2003
Iowa Turfgrass Research Report



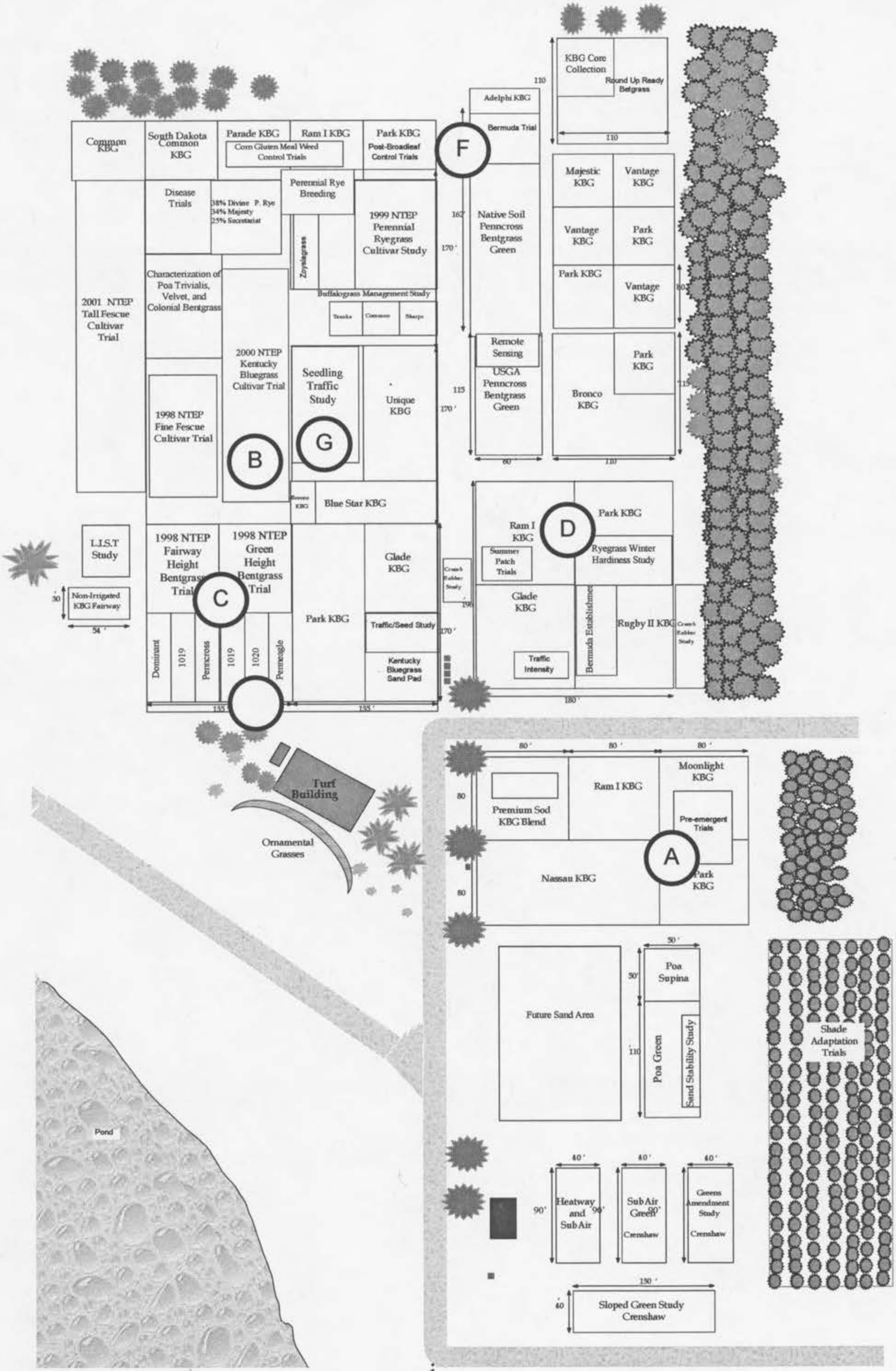


Iowa State University
University Extension
Ames, Iowa

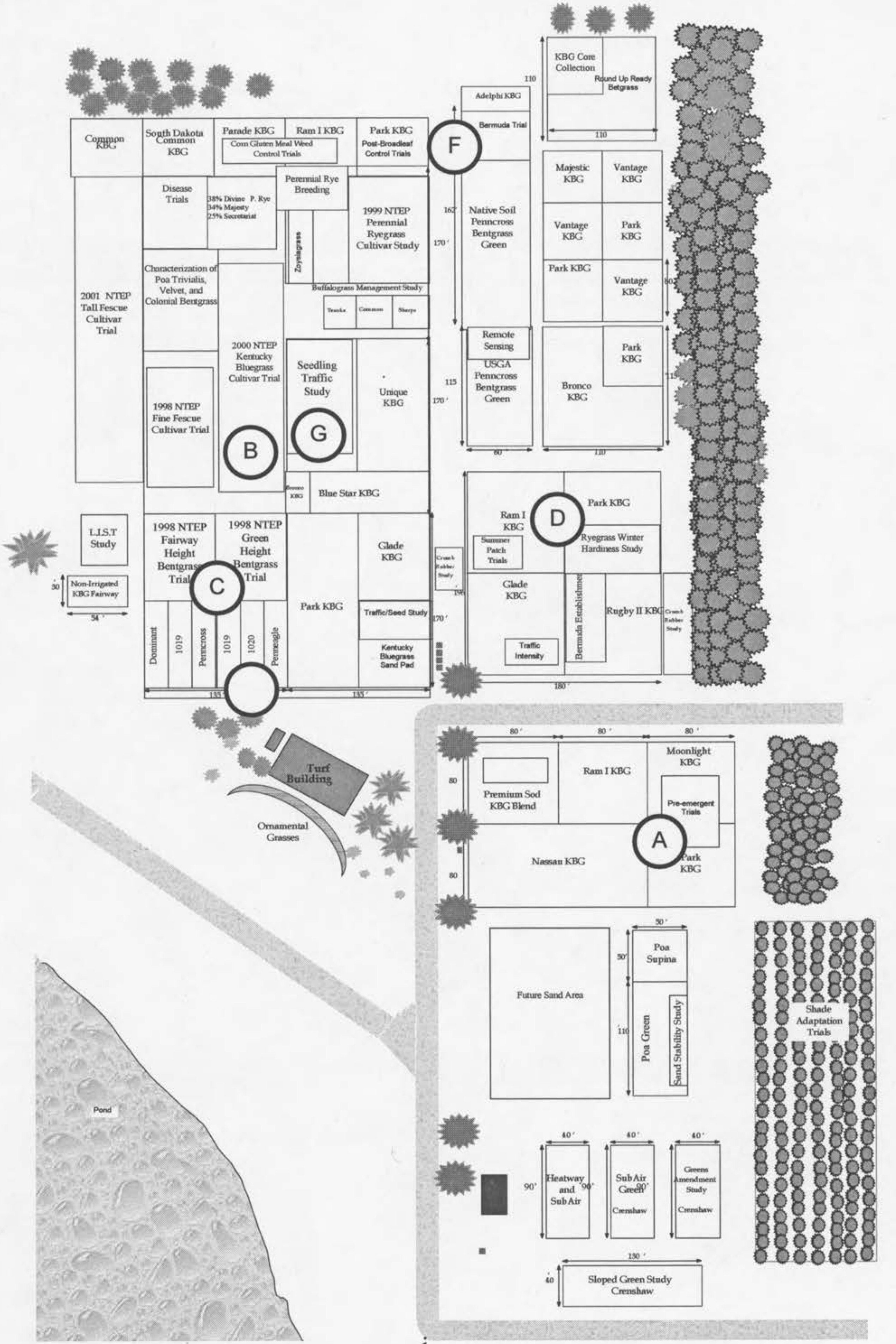
FG-467/July 2003

Department of Horticulture
Department of Plant Pathology
Department of Entomology
Cooperative Extension
IOWA STATE UNIVERSITY

In Cooperation with the
Iowa Turfgrass Institute



KBG Core Collection
Round Up Ready Bentgrass
110
110
Adelphi KBG
Bermuda Trial
Common KBG
South Dakota Common KBG
Parade KBG
Ram I KBG
Park KBG
Corn Gluten Meal Weed Control Trials
Post-Broadleaf Control Trials
F
Majestic KBG
Vantage KBG
Disease Trials
38% Divine P. Rye
34% Majesty
25% Secretariat
Perennial Rye Breeding
1999 NTEP Perennial Ryegrass Cultivar Study
Native Soil Penncross Bentgrass Green
Vantage KBG
Park KBG
Park KBG
Vantage KBG
Zoysiagrass
Buffalograss Management Study
2001 NTEP Tall Fescue Cultivar Trial
Characterization of Poa Trivialis, Velvet, and Colonial Bentgrass
2000 NTEP Kentucky Bluegrass Cultivar Trial
Seedling Traffic Study
Unique KBG
Remote Sensing
USGA Penncross Bentgrass Green
Park KBG
Bronco KBG
1998 NTEP Fine Fescue Cultivar Trial
B
G
Blue Star KBG
Park KBG
Ram I KBG
D
Summer Patch Trials
Ryegrass Winter Hardiness Study
L.I.S.T Study
1998 NTEP Fairway Height Bentgrass Trial
1998 NTEP Green Height Bentgrass Trial
C
Glade KBG
Glade KBG
Bermuda Establishment
Rugby II KBG
Non-Irrigated KBG Fairway
Park KBG
Traffic/Seed Study
Dominant
1019
Penncross
1019
1020
Penneagle
Kentucky Bluegrass Sand Pad
Traffic Intensity
135'
135'
180'
Turf Building
Ornamental Grasses
80'
80'
80'
Moonlight KBG
Premium Sod KBG Blend
Ram I KBG
Pre-emergent Trials
A
Nassau KBG
Park KBG
Poa Supina
Future Sand Area
Poa Green
Sand Stability Study
Shade Adaptation Trials
Pond
40'
40'
40'
Heatway and Sub Air
Sub Air Green
Crenshaw
Greens Amendment Study
Crenshaw
130'
Sloped Green Study Crenshaw



