants. It is not known if seed planted in October germinates and dies in the autumn, germinates in the autumn and continues to grow in the spring, or remains as dormant seed in the autumn and germinates in the following spring.

Objective
To determine effective renovation seeding dates and turfgrass species that optimize turf cover for football activities.

Methods
This study was established on a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) soil with 4.0% organic matter at the Horticulture Research Farm in Ames, Iowa USA, on 26 Sep 2003 and on 1 Oct 2004. Three species of turfgrass, Kentucky bluegrass KB (*Poa pratensis* L.), perennial ryegrass PR (*Lollium perenne* L.) and tall fescue TF (*Festuca arundinacea* L.) were used in the study. Seeding for year one occurred on 26 Sep, 3 Oct, 10 Oct, 17 Oct, 31 Oct, 14 Nov, and 28 Nov 2003 and 22 Apr, 13 May, and 3 Jun 2004. Year 2 seeding dates were 1 Oct, 15 Oct, 27 Oct, 15 Nov, 29 Nov 2004, and 15 Apr, 15 May, and 5 Jun of 2005. The experimental design was a randomized complete block with 3 replications and 2 factors (species and seeding dates). Seeding rates were 2 lb/1000 ft^2 of KB and 10 lb/1000 ft^2 of PR and TF.

Turf cover was evaluated before each seeding and on 29 Jun of 2004 and 27 Jun 2005. Only first year data for 2003-2004 is reported at this time. The data were analyzed using PROC ANOVA of the SAS software, Version 8 of the SAS System for Windows (SAS Institute, 1999). Means were separated ($\alpha = 0.05$) by Fischer's protected LSD.

Results
On 28 Nov 2003, perennial ryegrass and tall fescue produced considerably more turf cover (42-65% cover) than Kentucky bluegrass (10% cover) when all three grasses were seeded on 26 Sept 2003. Ryegrass and fescue provide faster and more complete coverage of the ground when fall seeded. Dormant seeding on 28 Nov 2003 did provide substantial turf cover (approximately 70% cover) for all three species by the following 29 June observation date. This indicates that autumn dormant seeding can be a successful method for increasing turf cover in the following summer. The 17 Oct seeding date produced the least amount of turf cover by the following summer on 29 June. This indicates that the least effective time to seed may be in Mid-October since it resulted in the lowest turf cover the following season. Even though this may be the least effective time to seed it did result in 33% to 57% turf cover by the following summer, and that may justify seeding through out the entire autumn football season.

Table 1. Percent cover of Kentucky bluegrass, perennial ryegrass and tall fescue observed during Fall 2003 and Spring 2004.

Seeding date	17-Oct	28-Nov	22-Apr	29-Jun
		%		
		Kentucky bluegrass		
26-Sep	8.3	10.0	10.0	68.3
3-Oct	3.7	1.7	2.3	70.0
10-Oct	0.0	0.0	1.0	78.3
17-Oct		0.0	2.0	33.3
31-Oct		0.0	3.0	60.0
14-Nov		0.0	3.0	66.7
28-Nov			1.3	68.3
22-Apr				83.3
13-May				65.0
3-Jun				70.0
		Perennial ryegrass		
26-Sep	32.7	65.0	83.3	83.3
3-Oct	20.0	26.7	21.7	75.0
10-Oct	0.0	1.0	1.3	70.0
17-Oct		0.0	1.3	50.0
31-Oct		0.0	1.3	60.0
14-Nov		0.0	2.3	71.7
28-Nov			1.7	70.0
22-Apr				81.7
13-May				80.0
3-Jun				70.0
		Tall fescue		
26-Sep	21.7	41.7	45.0	63.3
3-Oct	15.0	13.3	10.0	78.3
10-Oct	0.0	0.0	2.0	90.0
17-Oct		0.0	3.7	56.7
31-Oct		0.0	2.7	63.3
14-Nov		0.0	2.3	71.7
28-Nov			2.0	70.0
22-Apr				86.7
13-May				51.7
3-Jun				68.3
$LSD_{0.05}$	3.5	4.4	5.5	16.2

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1991 Corn Gluten Meal Crabgrass Control Study - Year 14-2004

Nick Christians and Luke Dant

Corn gluten meal (CGM) has been screened for efficacy as a natural herbicide and fertilizer for turf on the same plot since 1991. The study is being conducted at the Iowa State University Research Station north of Ames, IA on 'Parade' Kentucky bluegrass established on a Nicollet (fine-loamy, mixed, mesic Aquic Hapludolls) soil.