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170'
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Vantage KBG
Vantage KBG
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Park KBG
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Characterization of Poa Trivialis, Velvet, and Colonial Bentgrass
Buffalograss Management Study
Texoka
Common
Sharps
2000 NTEP Kentucky Bluegrass Cultivar Trial
Seedling Traffic Study
Unique KBG
Remote Sensing
USGA Penncross Bentgrass Green
115
170'
Park KBG
Bronco KBG
1998 NTEP Fine Fescue Cultivar Trial
B
G
80'
110
Bronco KBG
Blue Star KBG
Park KBG
Ram I KBG
D
Summer Patch Trials
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L.I.S.T Study
1998 NTEP Fairway Height Bentgrass Trial
1998 NTEP Green Height Bentgrass Trial
C
Glade KBG
Crumb Rubber Study
Glade KBG
30
Non-Irrigated KBG Fairway
54'
Park KBG
Traffic/Seed Study
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Pond
40'
40'
40'
90'
Heatway and Sub Air
90'
Sub Air Green
90'
Crenshaw
Greens Amendment Study
Crenshaw
130'
40
Sloped Green Study Crenshaw

A	Luke Dant	Preemergent Herbicide Trials
B	Nick Christians	Cool season grass variety trials; KBG, PR, TF
C	Nick Christians	Bentgrass Variety Trials
D	Shui-Zhang Fei	Turfgrass Breeding
E	Mark Howieson	Mowing Quality and Turf Performance
F	Federico Valverde	Weed control and turf establishment with soil solarization
G	Dave Minner	The effect of simulated traffic on seedling turf species
H	James Romer	Superior Crabapple Selections for Iowa
I	Cindy Haynes	New Plant Cultivars for Iowa Landscapes and Gardens -
J	Terry Finnerty and James Romer	The Pest and Disease Detectives: A Systematic Approach to Diagnosing Landscaping Pest Problems -
PESTICIDE CERTIFICATION TOPICS		
K	Chuck Eckermann	Pesticide Laws & Regulations
L	Mark Hanna	Equipment calibration and safe application techniques
M	Dr. Donald Lewis	Non-target injury and community problems

Introduction

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

The following research report is the 24th yearly publication of the results of turfgrass research projects performed at Iowa State University. This is the sixth 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 2002-2003, a new genotype screening trial of Roundup Ready® creeping bentgrass has been initiated. A trial on fairway and green conversion with Roundup Ready® creeping bentgrass has also been established at Veenker Memorial Golf Course to study the timing and frequency of Roundup application to ensure a smooth transition with minimal disturbance. Morphological and genetic characterization of a number of turfgrass species including *Poa trivialis*, colonial and velvet bentgrass, and Kentucky bluegrass are being conducted to study the range and the pattern of the variation and reproductive mode for breeding purposes. Another major project is the study of winter hardiness of perennial ryegrass using both conventional and molecular marker tools with a long-term goal of breeding winter hardy perennial ryegrass.

We experienced a dry fall in 2002 and this was followed by a cold but sunny winter with virtually no snow cover. These conditions were very conducive to winter injury by desiccation. Many of the autumn seeded grasses, especially those that were established in the later part of the fall, did not survive. Sod farms and other seedings that were exposed and open were damaged to the point that they required reestablishment in the spring of 2003. Established turf on putting greens was also damaged during the winter. Both of the creeping bentgrass and *Poa annua* greens were severely damaged by winter desiccation. A report with pictures is available at

http://www.iowaturfgrass.org/wiletter.htm

We would like to acknowledge Will Emley, superintendent of the ISU Horticulture Research Station; Rod St. John, manager of the turf research area; Luke Dant, undergraduate Research Associate; Federico Valverde, research associate; Dr. Young Joo, visiting scientist; Deying Li, Postdoctoral researcher; Mark Howieson, Robert Wieners, Yanwen Xiong, S.K. Lee, and Jason Kruse, graduate students; and all others employed at the field research area in the past year for their efforts in building the turf program.

Special thanks to Mark Hoffmann, 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.

Dr. Nick Christians
Phone: 515/294-0036
Fax: 515/294-0730
E-mail: nchris@iastate.edu

Dr. David Minner
Phone: 515/294-5726
Fax: 515/294-0730
E-mail: dminner@iastate.edu

Dr. Shui-Zhang Fei
Phone: 515/294-5119
Fax: 515/294-0730
E-mail: sfei@iastate.edu

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2002 Weather Data for the Turf Research Farm at Gilbert, IA.

Rain measured in inches. Maximum air temperature (Max) and minimum air temperature (Min) measured in degrees Fahrenheit (ºF).

Month	Day	Rain	Max	Min	Month	Day	Rain	Max	Min	Month	Day	Rain	Max	Min	Month	Day	Rain	Max	Min
1	1	0	18.0	5.1	2	1	0	24.0	6.9	3	1	na	na	na	4	1	0	54.5	28.1
1	2	0	24.1	5.2	2	2	0.02	37.2	7.9	3	2	na	na	na	4	2	0.03	54.5	25.8
1	3	0	30.6	2.7	2	3	0.01	29.4	4.9	3	3	na	na	na	4	3	0	54.4	17.6
1	4	0	42.4	22.0	2	4	na	na	na	3	4	na	na	na	4	4	0	54.4	11.9
1	5	0	43.2	23.8	2	5	na	na	na	3	5	na	na	na	4	5	0	54.4	24.7
1	6	0	31.6	9.5	2	6	na	na	na	3	6	na	na	na	4	6	0	54.4	25.8
1	7	0	34.8	3.8	2	7	na	na	na	3	7	na	na	na	4	7	0.05	54.4	44.8
1	8	0	63.7	26.8	2	8	na	na	na	3	8	na	na	na	4	8	0.05	54.3	40.1
1	9	0	56.0	32.5	2	9	na	na	na	3	9	na	na	na	4	9	0	54.4	29.7
1	10	0	38.8	29.9	2	10	na	na	na	3	10	na	na	na	4	10	0	54.4	43.4
1	11	0	54.8	21.8	2	11	na	na	na	3	11	na	na	na	4	11	0.55	54.4	45.2
1	12	0	42.7	27.4	2	12	na	na	na	3	12	na	na	na	4	12	0	54.3	41.2
1	13	0	52.0	28.5	2	13	na	na	na	3	13	na	na	na	4	13	0	54.3	33.6
1	14	0	37.9	25.0	2	14	na	na	na	3	14	na	na	na	4	14	0	54.3	46.6
1	15	0	28.1	21.1	2	15	na	na	na	3	15	na	na	na	4	15	0	54.3	59.1
1	16	0	27.6	14.4	2	16	na	na	na	3	16	na	na	na	4	16	0.14	54.3	62.6
1	17	0	34.1	13.3	2	17	na	na	na	3	17	na	na	na	4	17	0	54.3	51.8
1	18	0	25.3	8.6	2	18	na	na	na	3	18	na	na	na	4	18	0.36	54.2	53.4
1	19	0	36.5	16.6	2	19	na	na	na	3	19	na	na	na	4	19	0	54.2	43.6
1	20	0	45.5	21.4	2	20	na	na	na	3	20	0.08	52.4	25.4	4	20	0.51	54.2	42.0
1	21	0	51.0	20.1	2	21	na	na	na	3	21	0	25.3	12.1	4	21	0.24	54.1	34.3
1	22	0	58.2	27.1	2	22	na	na	na	3	22	0	38.9	18.8	4	22	0	54.1	34.8
1	23	0	31.6	18.8	2	23	na	na	na	3	23	0	49.0	19.9	4	23	0	54.1	42.0
1	24	0	47.3	7.5	2	24	na	na	na	3	24	0	38.2	29.3	4	24	0.12	54.1	37.3
1	25	0	61.1	26.0	2	25	na	na	na	3	25	0	39.1	21.0	4	25	0	54.1	33.5
1	26	0	67.6	37.0	2	26	na	na	na	3	26	0	46.7	16.2	4	26	0	54.0	32.2
1	27	0	58.2	26.4	2	27	na	na	na	3	27	0	58.1	24.1	4	27	1.24	54.0	42.2
1	28	0	33.3	23.1	2	28	na	na	na	3	28	0	60.6	41.4	4	28	0	54.0	37.4
1	29	0	28.7	21.8						3	29	0	60.6	32.7	4	29	0	54.0	38.7
1	30	0	28.0	19.6						3	30	0	49.7	32.0	4	30	0	54.0	48.1
1	31	0	28.3	23.0						3	31	0.04	48.9	27.8					

2002 Weather Data for the Turf Research Farm at Gilbert, IA.

Rain measured in inches. Maximum air temperature (Max) and minimum air temperature (Min) measured in degrees Fahrenheit (°F).