Experimental plots are 5 x 5 ft and there are five treatments with three replications. The experimental design is a randomized complete block. Corn gluten meal is applied once per year in April to the same plots at 0, 20, 40, 60, 80, 100, and 120 lbs per 1000 ft^2 (Table 1). Because corn gluten meal is 10% N, these rates are equivalent to 0, 2, 4, 6, 8, 10, and 12 lb N per 1000 ft^2. CGM is applied each year in a single early-spring preemergence application using 'shaker dispensers' and watered-in with the irrigation system. Supplemental irrigation provides adequate moisture to maintain grass in good growing condition. Applications were made on April 25, 2004.

Turf quality was monitored from May through September (Table 1). It was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.

Weed populations were measured by either counting the number of plants or by estimating the percentage cover per individual plot. Crabgrass infestations were determined by counting the number of plants per individual plot on July 28 and August 27 (Table 2). Dandelion populations were assessed by counting the number of plants per individual plot (Table 3). Clover populations were determined by estimating the percentage area of each plot covered by clover (Table 4).

Data were analyzed with the Statistical Analysis System (SAS) and the General Linear Model (GLM) procedure. Effects of CGM on turf quality and weed control were examined using Fisher's Least Significant Difference (LSD) means comparison tests.

Table 1. Visual quality[1] of Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	lbs N /1000 ft^2	May 5	May 28	June 29	July 28	August 27	Sept. 28
1	**Untreated control**	0	0	5	4	3	4	4	3
2	**Corn gluten meal**	20	2	6	6	5	5	6	5
3	**Corn gluten meal**	40	4	7	8	6	5	6	7
4	**Corn gluten meal**	60	6	6	8	7	6	6	6
5	**Corn gluten meal**	80	8	7	7	7	7	7	7
6	**Corn gluten meal**	100	10	6	7	7	7	7	7
7	**Corn gluten meal**	120	12	7	8	7	7	8	8
	$LSD_{0.05}$			NS	2	2	1	2	2

1Turf quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
NS = means are not significantly different at the 0.05 level.

Table 2. Crabgrass counts[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	July 28	August 27
1	**Untreated control**	0	16	14
2	**Corn gluten meal**	20	6	5
3	**Corn gluten meal**	40	0	0
4	**Corn gluten meal**	60	0	0
5	**Corn gluten meal**	80	1	1
6	**Corn gluten meal**	100	3	1
7	**Corn gluten meal**	120	0	0
	$LSD_{0.05}$		NS	NS

1Values represent the number of crabgrass plants per plot covered.
NS = means are not significantly different at the 0.05 level.

Table 3. Dandelion counts[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	May 5	May 28	June 29	July 28	August 27	Sept. 28
1	**Untreated control**	0	45	34	38	34	36	38
2	**Corn gluten meal**	20	22	21	21	15	18	21
3	**Corn gluten meal**	40	3	1	1	1	1	2
4	**Corn gluten meal**	60	1	1	0	0	1	1
5	**Corn gluten meal**	80	1	0	1	0	0	1
6	**Corn gluten meal**	100	2	1	2	0	0	1
7	**Corn gluten meal**	120	1	0	0	0	0	0
	$LSD_{0.05}$		29	NS	25	NS	NS	24

[1]Values represent the number of dandelion plants per plot.

Table 4. Percentage clover cover[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	May 5	May 28	June 29	July 28	August 27	Sept. 28
1	**Untreated control**	0	12	23	28	33	29	31
2	**Corn gluten meal**	20	5	6	10	22	15	21
3	**Corn gluten meal**	40	4	6	7	12	7	8
4	**Corn gluten meal**	60	7	4	4	4	4	5
5	**Corn gluten meal**	80	4	9	5	8	7	4
6	**Corn gluten meal**	100	8	9	14	20	17	11
7	**Corn gluten meal**	120	3	2	3	5	2	3
	$LSD_{0.05}$		NS	NS	NS	NS	NS	NS

[1]Values represent the area per plot covered by clover.
NS = means are not significantly different at the 0.05 level.