Month	Day	Rain	Max	Min	Month	Day	Rain	Max	Min	Month	Day	Rain	Max	Min	Month	Day	Rain	Max	Min
5	1	0.63	59.3	39.5	6	1	0	95.9	63.4	7	1	0	90.8	74.4	8	1	na	na	na
5	2	0	59.6	34.7	6	2	0.44	76.6	60.0	7	2	0	90.0	70.1	8	2	na	na	na
5	3	0	67.6	32.6	6	3	0	80.2	57.2	7	3	0	91.5	68.1	8	3	na	na	na
5	4	0	70.5	46.0	6	4	0	65.9	53.5	7	4	1.09	91.0	70.6	8	4	na	na	na
5	5	0.06	80.8	45.2	6	5	0	76.3	50.8	7	5	0.01	91.5	70.2	8	5	na	na	na
5	6	0	82.8	54.3	6	6	0	79.3	53.4	7	6	0.54	92.7	68.4	8	6	na	na	na
5	7	0	73.3	47.9	6	7	0	84.2	59.8	7	7	0	87.7	66.5	8	7	na	na	na
5	8	0	82.2	48.8	6	8	0	86.9	64.1	7	8	0	93.9	73.9	8	8	na	na	na
5	9	0	57.8	42.3	6	9	0	87.7	66.1	7	9	0	90.0	69.7	8	9	0.01	82.9	66.0
5	10	0	69.5	37.2	6	10	0.07	81.6	68.0	7	10	1.46	83.5	66.7	8	10	0	87.1	64.5
5	11	2.22	58.9	47.6	6	11	0.73	83.5	65.9	7	11	na	na	na	8	11	0	91.6	67.5
5	12	0	51.1	42.9	6	12	0.14	83.5	66.1	7	12	na	na	na	8	12	0.67	82.7	62.1
5	13	0	69.3	39.9	6	13	0.02	74.8	56.8	7	13	na	na	na	8	13	0.22	73.2	59.7
5	14	0	70.4	41.3	6	14	0	75.8	54.3	7	14	na	na	na	8	14	0	82.6	56.2
5	15	0.07	73.3	53.4	6	15	0	77.7	53.7	7	15	na	na	na	8	15	0	82.6	59.6
5	16	0.19	67.3	50.8	6	16	0	81.4	47.2	7	16	na	na	na	8	16	0.06	79.0	54.0
5	17	0	61.1	40.4	6	17	0.09	79.4	61.6	7	17	na	na	na	8	17	0.48	74.3	53.5
5	18	0	62.9	35.7	6	18	0	84.5	64.7	7	18	na	na	na	8	18	0	72.3	46.8
5	19	0	64.2	34.0	6	19	0.01	85.4	71.6	7	19	na	na	na	8	19	0	77.7	56.8
5	20	0	60.7	39.2	6	20	0.01	90.1	64.9	7	20	na	na	na	8	20	0	80.5	55.3
5	21	0	64.4	40.0	6	21	0	90.1	73.3	7	21	na	na	na	8	21	0	83.7	69.6
5	22	0	75.6	48.1	6	22	0	90.6	72.2	7	22	na	na	na	8	22	0.46	85.9	69.5
5	23	0.22	73.1	48.5	6	23	0	90.4	69.0	7	23	na	na	na	8	23	2.24	82.2	65.8
5	24	0.06	68.9	42.3	6	24	0	90.3	67.2	7	24	na	na	na	8	24	0	81.7	64.3
5	25	0.53	66.7	46.9	6	25	0	92.4	67.4	7	25	na	na	na	8	25	0	86.4	61.8
5	26	0	77.8	54.2	6	26	0	95.8	65.2	7	26	na	na	na	8	26	0	88.2	62.1
5	27	0	81.3	57.5	6	27	0	88.8	58.6	7	27	na	na	na	8	27	0	83.7	63.3
5	28	0	83.4	61.3	6	28	0	89.4	60.8	7	28	na	na	na	8	28	0	83.6	63.5
5	29	0.14	82.5	64.6	6	29	0	95.4	66.7	7	29	na	na	na	8	29	0	83.5	63.5
5	30	0	91.5	63.9	6	30	0	93.2	75.3	7	30	na	na	na	8	30	0	81.6	60.4
5	31	0	91.2	59.2						7	31	na	na	na	8	31	0	84.8	63.1

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Month	Day	Rain	Max	Min
9	1	0	86.6	65.1
9	2	0	89.9	60.7
9	3	0	87.5	51.4
9	4	0	85.0	53.0
9	5	0	88.1	59.5
9	6	0	91.0	63.8
9	7	0	92.5	67.5
9	8	0	92.4	65.7
9	9	0	91.5	66.9
9	10	0	74.6	54.6
9	11	0	79.4	48.0
9	12	0	79.4	47.2
9	13	0	76.2	54.2
9	14	0.03	70.5	54.4
9	15	0	76.0	46.3
9	16	0	83.1	41.8
9	17	0	80.6	51.4
9	18	0.62	82.2	64.8
9	19	0.07	69.2	60.7
9	20	0	76.6	55.6
9	21	0	67.4	47.7
9	22	0	65.3	42.8
9	23	0	65.5	38.5
9	24	0	67.5	33.5
9	25	0	71.7	53.8
9	26	0	69.7	47.0
9	27	0.14	66.5	50.1
9	28	0.03	71.0	46.5
9	29	0	88.3	56.1
9	30	0	89.1	66.7

Month	Day	Rain	Max	Min
10	1	0.75	75.4	62.5
10	2	0.69	66.4	48.6
10	3	0.17	61.3	49.9
10	4	0.23	68.8	42.2
10	5	0	67.0	36.0
10	6	0	60.2	38.7
10	7	0.01	61.1	49.7
10	8	0	70.8	46.6
10	9	0.01	69.1	50.2
10	10	0.09	75.5	54.5
10	11	0.01	76.4	59.9
10	12	0.02	62.8	37.2
10	13	0	59.5	34.7
10	14	0	62.6	38.3
10	15	0	55.3	35.0
10	16	0.04	49.3	37.1
10	17	0.01	49.6	38.8
10	18	0	64.0	41.3
10	19	0	46.5	37.3
10	20	0	54.5	40.2
10	21	0.11	49.8	35.6
10	22	0.01	43.8	34.0
10	23	0.09	39.0	33.8
10	24	0.35	40.7	32.8
10	25	0.22	46.4	40.2
10	26	0	52.1	31.6
10	27	0.04	39.3	35.8
10	28	0.28	42.6	32.9
10	29	0.03	44.6	39.9
10	30	0	44.3	34.0
10	31	0	36.5	39.9

Month	Day	Rain	Max	Min
11	1	0	40.0	19.1
11	2	0	47.2	20.5
11	3	0	46.1	27.0
11	4	0	32.6	27.2
11	5	0.11	39.1	30.2
11	6	0	53.4	28.0
11	7	0	69.4	27.6
11	8	0	61.3	40.7
11	9	0	63.8	42.3
11	10	0	48.7	28.5
11	11	0.05	32.6	20.5
11	12	0.02	59.7	20.3
11	13	0	59.2	25.6
11	14	0	46.4	26.1
11	15	0	34.9	24.8
11	16	0	35.5	18.8
11	17	0	41.1	17.7
11	18	0	48.7	29.7
11	19	0	55.7	32.9
11	20	0	58.8	31.4
11	21	0	43.5	31.4
11	22	0	41.8	20.6
11	23	0	47.3	28.1
11	24	0	37.6	22.4
11	25	0	34.2	13.9
11	26	0	33.0	12.7
11	27	0	30.0	9.7
11	28	0	45.6	16.0
11	29	0	50.3	26.0
11	30	0	27.8	10.0

Month	Day	Rain	Max	Min
12	1	0	51.5	11.6
12	2	0	33.1	11.0
12	3	0	26.9	8.6
12	4	0	28.8	14.5
12	5	0	24.7	8.0
12	6	0	47.2	9.1
12	7	0	43.4	21.4
12	8	0	31.8	4.4
12	9	0	43.2	3.0
12	10	0	46.9	21.1
12	11	0	40.2	29.0
12	12	0	44.8	24.5
12	13	0	50.0	17.0
12	14	0	54.8	15.7
12	15	0	57.4	22.0
12	16	0	35.3	28.5
12	17	0	40.2	31.2
12	18	0.01	45.5	34.7
12	19	0	39.8	25.2
12	20	0	34.6	29.3
12	21	0	35.4	21.4
12	22	0	33.8	20.2
12	23	0	32.2	15.8
12	24	0	22.5	14.0
12	25	0	29.7	10.2
12	26	0	43.8	8.2
12	27	0	41.3	24.4
12	28	0	58.8	23.2
12	29	0	48.6	26.1
12	30	0	46.4	19.8
12	31	0	41.4	13.9

2000 High-Maintenance Kentucky Bluegrass Cultivar Trial

Rodney A. St. John and Nick E. Christians

The National Turfgrass Evaluation Project (NTEP) has sponsored several regional Kentucky bluegrass cultivar trials conducted at most of the northern agricultural experiment stations. The 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 2002 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 2002 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.