1995 Corn Gluten Meal Rate Weed Control Study - Year 10-2004

Nick Christians and Luke Dant

Corn gluten meal (CGM) is being screened for efficacy as a natural herbicide for turf. This long-term study began in 1995 at the Iowa State University Horticulture Research Station north of Ames, IA. The experimental plot is in established 'Ram 1' Kentucky bluegrass. The soil is a Nicollet (fine-loamy, mixed, mesic Aquic Hapludolls). Prior to treatment in 1995, the percentage broadleaf weed cover within the study perimeter exceeded 50%.

The experimental design is a randomized complete block design. Individual experimental plots are 10 x 10 ft with three replications. Each year corn gluten meal is applied to the same plots at a yearly rate of 40 lb CGM/1000 ft^2 (equivalent to 4 lb N/1000 ft^2) using four different regimes of single and split applications for a total of five treatments (Table 1). Treatments include: four applications of 10 lb/1000 ft^2, split applications of 20 lb/1000 ft^2, an initial application of 30 lb plus a sequential of 10 lb/1000 ft^2, a single application of 40 lb/1000 ft^2 and an untreated control.

Initial applications in 2004 were made on April 25 before crabgrass germination. The second application of treatment 2 was made on June 5. The third application of treatment 2 and the second of treatments 3 and 4 were made on August 16. The final application of treatment 2 was made on Sept 17.

The experimental plot was screened for phytotoxicity after each treatment. Turf quality data were taken monthly from spring greenup in May through September. Visual quality was measured using a 9 to 1 scale with 9 = best and 6 = lowest acceptable, and 1 = worst quality (Table 1).

Crabgrass plant populations per plot were recorded on July 28, and August 27 (Table 2).

Broadleaf data were taken from May through September. Dandelion and clover were the predominate broadleaf weed species within the experimental plot. Dandelion populations were measured by counting the number of plants per plot (Table 3). Clover infestations were estimated by determining the percentage area in each individual plot covered by clover (Table 4).

Data were analyzed with the Statistical Analysis System (SAS) and the General Linear Model (GLM) procedure. Means comparisons were made with Fisher's Least Significant Difference test (LSD).

Table 1. Turf quality[1] of Kentucky bluegrass treated with corn gluten meal for the 1995 Corn Gluten Meal Rate Weed Control Study.

	Material	Rate lb product/1000 ft^2	May 5	May 28	June 29	July 28	August 27	Sept. 28
1.	**Untreated control**	NA	5	4	4	4	4	4
2.	**Corn gluten meal**	10-10-10-10	6	6	7	6	6	6
3.	**Corn gluten meal**	20-20	6	6	6	6	6	6
4.	**Corn gluten meal**	30-10	6	6	6	6	6	6
5.	**Corn gluten meal**	40	7	6	7	7	7	6
	$LSD_{0.05}$		NS	NS	NS	NS	NS	NS

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
NS = means are not significantly different at the 0.05 level.

Table 2. Crabgrass counts[1] in Kentucky bluegrass treated with corn gluten meal in the 1995 Corn Gluten Meal Rate Weed Control Study.

	Material	Rate lb product/1000 ft^2	July 28	August 27
1.	**Untreated control**	NA	2	2
2.	**Corn gluten meal**	10-10-10-10	2	1
3.	**Corn gluten meal**	20-20	0	0
4.	**Corn gluten meal**	30-10	1	0
5.	**Corn gluten meal**	40	1	1
	$LSD_{0.05}$		NS	NS

[1]Values represent the number of crabgrass plants per plot.
NS = means are not significantly different at the 0.05 level.

Table 3. Dandelion counts[1] in Kentucky bluegrass treated with corn gluten meal in the 1995 Corn Gluten Meal Rate Weed Control Study.

	Material	Rate lb product/1000 ft^2	May 5	May 28	June 29	July 28	August 27	Sept. 28
1.	**Untreated control**	NA	52	58	49	54	54	54
2.	**Corn gluten meal**	10-10-10-10	15	12	12	12	14	17
3.	**Corn gluten meal**	20-20	20	14	15	15	15	21
4.	**Corn gluten meal**	30-10	14	9	9	53	8	12
5.	**Corn gluten meal**	40	29	16	22	19	16	21
	$LSD_{0.05}$		24	NS	NS	NS	NS	NS

[1]Values represent the number of dandelion plants per plot.
NS = means are not significantly different at the 0.05 level.

Table 4. Percentage clover cover[1] in Kentucky bluegrass treated with corn gluten meal in the 1995 Corn Gluten Meal Rate Weed Control Study.

	Material	Rate lb product/1000 ft^2	May 5	May 28	June 29	July 28	August 27	Sept. 28
1.	**Untreated control**	NA	23	21	32	45	50	58
2.	**Corn gluten meal**	10-10-10-10	4	5	10	10	9	13
3.	**Corn gluten meal**	20-20	5	6	4	4	4	8
4.	**Corn gluten meal**	30-10	7	6	5	11	10	7
5.	**Corn gluten meal**	40	2	4	4	6	5	6
	$LSD_{0.05}$		NS	NS	NS	28	31	23

[1]Values represent the percentage of each plot covered by clover.
NS = means are not significantly different at the 0.05 level.

1999 Corn Gluten Meal/Urea Crabgrass Control Study - Year 6-2004

Nick Christians and Luke Dant

This study was initiated in 1999 to determine if the levels of annual grass and broadleaf weed control provided by corn gluten meal (CGM) treatments can be explained by the nitrogen response of treated bluegrass and not herbicidal activity of CGM. The study is being conducted at the Iowa State University Research Station north of Ames, IA in an area of 'Parade' Kentucky bluegrass. The soil in this experimental area is a Nicollet (fine-loamy, mixed, mesic Aquic Hapludolls) with an organic matter content of 4.2%, a pH of 6.75, 17 ppm P, and 103 ppm K.

The experimental design is a randomized complete block with three replications. Individual experimental plots are 5 x 5 ft with five treatments. Corn gluten meal and urea are applied yearly to the same plots at an annual rate of 4 lbs N/1000 ft^2 (Table 1). Treatments include split applications of 2 lb N/1000 ft^2 and four applications of 1 lb N/1000 ft^2 each. The CGM and urea are applied using cardboard containers as 'shaker dispensers'. The materials are watered-in with the irrigation system. Supplemental irrigation is used to provide adequate moisture to maintain the grass in good growing condition. In 2004, initial applications of all urea and CGM treatments were made on April 25. Sequential applications of 1 lb N/1000 ft^2 were made on June 5, August 16, and September 17. The second applications of 2 lb N/1000 ft^2 for urea and CGM (Treatment 3 and 5) were made on August 16.

Turf quality was monitored from May through September (Table 1). Visual turf quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.

Crabgrass data represent the number of plants per individual plot. Crabgrass counts were made on July 28 and August 27 (Table 2).

Broadleaf weed populations were measured by either counting the number of plants or estimating the percentage cover per individual plot. Data for dandelion and clover were taken beginning in May and ending in September. Dandelion infestations were determined by counting the number of plants per individual plot. Clover populations were estimated by assessing the percentage area of each plot covered by clover.

Data were analyzed with the Statistical Analysis System (SAS) and the General Linear Model (GLM) procedure. Effects of CGM and urea on bluegrass quality and weed control were examined using Fisher's Least Significant Difference (LSD) means comparison tests.

Table 1. Visual quality[1] of Kentucky bluegrass treated in the 1999 Corn Gluten Meal Weed Control Study.

	Material	lbs N /1000 ft^2	Number of applications	May 5	May 28	June 29	July 28	August 27	Sept. 28
1	**Untreated control**	NA	NA	4	3	4	5	5	5
2	**Corn gluten meal**	4	4	4	4	5	5	6	5
3	**Corn gluten meal**	4	2	5	5	5	5	6	5
4	**Urea (46-0-0)**	4	4	5	5	5	5	5	5
5	**Urea (46-0-0)**	4	2	4	4	5	5	5	4
	$LSD_{0.05}$			NS	NS	NS	NS	NS	NS

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
NS = means are not significantly different at the 0.05 level.

Table 2. Crabgrass counts[1] in Kentucky bluegrass treated in the 1999 Corn Gluten Meal/Urea Weed Control Study.