Table 1. 2002 visual quality and other ratings for the High-Maintenance Kentucky Bluegrass Trial

			Quality						
Kentucky Bluegrass Cultivar	**GENCOLOR**	**LEAFTEX**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
	9-1; 9 Best								
BAR PP 0573	7.0	6.3	7.7	7.0	7.3	8.7	8.0	7.7	7.7
TSUNAMI (J-2487)	7.0	7.0	6.3	5.3	6.7	8.7	7.7	8.3	7.2
A97-1432	7.3	6.7	7.0	6.7	6.0	8.0	7.7	7.0	7.1
ARCADIA	7.3	7.0	6.7	6.3	6.7	8.0	7.3	7.3	7.1
BAR PP 0566	7.3	6.0	6.7	6.3	6.3	7.7	7.3	8.0	7.1
BEDAZZLED	6.7	6.0	6.0	7.0	6.7	7.3	7.7	8.0	7.1
A97-1409	7.0	6.3	6.3	6.7	7.0	7.3	7.0	7.0	6.9
ASCOT	7.3	6.0	6.7	6.7	6.7	7.7	7.3	6.7	6.9
BA 00-6001	7.0	6.3	7.0	7.0	6.7	7.3	7.3	6.3	6.9
H92-558	7.0	6.3	6.3	6.7	7.0	8.0	6.7	7.0	6.9
BARRISTER (J-1655)	7.7	7.0	5.7	6.3	6.7	7.0	7.7	7.7	6.8
CHICAGO II	8.0	6.7	6.3	7.0	7.0	6.7	7.3	6.3	6.8
MIDNIGHT II (A98-739)	6.7	6.7	6.0	5.7	6.7	8.0	7.7	7.0	6.8
PICK 417	7.7	6.0	6.7	7.3	7.0	7.7	6.0	6.0	6.8
RITA	6.7	6.3	6.3	6.3	6.0	7.7	7.0	7.3	6.8
UNKNOWN	7.7	7.0	6.0	6.0	6.0	7.3	7.7	8.0	6.8
WILDWOOD	7.0	7.0	6.7	6.0	8.0	7.7	6.3	6.3	6.8
BA 82-288	6.7	6.0	6.0	6.3	6.3	7.0	7.3	7.3	6.7
BA 83-113	7.0	6.7	6.3	6.7	6.0	6.7	7.3	7.0	6.7
BLACKSBURG II (PST-1BMY)	6.7	6.7	6.0	6.7	6.3	6.7	6.3	8.0	6.7
BLUESTONE (PST-731)	7.0	6.7	6.0	6.3	6.7	7.0	7.7	6.7	6.7
CABERNET	6.3	7.0	7.0	6.0	6.0	7.7	6.7	6.7	6.7
CHAMPAGNE	6.0	6.7	6.3	5.0	6.3	7.7	8.0	6.7	6.7
JULIUS	6.3	6.0	6.7	7.0	7.0	7.3	5.3	7.0	6.7
SERENE	7.0	6.3	6.0	7.0	6.7	7.0	7.0	6.3	6.7
SI A96-386	7.7	6.7	5.3	6.7	7.0	6.7	7.7	7.0	6.7
ALLURE	6.0	6.7	8.0	6.3	6.3	6.3	6.0	6.3	6.6
ARROW (A97-1567)	6.7	6.3	5.7	6.3	6.7	7.3	7.3	6.3	6.6
BARONETTE (BA 81-058)	6.7	7.0	5.0	6.3	6.0	7.0	7.7	7.3	6.6
BLACKSTONE	7.0	7.0	6.0	6.7	6.7	6.7	7.0	6.7	6.6
J-1368	7.7	7.0	6.7	5.3	6.0	7.3	6.7	7.3	6.6
JEFFERSON	5.7	7.3	6.3	6.3	7.0	6.7	6.3	7.0	6.6
LAKESHORE (A93-200)	5.3	6.3	6.7	6.0	5.7	6.7	7.0	7.3	6.6
LANGARA	7.0	7.0	6.7	6.0	6.7	6.3	6.7	7.3	6.6
NORTH STAR	7.0	7.0	4.7	5.7	7.0	7.3	7.3	7.3	6.6
PST-108-79	7.0	7.0	5.7	7.3	7.3	6.7	6.7	5.7	6.6
PST-YORK HARBOR 4	7.3	6.7	5.3	6.0	7.0	8.0	7.0	6.3	6.6
SHOWCASE	7.0	6.0	6.3	6.0	6.0	7.3	7.0	6.7	6.6
SR 2284 (SRX 2284)	7.0	6.0	5.3	6.3	6.7	7.3	7.0	6.7	6.6
A98-881	7.0	6.7	5.7	5.7	6.0	7.3	7.3	7.0	6.5
BOUTIQUE	7.7	6.0	6.0	7.0	6.3	7.7	6.0	6.0	6.5

Kentucky Bluegrass Cultivar	GENCOLOR	LEAFTEX	MAY	JUN	JUL	AUG	SEP	OCT	MEAN
J-1838	6.3	6.7	5.7	5.3	5.7	7.3	7.3	7.7	6.5
J-2890	7.0	6.7	5.7	5.7	6.0	7.7	7.0	7.0	6.5
MONTE CARLO (A96-402)	7.0	6.0	6.0	6.7	6.3	6.7	6.7	6.7	6.5
PST-161	6.7	6.7	6.0	5.7	6.3	6.7	7.0	7.3	6.5
SHAMROCK	6.0	6.3	6.3	6.3	7.0	6.7	6.7	6.0	6.5
A96-427	6.3	5.7	6.3	6.3	6.0	6.3	6.7	6.7	6.4
A98-139	6.7	7.0	7.0	7.0	6.0	6.7	6.3	5.7	6.4
B3-171	6.3	6.3	5.7	5.7	6.7	7.3	6.7	6.7	6.4
BARTITIA	6.7	7.7	5.7	6.0	6.0	7.3	6.3	7.0	6.4
BLUE KNIGHT	6.3	6.3	6.0	6.0	6.3	7.7	6.3	6.3	6.4
BLUE RIDGE (A97-1449)	7.3	6.0	6.3	5.7	6.3	6.7	6.3	7.0	6.4
CHELSEA	5.7	8.0	6.0	6.0	6.3	7.3	6.7	6.0	6.4
DLF 76-9032	7.7	7.3	6.0	6.3	5.7	6.7	7.0	6.7	6.4
DLF 76-9036	6.7	6.3	5.0	6.3	6.3	7.3	6.7	6.7	6.4
HALLMARK	7.7	7.0	5.0	7.0	6.7	6.7	7.3	6.0	6.4
J-2561	7.0	7.0	6.0	5.3	5.7	7.3	7.0	7.0	6.4
PST-1701	6.0	7.3	5.3	6.7	7.0	6.7	6.7	6.3	6.4
PST-B3-170	7.3	7.0	5.0	6.3	6.7	7.7	6.7	6.3	6.4
PST-B5-89	7.3	6.3	6.0	5.7	7.0	7.3	6.7	5.7	6.4
RUGBY II	7.3	6.7	6.3	6.3	6.0	6.7	7.0	6.0	6.4
SONOMA	7.0	6.7	5.7	6.0	6.3	7.0	7.0	6.3	6.4
SRX 2114	7.3	7.0	5.5	6.0	7.0	7.0	6.0	6.3	6.4
SRX QG245	6.0	8.0	6.7	5.7	6.7	7.7	6.3	5.7	6.4
A97-1715	6.3	6.7	7.7	6.7	5.7	6.3	5.3	6.3	6.3
A98-1028	6.7	6.7	5.7	6.0	6.7	6.3	7.0	6.0	6.3
A98-183	7.7	6.0	6.3	6.0	6.0	6.7	6.3	6.3	6.3
A98-365	7.0	6.7	5.7	6.0	6.0	7.0	6.7	6.7	6.3
BORDEAUX	7.3	6.3	5.7	5.7	6.3	6.7	7.0	6.3	6.3
CHAMPLAIN (A98-1275)	7.0	6.3	5.3	7.0	7.7	6.3	6.0	5.7	6.3
FREEDOM II	7.0	7.3	7.0	6.7	5.7	6.0	6.0	6.7	6.3
GOLDSTAR (A98-296)	7.0	6.3	5.7	6.0	5.7	7.0	6.3	7.3	6.3
J-1420	8.0	7.0	6.7	6.0	5.7	6.3	6.3	6.7	6.3
LIBERATOR	7.3	6.7	6.3	5.7	6.0	6.3	6.3	7.0	6.3
LIMERICK	6.3	6.7	6.3	7.0	6.0	7.3	5.3	6.0	6.3
MISTY	6.0	7.0	5.3	5.0	6.0	7.7	7.0	6.7	6.3
MOON SHADOW (PICK 113-3)	7.0	7.0	6.3	6.0	5.7	6.7	6.7	6.7	6.3
PP H 6366	7.0	7.3	6.7	7.0	7.0	7.0	5.3	4.7	6.3
PRO SEEDS - 453	6.7	7.0	6.0	6.3	5.7	6.3	7.0	6.7	6.3
PST-1804	6.0	6.7	6.7	6.0	6.3	7.0	6.0	6.3	6.3
QUANTUM LEAP	7.3	7.0	5.7	5.3	5.3	7.0	7.3	7.0	6.3
RAVEN	7.0	6.3	5.7	6.0	6.7	7.0	6.0	6.3	6.3
A96-739	7.3	6.7	5.7	6.0	6.7	6.3	6.3	6.3	6.2
ALPINE	6.7	7.7	6.0	5.7	6.3	6.7	6.3	6.0	6.2
BAR PP 0468	6.3	6.3	5.7	6.7	5.7	6.3	6.7	6.0	6.2
BARONIE	5.0	6.3	6.0	5.7	5.7	6.3	6.7	7.0	6.2
BARZAN	5.3	7.7	5.0	5.0	5.7	7.7	7.0	6.7	6.2
BH 00-6003	6.7	6.3	6.3	5.7	6.3	6.7	6.3	6.0	6.2
BRILLIANT	6.3	7.0	5.7	5.7	5.7	7.0	6.0	7.3	6.2
CHATEAU	6.0	6.3	7.3	6.0	5.3	5.3	7.0	6.0	6.2
GOLDRUSH	6.3	6.3	5.0	5.7	6.3	7.0	6.3	6.7	6.2
H92-203	6.0	6.0	5.7	7.0	5.3	6.3	6.3	6.3	6.2
LILY	6.7	6.7	6.3	6.7	6.3	6.0	5.7	6.3	6.2
MALLARD (A97-1439)	6.7	6.0	5.0	5.7	6.0	6.7	7.3	6.7	6.2
PICK-232	6.7	6.3	6.3	6.3	5.7	6.0	6.7	6.3	6.2
PP H 7832	6.7	6.0	5.7	5.7	6.7	7.0	6.0	6.3	6.2
PP H 7907	7.7	7.7	5.7	5.7	6.7	7.7	6.3	5.3	6.2
ROYALE (A97-1336)	7.0	6.3	5.3	6.7	6.7	6.7	6.0	6.0	6.2
99AN-53	5.3	6.7	6.0	5.0	6.3	6.3	6.3	6.3	6.1
A96-742	6.3	6.7	5.7	5.7	6.3	6.7	6.3	5.7	6.1
A97-1330	7.0	6.7	6.0	5.7	5.7	6.3	7.0	6.0	6.1
A97-857	7.3	7.0	5.0	6.0	5.7	7.0	6.0	6.7	6.1
B3-185	6.7	6.3	5.7	5.7	5.7	6.3	6.3	6.7	6.1
B5-43	6.0	6.3	6.3	6.0	6.0	6.3	6.0	5.7	6.1
B5-45	6.0	6.3	6.3	5.7	6.7	6.3	5.7	6.0	6.1
BARIRIS	6.7	6.3	6.7	6.0	5.3	6.3	5.7	6.3	6.1
DLF 76-9037	6.0	6.3	5.3	6.0	5.3	6.7	7.3	5.7	6.1
HV 238	5.3	6.3	5.3	6.0	6.7	7.0	5.7	5.7	6.1
JEWEL	6.0	6.7	5.7	5.0	6.7	7.0	6.3	5.7	6.1
LIMOUSINE	7.0	7.0	5.3	6.0	6.3	7.0	6.0	5.7	6.1

Kentucky Bluegrass Cultivar	GENCOLOR	LEAFTEX	MAY	JUN	JUL	AUG	SEP	OCT	MEAN
MARQUIS	7.0	6.0	5.0	6.3	7.0	6.7	5.7	5.7	6.1
ODYSSEY	7.0	7.0	6.0	5.7	5.3	6.3	6.3	7.0	6.1
PRINCETON 105	6.3	6.3	5.3	5.7	6.0	6.3	6.7	6.3	6.1
PST-B4-246	7.3	7.0	5.0	6.0	6.3	6.7	6.0	6.3	6.1
PST-H6-150	6.3	6.7	5.0	6.3	5.3	7.0	6.7	6.3	6.1
SRX 2394	6.7	6.7	5.3	5.7	5.7	6.3	7.0	6.3	6.1
SRX 26351	6.7	7.0	5.7	5.3	5.7	7.3	6.3	6.0	6.1
ABBEY	7.3	6.3	6.0	5.3	5.7	6.0	6.3	6.7	6.0
BARON	6.3	6.7	4.7	5.0	6.7	6.7	6.7	6.3	6.0
BH 00-6002	5.7	6.7	7.3	5.7	5.7	6.0	5.3	6.0	6.0
BODACIOUS	7.0	6.7	5.7	5.3	5.7	6.7	5.7	7.0	6.0
BOOMERANG	7.3	7.3	5.3	4.7	5.0	7.7	6.7	6.7	6.0
ENVICTA	7.0	6.0	4.7	5.7	7.0	7.0	6.0	5.7	6.0
MIDNIGHT	7.0	6.0	5.3	5.3	5.7	6.7	6.7	6.3	6.0
MOONLIGHT	7.0	5.3	5.3	6.0	5.7	6.3	6.3	6.3	6.0
NA-K991	8.0	6.3	5.7	6.7	6.7	6.0	5.7	5.3	6.0
PICK 453	7.3	6.3	5.7	6.7	6.3	5.7	5.7	6.0	6.0
UNIQUE	6.0	6.3	6.3	6.0	5.7	6.0	6.3	5.7	6.0
A98-407	6.7	6.0	5.5	6.0	5.7	5.3	6.0	6.7	5.9
AWARD	7.3	6.3	6.0	5.7	6.3	6.3	5.3	6.0	5.9
B5-144	6.0	6.3	6.3	6.7	5.0	6.0	5.7	5.7	5.9
BAR PP 0471	6.0	7.0	5.0	5.7	5.7	7.0	6.3	6.0	5.9
BEYOND (J-1880)	7.0	6.7	5.7	5.7	5.3	6.0	5.7	7.0	5.9
BROOKLAWN	6.0	7.0	6.0	6.0	5.3	5.7	6.0	6.3	5.9
COVENTRY	6.7	6.3	7.0	6.0	5.7	5.7	5.0	6.0	5.9
EAGLETON	6.0	6.3	5.7	6.3	5.7	6.7	5.7	5.3	5.9
EVERGLADE	7.0	6.3	5.0	4.7	5.3	8.0	6.3	6.3	5.9
FAIRFAX	6.3	6.0	6.0	6.3	6.3	5.7	5.3	6.0	5.9
J-2695	8.0	6.7	5.3	6.3	5.3	6.3	6.3	6.0	5.9
NUGLADE	7.0	7.0	5.3	4.7	5.7	7.0	6.0	6.7	5.9
PST-1QG-27	6.7	5.7	6.7	5.7	6.0	5.3	5.7	6.0	5.9
PST-H5-35	7.3	6.3	5.3	5.3	5.7	6.3	6.7	6.3	5.9
RAMBO	5.7	7.0	5.3	5.7	5.3	6.0	6.7	6.7	5.9
ROYCE (A98-304)	7.0	6.7	5.7	6.0	5.7	6.0	6.0	6.0	5.9
EVEREST	7.0	7.3	5.7	5.7	5.3	6.7	5.7	5.7	5.8
H94-293	6.7	6.0	4.7	5.3	6.3	6.7	6.3	5.3	5.8
HV 140	6.3	7.7	5.7	6.0	6.0	6.7	5.3	5.3	5.8
J-1513	7.0	6.7	6.0	5.3	5.0	5.7	6.3	6.7	5.8
JULIA	6.3	6.7	5.3	5.7	5.3	6.7	6.3	5.7	5.8
PST-604	7.7	5.7	5.3	5.7	5.3	6.3	5.7	6.3	5.8
PST-B5-125	7.0	7.0	4.7	5.7	6.0	7.0	6.0	5.3	5.8
SRX 27921	7.3	6.7	5.0	5.7	6.3	5.7	6.0	6.0	5.8
A96-451	7.3	6.3	4.7	5.7	5.3	6.7	6.0	5.7	5.7
B4-128A	6.0	6.3	5.7	5.7	5.7	6.7	5.0	5.3	5.7
J-2885	7.0	6.3	4.7	5.0	6.0	6.0	6.3	6.3	5.7
PP H 6370	6.3	7.7	5.3	5.7	5.7	6.7	5.3	5.3	5.7
TOTAL ECLIPSE	7.0	7.0	5.0	5.7	5.3	6.3	5.7	6.3	5.7
WASHINGTON	5.0	8.3	4.7	5.7	5.3	6.7	5.7	6.0	5.7
1B7-308	7.0	6.0	5.3	5.0	5.3	6.0	5.7	6.0	5.6
BARITONE	6.0	6.0	7.0	5.7	5.3	5.7	5.3	4.7	5.6
DLF 76-9034	6.0	6.0	4.7	5.7	5.3	6.0	6.0	5.7	5.6
EXCURSION (J-1648)	7.3	6.3	4.3	5.7	5.7	6.0	6.0	5.7	5.6
PP H 7929	6.0	7.0	5.3	5.0	5.7	5.7	6.0	5.7	5.6
IMPACT	7.3	7.0	5.3	4.3	6.0	6.3	5.0	6.0	5.5
WELLINGTON	4.3	8.3	5.3	4.3	5.0	7.0	5.7	5.7	5.5
APOLLO	7.0	7.0	4.7	5.3	5.0	6.0	5.7	5.7	5.4
J-1515	7.0	6.7	5.3	5.3	5.3	5.0	5.3	6.0	5.4
KENBLUE	5.0	8.7	4.3	4.7	5.7	6.7	6.0	5.3	5.4
NA-K992	5.0	7.0	5.7	4.3	4.3	7.3	5.0	5.7	5.4
PST-222	7.3	6.0	4.7	5.7	5.7	5.3	5.0	6.3	5.4
CVB-20631	6.7	6.7	4.3	4.7	5.0	6.0	6.3	5.7	5.3
GO-9LM9	4.7	8.7	4.7	5.0	5.3	6.0	5.0	5.0	5.2
BA 84-140	7.0	7.0	5.0	4.7	5.7	5.3	4.0	4.7	4.9
LSD	1.2	1.0	2.0	2.1	2.0	2.3	2.8	1.9	1.6

1999 Perennial Ryegrass Cultivar Trial

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

This was the third 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 2002 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 2002 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 data were taken in April 2002 and were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf.

Table 1. The 2002 ratings for the 1999 National Perennial Ryegrass Study.