	Material	lbs N /1000 ft^2	Number of applications	August 27	Sept. 28
1	**Untreated control**	NA	NA	9	6
2	**Corn gluten meal**	4	4	9	5
3	**Corn gluten meal**	4	2	7	3
4	**Urea (46-0-0)**	4	4	16	11
5	**Urea (46-0-0)**	4	2	15	10
	$LSD_{0.05}$			NS	NS

[1]Values represent the number of crabgrass plants per plot covered.
NS = means are not significantly different at the 0.05 level.

Table 3. Dandelion counts[1] in Kentucky bluegrass treated in the 1999 Corn Gluten Meal/Urea Weed Control Study.

	Material	lbs N /1000 ft^2	Number of applications	May 5	May 28	June 29	July 28	August 27	Sept. 28
1	**Untreated control**	NA	NA	22	25	24	16	24	17
2	**Corn gluten meal**	4	4	24	16	14	12	14	11
3	**Corn gluten meal**	4	2	20	16	11	9	10	11
4	**Urea (46-0-0)**	4	4	19	15	15	9	9	10
5	**Urea (46-0-0)**	4	2	23	19	15	10	12	14
	$LSD_{0.05}$			NS	NS	NS	NS	8	NS

[1]Values represent the number of dandelion plants per plot.
NS = means are not significantly different at the 0.05 level.

Table 4. Percentage clover cover[1] in Kentucky bluegrass treated in the 1999 Corn Gluten Meal/Urea Weed Control Study.

	Material	lbs N /1000 ft^2	Number of applications	May 5	May 28	June 29	July 28	August 27	Sept. 28
1	**Untreated control**	NA	NA	20	12	16	38	29	24
2	**Corn gluten meal**	4	4	9	25	28	33	24	26
3	**Corn gluten meal**	4	2	11	9	25	28	17	12
4	**Urea (46-0-0)**	4	4	11	17	28	36	24	26
5	**Urea (46-0-0)**	4	2	20	22	24	50	27	24
	$LSD_{0.05}$			NS	NS	NS	NS	NS	NS

[1]Values represent the area per plot covered by clover.
NS = means are not significantly different at the 0.05 level.

Field Assessment of Winter Injury on Creeping Bentgrass and Annual Bluegrass Putting Greens