				Quality						
Perennial Ryegrass Cultivar	**GREENUP**	**GENCOLOR**	**LEAFTEX**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
	9-1; 9 Best									
PINNACLE II (BAR 9 B2)	8.7	8.7	8.0	7.7	7.7	7.7	7.7	8.3	8.3	7.9
ALL STAR2 (CIS-PR-78)	8.3	9.0	8.0	8.0	7.0	8.0	7.0	8.0	8.0	7.7
CITATION FORE (PST-2BR)	8.3	8.0	8.0	8.0	7.0	7.7	6.7	8.3	8.3	7.7
GATOR 3 (CIS-PR-85)	8.0	8.3	8.0	7.7	7.0	7.3	7.7	8.3	8.0	7.7
PST-2M4	7.7	8.3	8.0	8.0	7.3	7.7	7.0	7.7	8.3	7.7
ABT-99-4.834	8.0	8.7	8.0	8.0	7.3	7.7	7.0	7.7	7.7	7.6
CABO (CIS-PR-80)	9.0	8.0	8.0	8.7	7.3	7.0	7.3	7.7	7.3	7.6
CIS-PR-84	8.0	8.3	8.0	8.0	7.3	7.3	7.0	8.0	8.0	7.6
MACH 1 (ROBERTS-627)	8.7	8.0	8.0	8.0	7.0	7.3	7.0	8.3	7.7	7.6
PIZZAZZ	8.0	8.0	8.0	7.7	7.0	8.0	7.3	7.7	7.7	7.6
PST-2LA	8.0	8.0	8.0	8.0	7.0	7.7	6.7	8.0	8.0	7.6
WILMINGTON	8.0	7.7	7.7	8.0	7.0	7.0	7.3	8.0	8.0	7.6
ABT-99-4.724	8.7	7.7	8.0	8.3	7.3	7.0	7.0	7.7	7.7	7.5
BLAZER IV (PICK MDR)	8.0	7.7	8.0	7.7	7.0	7.3	7.0	8.0	8.0	7.5
PENNANT II	7.7	7.7	8.0	7.7	7.3	7.0	7.0	8.0	8.0	7.5
ABT-99-4.560	8.0	8.0	8.0	8.0	7.7	7.7	6.7	7.0	7.3	7.4
APPLAUD (PENNINGTON-11301)	8.7	8.0	8.0	8.0	7.0	7.0	7.0	7.7	7.7	7.4
PROSPORT (AG-P981)	8.0	8.0	7.7	8.0	7.3	7.3	7.0	7.3	7.3	7.4
RACER II (PICK RC2)	8.0	7.7	8.0	8.0	7.7	7.0	7.0	7.3	7.3	7.4
SEVILLE II	8.3	7.3	8.0	8.3	7.0	6.7	7.0	8.0	7.7	7.4
ABT-99-4.965	8.3	8.0	8.0	7.7	6.3	7.3	7.0	7.7	7.7	7.3
AMAZING (B1)	8.7	8.7	8.0	8.0	6.3	7.3	7.0	8.0	7.3	7.3
BARLENNIUM	8.3	7.0	8.0	8.0	7.0	7.0	6.7	7.7	7.3	7.3
CHARISMATIC (LTP 98-501)	8.3	7.3	8.0	8.3	7.3	6.7	7.0	7.3	7.3	7.3
CHURCHILL	8.3	7.3	8.0	8.0	7.0	7.0	7.0	7.7	7.3	7.3
COURAGE (MB 410)	8.0	7.7	8.0	8.0	7.3	6.7	6.7	7.3	7.7	7.3
ELFKIN	7.7	7.3	8.0	8.0	7.7	6.7	6.7	7.3	7.3	7.3
HAWKEYE (SRX 4RHT)	8.3	7.7	8.0	8.0	7.7	6.0	7.3	7.7	7.3	7.3
ICON (MB 414)	8.0	7.7	8.0	7.7	6.7	7.0	7.0	8.0	7.7	7.3
INSPIRE (R8000)	8.7	7.7	8.0	7.7	7.3	6.7	6.7	8.0	7.3	7.3
MANHATTAN 4 (PST-2CRL)	8.3	7.0	7.7	8.3	7.0	6.3	7.0	7.7	7.3	7.3
PALMER III	7.7	7.7	8.0	7.7	7.3	7.0	7.0	7.3	7.3	7.3
PHANTOM	7.7	7.3	8.0	8.0	7.0	7.0	7.0	7.3	7.3	7.3
PREMIER II	8.3	7.7	8.0	7.7	7.3	7.0	7.0	7.0	7.7	7.3
PST-2CRR	8.0	8.0	8.0	7.7	7.0	7.3	7.0	7.3	7.3	7.3
RACER	8.0	7.0	7.7	8.0	7.3	6.7	7.0	7.3	7.3	7.3

Perennial Ryegrass Cultivar	GREENUP	GENCOLOR	LEAFTEX	MAY	JUN	JUL	AUG	SEP	OCT	MEAN
SR 4220 (SRX 4801)	8.3	7.7	8.0	8.0	7.0	6.7	7.0	7.7	7.3	7.3
SR 4420 (SRX 4820)	8.0	7.7	8.0	7.7	7.3	7.0	6.7	7.7	7.7	7.3
ALLSPORT	7.7	8.0	8.0	7.7	7.0	6.7	7.0	7.3	7.3	7.2
APR 1231	7.7	7.7	8.0	8.0	7.3	6.7	7.0	7.0	7.0	7.2
ASCEND	8.0	7.3	8.0	8.0	7.0	6.7	6.7	7.3	7.3	7.2
BRIGHTSTAR II	8.0	8.0	8.0	8.0	6.7	6.7	7.0	7.7	7.3	7.2
BRIGHTSTAR SLT (PST-2A6B)	7.7	7.7	8.0	7.3	7.3	7.0	6.7	7.7	7.3	7.2
GALLERY (MB 412)	8.7	7.0	7.7	8.3	6.7	7.0	7.0	7.0	7.0	7.2
GRAND SLAM (PST-2L96)	8.0	7.7	8.0	7.7	7.3	6.7	7.0	7.3	7.0	7.2
LPR 98-144	7.3	7.3	8.0	7.3	7.0	7.0	6.7	7.3	8.0	7.2
LTP-ME	8.0	7.7	7.7	7.3	6.7	7.0	7.0	7.7	7.3	7.2
MANHATTAN 3	7.3	7.3	8.0	7.3	7.3	7.0	6.7	7.3	7.3	7.2
MDP	8.0	7.3	8.0	7.7	7.0	6.7	7.0	7.7	7.0	7.2
PARAGON	8.3	7.7	8.0	8.0	7.3	6.3	7.0	7.3	7.3	7.2
PENTIUM (NJ-6401)	7.7	7.7	8.0	7.3	7.0	7.0	6.7	7.7	7.7	7.2
PICK PRNGS	8.3	7.3	8.0	8.0	7.0	6.7	7.0	7.3	7.3	7.2
PLEASURE XL	7.3	7.3	8.0	7.3	7.3	6.7	7.0	7.3	7.3	7.2
PST-2RT	7.7	8.0	8.0	7.7	7.3	6.7	6.7	7.3	7.7	7.2
SKYHAWK	8.7	7.3	8.0	8.0	7.0	6.3	7.0	7.3	7.3	7.2
ABT-99-4.115	8.0	7.3	8.0	8.0	7.3	6.3	6.7	7.0	7.0	7.1
ABT-99-4.464	8.0	7.0	8.0	8.0	7.0	6.3	6.7	7.3	7.3	7.1
ABT-99-4.625	8.0	7.3	8.0	8.0	7.0	6.7	6.7	7.0	7.0	7.1
APR 776	7.3	7.0	8.0	7.7	7.0	6.3	6.7	7.3	7.3	7.1
CATALINA	7.3	7.7	8.0	7.3	6.3	7.3	6.7	7.7	7.3	7.1
DLF-LDD	8.0	7.7	7.7	8.0	6.7	6.7	7.0	7.0	7.3	7.1
EPD	8.3	7.3	8.0	7.3	7.3	6.7	7.0	7.0	7.0	7.1
HEADSTART	7.7	7.3	8.0	7.7	7.0	6.3	6.7	7.3	7.3	7.1
JET	8.3	7.3	8.0	7.7	7.7	5.7	6.7	7.7	7.0	7.1
JR-128	7.7	7.3	8.0	7.7	7.0	6.3	7.0	7.3	7.3	7.1
KOKOMO (CIS-PR-69)	8.0	7.3	8.0	7.7	7.3	6.3	6.7	7.3	7.0	7.1
MONTEREY II (JR-187)	7.7	8.0	8.0	7.7	7.7	6.3	6.3	7.3	7.3	7.1
MP107	8.3	7.7	8.0	8.3	7.0	6.7	6.7	7.0	7.0	7.1
MP88	7.3	7.0	8.0	7.7	7.0	6.3	6.7	7.3	7.3	7.1
PACESETTER (6011)	7.7	7.3	8.0	7.3	7.3	6.3	6.7	7.3	7.3	7.1
PANTHER	8.0	8.0	8.0	7.7	6.7	7.0	6.7	7.3	7.3	7.1
PST-2SBE	8.3	7.7	8.0	8.0	7.0	6.7	7.0	7.3	6.7	7.1
SPLENDID (MB 411)	8.3	8.0	8.0	8.3	6.3	7.0	6.7	7.0	7.0	7.1
STELLAR (CIS-PR-72)	8.3	7.7	8.0	7.7	7.0	6.7	6.7	7.3	7.3	7.1
SUMMERSET (MB 413)	8.7	7.7	8.0	8.0	7.3	6.0	6.7	7.3	7.3	7.1
SUPERSTAR (EP57)	8.0	6.7	7.3	8.0	6.3	7.0	6.7	7.3	7.0	7.1
TERRADYNE (A5C)	8.7	8.0	8.0	8.0	6.7	6.7	7.0	7.3	7.0	7.1
UT-1000 (ABT-99-4.709)	8.7	7.0	8.0	8.3	7.0	5.7	7.0	7.3	7.3	7.1
ABT-99-4.600	7.3	8.0	8.0	7.7	7.0	6.7	7.0	6.7	7.0	7.0
ABT-99-4.721	8.0	7.0	8.0	8.0	7.0	6.0	7.0	7.0	7.0	7.0
AFFIRMED	8.0	7.7	8.0	7.3	7.0	6.3	6.7	7.3	7.3	7.0
APR 1237	7.3	7.0	8.0	7.3	7.3	6.7	6.7	7.0	7.0	7.0
CALYPSO II	8.3	7.3	8.0	8.3	7.3	6.3	6.3	6.7	7.0	7.0
CAS-LP84	8.0	7.3	8.0	8.3	7.0	6.3	6.3	7.0	7.0	7.0
CATALINA II (PST-CATS)	8.0	7.7	8.0	8.3	6.7	6.0	7.0	7.0	7.0	7.0
FIESTA 3	7.7	7.7	8.0	7.0	7.0	6.3	7.0	7.3	7.3	7.0
MP103	8.0	7.0	7.5	7.0	7.0	6.5	6.7	7.5	7.5	7.0
PARADIGM (APR 1236)	7.7	7.3	8.0	7.3	7.0	7.0	6.7	7.0	7.0	7.0
PICK PR QH-97	8.3	7.3	8.0	8.0	6.7	5.7	7.0	7.3	7.3	7.0
PROMISE	7.7	7.0	8.0	7.3	6.7	6.7	7.0	7.3	7.0	7.0
PST-2JH	7.7	7.3	8.0	7.7	7.3	6.3	6.3	7.3	7.0	7.0
RADIANT	8.3	7.0	8.0	8.0	6.3	6.0	6.7	7.7	7.3	7.0
ADMIRE (JR-151)	7.7	6.7	8.0	8.0	7.3	6.3	6.3	7.0	6.7	6.9
APR 1232	7.3	7.0	8.0	7.3	6.7	6.7	6.7	6.7	7.7	6.9
APR 1233	7.3	7.3	8.0	7.0	7.3	6.7	6.3	7.0	7.0	6.9
APR 1234	7.0	7.7	8.0	7.0	7.3	6.7	6.7	7.0	7.0	6.9
CHARGER II	8.0	8.0	8.0	7.0	6.3	7.0	6.7	7.0	7.3	6.9

Perennial Ryegrass Cultivar	GREENUP	GENCOLOR	LEAFTEX	MAY	JUN	JUL	AUG	SEP	OCT	MEAN
CIS-PR-75	8.0	7.7	8.0	8.0	6.0	6.0	6.7	7.7	7.0	6.9
DIVINE	8.3	7.0	8.0	8.0	7.0	5.7	6.3	7.3	7.3	6.9
DP LP-1	7.3	7.3	7.7	7.0	7.0	6.7	6.3	7.3	7.3	6.9
EXACTA	8.3	7.0	8.0	8.0	6.7	6.3	6.3	7.0	7.0	6.9
MAJESTY	7.7	7.0	7.3	7.3	7.3	6.0	6.7	7.3	7.0	6.9
PREMIER	7.0	7.0	8.0	7.7	7.0	6.0	6.3	7.3	7.0	6.9
SALINAS (PST-2SLX)	8.0	7.3	7.3	8.0	7.0	5.7	7.0	7.0	7.0	6.9
ABT-99-4.339	7.3	7.3	8.0	7.7	7.3	6.0	6.3	6.7	6.7	6.8
ABT-99-4.815	8.0	7.0	8.0	7.7	7.0	6.3	6.3	7.0	6.7	6.8
BUCCANEER	7.0	6.7	8.0	7.0	7.0	5.7	6.3	7.3	7.3	6.8
BY-100	7.0	7.0	8.0	7.3	7.0	6.0	6.3	7.0	7.3	6.8
CATHEDRAL II	7.7	8.0	8.0	7.7	7.3	6.0	6.0	7.0	7.0	6.8
LINE DRIVE	7.7	7.0	8.0	7.3	7.0	6.3	6.3	7.0	7.0	6.8
LPR 98-143	7.0	7.0	6.7	7.0	7.3	6.3	6.0	7.0	7.0	6.8
NEXUS	8.7	7.3	7.7	8.0	6.7	6.3	6.3	7.0	6.7	6.8
PICK PR B-97	8.0	7.3	8.0	7.7	6.7	5.7	6.7	7.3	7.0	6.8
PROWLER (APR 777)	7.0	7.0	7.7	7.3	7.0	7.0	5.7	7.0	7.0	6.8
SR 4500	7.7	7.3	8.0	7.7	7.3	6.0	6.3	7.0	6.7	6.8
AFFINITY	7.0	7.3	7.7	7.0	7.0	7.0	6.3	6.3	6.7	6.7
APR 1235	7.0	7.7	7.7	6.7	7.0	7.0	6.3	6.7	6.7	6.7
DP 17-9069	7.0	7.0	8.0	6.7	7.3	6.7	6.0	6.7	6.7	6.7
EP53	8.0	7.3	8.0	7.3	6.7	6.0	7.0	6.7	6.7	6.7
EXTREME (JR-317)	7.7	7.0	8.0	7.3	7.0	5.0	6.7	7.3	6.7	6.7
MEPY	7.3	7.0	8.0	7.0	6.3	6.0	6.7	7.3	7.0	6.7
PASSPORT	7.7	7.3	8.0	7.3	7.0	6.0	6.3	7.0	6.7	6.7
PICK EX2	7.0	7.3	8.0	7.3	7.3	5.7	6.3	6.7	6.7	6.7
PICK PR 1-94	7.0	7.0	8.0	7.3	7.0	5.7	6.3	7.0	7.0	6.7
SECRETARIAT	7.0	7.0	8.0	7.0	6.7	6.0	6.3	7.0	7.0	6.7
SRX 4120	7.3	7.3	8.0	7.0	7.0	6.0	5.7	7.0	7.3	6.7
WVPB-R-82	6.0	7.3	8.0	6.7	7.3	6.7	5.7	6.7	7.0	6.7
KOOS R-71	7.0	7.0	7.7	6.3	6.7	6.3	6.0	6.7	7.7	6.6
WVPB-R-84	7.3	7.0	8.0	7.3	7.3	6.0	6.0	6.3	6.3	6.6
EDGE	7.0	6.7	8.0	6.7	7.0	5.7	5.7	6.7	6.3	6.3
YATSUGREEN	7.3	6.7	7.3	6.7	7.7	6.0	5.3	6.0	6.0	6.3
DP 17-9391	6.3	7.3	7.3	5.7	6.7	6.7	5.3	6.3	6.3	6.2
DP 17-9496	6.3	6.0	7.0	6.0	7.7	6.0	5.0	5.3	6.0	6.0
LINN	6.0	6.0	6.0	3.0	5.7	5.7	4.7	5.3	7.0	5.2
LSD	1.0	1.1	0.5	0.9	2.4	1.7	0.9	1.0	1.1	0.6

2001 Tall Fescue Cultivar Trial

Shui-zhang Fei and Rodney A. St. John

This is the first full year of the tall fescue trial that 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 the regional adaptation of 160 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".

The visual quality was evaluated monthly in 2002 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 2002 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. Percent fall ground coverage following establishment (GRCOVFAL) was collected in the fall of 2001 on a scale of 100% to 0%, with 100% = fully covered and 0% = bare ground.

Table 1. Visual ratings on turfgrass quality, genetic color, leaf texture, and ground coverage following establishment for 2001 National Tall Fescue Cultivar Trial in Ames, IA.

				Quality						
Tall Fescue Cultivar	**GRCOVFAL**	**GENCOLOR**	**LEAFTEX**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
		9-1; 9 Best								
MILLENNIUM	46.7	6.7	6.7	8.3	7.3	5.0	6.3	7.0	7.0	6.8
FOCUS	45.0	7.0	7.0	8.0	7.0	5.3	5.7	6.7	6.7	6.6
GRANDE II	41.7	7.0	7.3	8.0	6.7	5.3	6.0	6.3	6.3	6.4
ATF 704	41.7	7.0	6.7	7.0	6.3	5.7	7.0	6.0	6.0	6.3
ATF-800	40.0	6.7	7.0	7.3	7.0	5.3	6.0	6.0	6.0	6.3
CIS-TF-65	38.3	7.0	7.0	7.0	6.7	5.3	6.0	6.3	6.3	6.3
LEGITIMATE	48.3	6.0	6.3	7.3	6.7	5.7	6.7	5.7	6.0	6.3
LTP-7801	48.3	6.7	7.0	7.0	6.0	5.0	6.7	6.7	6.3	6.3
NJ4	40.0	6.7	6.7	7.3	7.0	5.3	5.7	6.3	6.3	6.3
TAR HEEL	50.0	6.7	6.3	7.7	6.7	5.0	5.3	6.7	6.7	6.3
TEMPEST	41.7	7.0	6.7	8.0	7.0	5.3	6.0	5.7	5.7	6.3
JAGUAR 3	38.3	7.0	6.7	8.0	6.0	5.3	6.0	6.0	6.0	6.2
R-4	46.7	7.0	7.0	7.7	6.7	4.7	6.0	6.0	6.0	6.2
SCORPION	45.0	7.0	7.0	7.3	6.7	5.0	5.7	6.3	6.3	6.2
WYATT	45.0	6.3	7.3	8.0	6.3	5.0	6.0	6.0	6.0	6.2
CIS-TF-33	38.3	7.0	7.0	7.3	6.3	5.0	6.0	6.0	6.0	6.1
PICK TF H-97	45.0	7.3	7.3	6.7	5.7	5.0	6.7	6.3	6.0	6.1
PICK-OD3-01	46.7	7.3	6.7	7.3	6.7	5.0	6.3	5.7	5.7	6.1
PST-5BAB	35.0	7.0	6.0	7.3	6.3	5.0	6.0	6.0	6.0	6.1
QUEST	50.0	6.7	7.0	7.0	6.0	5.3	6.0	6.0	6.0	6.1
TITAN LTD.	45.0	6.3	7.0	7.3	6.3	5.3	6.0	6.0	5.7	6.1
BAR FA 1005	31.7	7.0	6.3	7.0	6.7	4.7	5.7	6.0	6.0	6.0
BARLEXAS	41.7	6.7	7.0	7.3	6.3	5.0	6.0	5.7	5.7	6.0
F-4	50.0	7.0	7.3	7.3	6.0	4.7	6.0	6.0	6.0	6.0
PICASSO	36.7	7.3	7.0	7.0	6.0	4.7	5.7	6.3	6.3	6.0
BONSAI	38.3	6.3	6.7	6.7	6.3	5.0	6.0	5.7	5.7	5.9
DLF-J210	41.7	7.0	6.3	7.3	6.0	4.7	5.7	6.0	6.0	5.9
FINESSE II	46.7	7.3	7.0	6.7	7.0	5.0	5.7	5.7	5.7	5.9
JTTFF-2000	30.0	7.3	6.7	7.0	6.3	4.7	5.7	6.0	6.0	5.9
K01-E09	38.3	7.3	7.3	7.0	6.7	4.7	6.0	5.7	5.7	5.9
PST-5BZ	43.3	7.0	6.3	6.3	6.3	5.0	5.3	6.3	6.3	5.9
UT-155	41.7	7.3	6.7	6.7	6.7	4.7	6.0	5.7	5.7	5.9
UT-RB3	41.7	7.3	6.7	6.7	6.3	5.0	6.0	5.7	5.7	5.9
`018	55.0	6.7	7.3	7.3	5.7	5.0	5.3	6.0	6.0	5.9
01-ORU1	40.0	7.0	7.3	7.0	6.0	5.0	5.7	5.7	5.7	5.8
01-TFOR3	41.7	7.0	6.7	7.7	6.0	4.3	5.7	5.3	5.7	5.8
2ND MILLENNIUM	46.7	7.0	6.3	7.3	5.0	4.7	6.0	6.0	6.0	5.8
MA 127	41.7	7.0	6.3	7.0	6.7	4.7	5.7	5.3	5.3	5.8