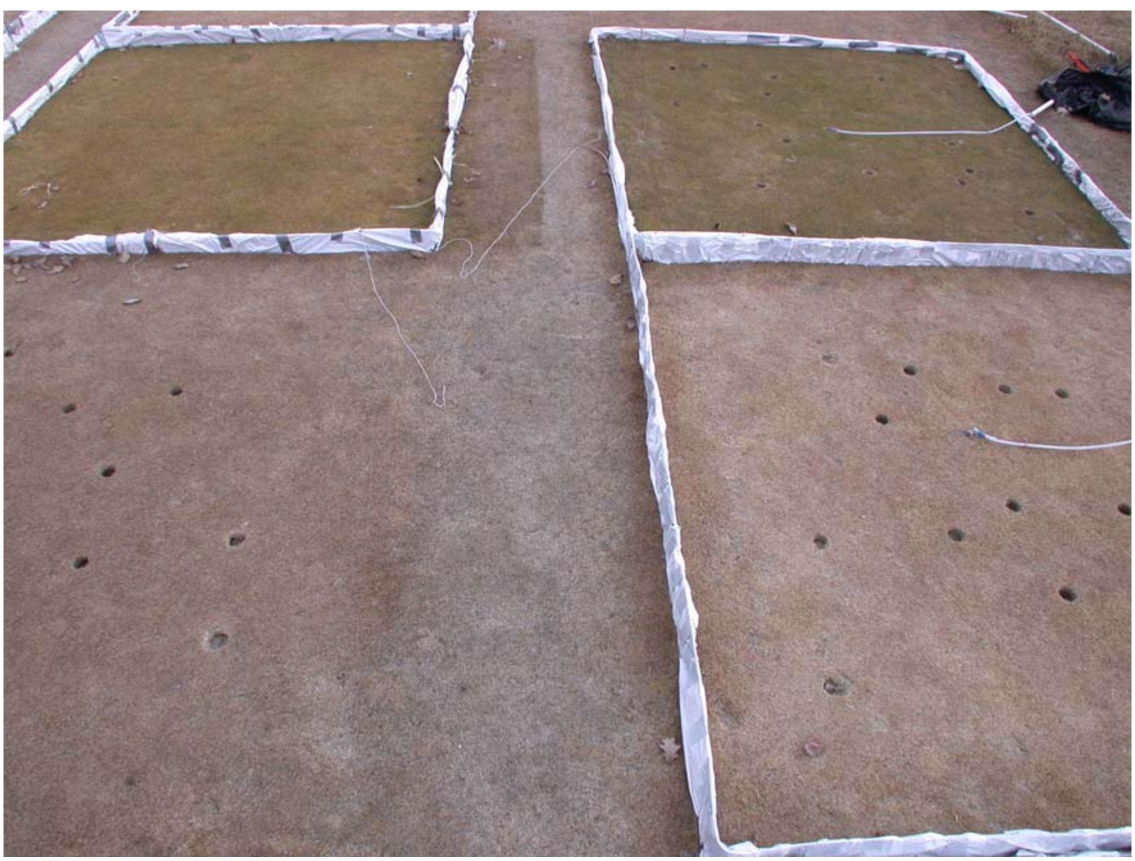
Dave Minner and Federico Valverde

The winter of 2005 represents the final year of a 3-year study sponsored by IaGCSA and GCSAA. Ten winter scenarios were applied to a creeping bentgrass soil green at Veenker Memorial Golf Course and also to a *Poa annua* USGA sand based green at the Horticulture Research Station. Covers were placed in early December and ice and snow treatments started during the first week of January and lasted for 66, 60 and 50 days in 2003, 2004 and 2005 respectively. The first two years of the study indicated that *Poa annua* was much more sensitive to winter ice cover than creeping bentgrass. In fact, bentgrass was never killed with up to 66 days of continuous ice cover while *Poa annua* had above 50 percent winter kill from ice cover. Bentgrass showed more turf bleaching and delayed spring green-up but never any loss in turf cover. It is interesting to note that removal of ice after 30 days of continuous ice cover provided no improvement in either creeping bentgrass or *Poa annua* compared to the control or the 66 days of continuous ice cover treatments. The Evergreen Turf Cover or natural snow cover always resulted in earlier spring green up of bentgrass and more winter survival of ***Poa annua.***

Winter conditions, as they relate to turfgrass injury, across Iowa were variable. We can always count on very cold temperature and in 2005 there were 40 days below 32°F. Soil temperatures at 0.5-inches dropped below freezing on 26 December and did not rise above freezing until after 4 February. The coldest soil temperature was 8°F on 17 January. Ice, snow, and desiccation were more variable. Northwest Iowa experienced open, dry and desiccation conditions during early winter while the north central area had an ice storm in early January that occurred on ground that was barely frozen. Snow and rain in January provided some reassurance for most superintendents that desiccation was not going to be a problem on soil based greens, while those with sand based greens were still standing by with water tankers incase winter watering was necessary. It is important to remember that even a single well timed winter watering may be sufficient to keep greens alive.

All of the samples taken through February 2005 in the creeping bentgrass winter trial have completely recovered in the growth chamber indicating that we do not anticipate any degree of winter injury up to that point. The 2005 *Poa annua* green had about 25 percent loss of turf cover for treatments, whereas, in the previous two years we had approximately 50% turf loss on *Poa annua* from ice cover. I do not anticipate any severe loss of putting green turf from ice cover this year and there was no need for superintendents to implement ice removal practices in 2005. Most of the winter turf injury and slow green-up we experience on putting greens is caused by desiccation and superintendents should always have a plan to reduce this type of injury. Three proven methods, in order of preference, to reduce winter desiccation are covers, winter watering, and topdressing.

Pictured below is the *Poa annua* Putting Green Winter Injury Study at the Horticulture Research Station on 21 March 2005 (upper left was GreenJacket cover + 4-inches of ice cover for 50 days, lower left was winter watered, upper right was Evergreen cover, and lower left was ice cover for 50 days).



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Companies and Organizations That Made Donations or Supplied Products to the Iowa State University Turfgrass Research Program

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