Tall Fescue Cultivar	GRCOVFAL	GENCOLOR	LEAFTEX	MAY	JUN	JUL	AUG	SEP	OCT	MEAN
MRF 211	45.0	7.7	7.0	6.3	6.3	4.3	5.7	6.0	6.0	5.8
SR 8600	43.3	6.7	7.0	6.7	6.3	5.0	5.7	5.7	5.7	5.8
TOMAHAWK RT	43.3	7.0	7.3	7.0	6.3	4.7	5.7	5.7	5.7	5.8
ATF-803	38.3	7.0	6.3	6.7	6.3	4.3	5.7	5.7	5.7	5.7
BINGO	41.7	7.0	7.0	7.0	5.3	4.3	5.3	6.0	6.0	5.7
BRAVO	40.0	7.0	6.7	6.3	6.0	5.0	5.3	5.7	5.7	5.7
CAS-ED	38.3	7.0	5.7	7.0	6.0	4.3	5.7	5.7	5.7	5.7
DLSD	35.0	7.3	6.7	6.7	5.7	4.7	5.7	5.7	5.7	5.7
DOMINION	56.7	6.3	6.7	6.3	6.0	4.7	5.7	5.7	5.7	5.7
MA 138	41.7	7.7	6.0	6.0	6.3	4.7	5.7	5.7	5.7	5.7
PST-578	45.0	6.7	7.0	6.7	5.3	4.7	5.7	6.0	6.0	5.7
REBEL EXEDA	41.7	7.0	7.0	6.3	5.7	5.0	5.7	5.7	5.7	5.7
SOUTHERN CHOICE II	40.0	7.3	6.3	6.3	6.0	4.7	6.0	5.7	5.7	5.7
SR 8250	53.3	7.0	7.0	6.7	5.7	4.3	5.7	6.0	6.0	5.7
WOLFPACK	46.7	6.3	7.0	7.3	5.0	4.7	5.7	5.7	5.7	5.7
BAR FA 1003	36.7	6.7	6.7	7.0	5.7	4.3	5.3	5.7	5.7	5.6
BARLEXAS II	46.7	7.7	7.0	6.3	5.3	4.7	5.7	5.7	5.7	5.6
BARRINGTON	36.7	7.3	6.7	6.7	6.0	4.3	5.7	5.3	5.3	5.6
DP 50-9082	45.0	6.0	7.0	6.7	5.7	4.3	6.0	5.3	5.3	5.6
DP 50-9226	41.7	6.3	7.0	6.3	5.7	4.3	6.0	5.7	5.7	5.6
ENDEAVOR	43.3	7.0	7.3	6.0	5.7	4.7	6.0	5.7	5.7	5.6
FALCON II	46.7	6.7	6.0	7.3	5.7	4.7	5.3	5.3	5.3	5.6
GO-FL3	56.7	6.0	6.7	6.3	6.0	4.7	6.0	5.3	5.3	5.6
MA 158	41.7	7.0	6.0	6.3	6.3	4.3	5.7	5.3	5.3	5.6
OLYMPIC GOLD	50.0	6.3	7.0	6.7	5.3	4.3	5.7	5.7	5.7	5.6
PLANTATION	45.0	7.0	7.0	6.7	5.3	4.3	5.3	6.0	6.0	5.6
PST-5ASR	38.3	6.7	6.7	5.3	6.0	5.0	5.7	5.7	5.7	5.6
SBM	48.3	7.7	6.7	6.7	5.7	4.3	5.3	5.7	5.7	5.6
SRX 805	51.7	7.0	6.7	7.0	5.3	4.7	5.3	5.7	5.7	5.6
ATF 706	38.3	7.7	6.0	6.3	5.7	4.3	5.3	5.7	5.7	5.5
BE1	38.3	7.3	7.0	6.7	6.0	4.3	5.3	5.3	5.3	5.5
GO-RD4	40.0	6.0	6.7	6.3	5.3	4.7	5.3	5.7	5.7	5.5
LANCER	55.0	7.0	7.0	6.0	5.7	4.3	5.7	5.7	5.7	5.5
MATADOR	36.7	7.3	6.3	6.0	6.0	4.3	5.3	5.7	5.7	5.5
MCN-RC	45.0	7.7	6.7	6.3	5.7	4.7	5.7	5.3	5.3	5.5
MRF 210	38.3	7.0	6.3	6.7	5.7	4.3	5.0	5.7	5.7	5.5
PROSEEDS 5301	45.0	7.0	6.3	6.7	5.3	4.3	5.5	5.7	5.7	5.5
PST-5LO	41.7	6.7	7.0	7.7	6.0	4.0	5.3	5.0	5.0	5.5
PST-5T1	43.3	6.7	6.7	6.0	6.0	4.3	5.3	5.7	5.7	5.5
RB2-01	46.7	7.0	7.3	6.0	5.3	4.3	6.0	5.7	5.7	5.5
01-RUTOR2	40.0	7.0	7.0	6.3	5.3	4.3	5.0	5.7	5.7	5.4
ATF-593	46.7	7.3	7.3	6.7	5.7	4.7	5.3	5.0	5.0	5.4
BE-2	35.0	7.0	7.0	6.3	5.7	4.3	5.3	5.3	5.3	5.4
CIS-TF-77	36.7	7.0	6.7	6.0	6.0	4.7	5.3	5.3	5.3	5.4
COYOTE	33.3	7.7	7.0	6.3	6.0	4.3	5.3	5.3	5.3	5.4
EA 163	35.0	7.3	7.0	6.7	5.3	4.3	5.3	5.3	5.3	5.4
ELISA	35.0	6.3	6.0	6.7	5.7	4.0	5.3	5.3	5.3	5.4
MRF 25	48.3	7.0	6.7	6.7	5.7	4.3	5.3	5.3	5.3	5.4
MRF 28	36.7	7.3	7.0	6.7	5.7	4.3	5.3	5.3	5.3	5.4
MUSTANG 3	38.3	7.0	6.7	6.7	5.7	4.3	5.3	5.3	5.3	5.4
P-58	36.7	7.0	6.3	6.0	6.0	4.3	5.3	5.3	5.3	5.4
PICK-00-AFA	43.3	6.7	7.0	6.7	5.3	4.7	5.3	5.3	5.3	5.4
PST-57E	51.7	6.7	7.0	6.0	5.0	4.7	5.7	5.7	5.7	5.4
PST-5KU	53.3	7.7	7.0	6.3	5.3	4.0	5.3	5.7	5.7	5.4
PST-5S12	46.7	7.0	6.7	6.0	5.7	4.3	5.7	5.3	5.3	5.4
PST-5TR1	40.0	7.0	6.0	6.3	5.3	4.3	5.7	5.3	5.3	5.4
REMBRANDT	33.3	7.0	6.3	7.0	5.0	4.3	5.3	5.3	5.3	5.4
ROBERTS SM4	36.7	7.0	6.7	6.7	5.3	4.3	5.3	5.3	5.3	5.4
STETSON	41.7	6.7	6.3	6.7	5.3	4.3	5.3	5.3	5.3	5.4
TRACER	36.7	7.3	6.7	6.3	6.0	4.3	5.3	5.3	5.3	5.4
ATF 702	38.3	7.7	7.0	6.3	5.7	4.0	5.0	5.7	5.3	5.3
B-7001	45.0	6.7	6.3	6.7	4.7	4.3	5.3	5.3	5.3	5.3
BARRERA	35.0	6.7	7.0	6.7	5.7	4.0	5.7	5.0	5.0	5.3
BILTMORE	40.0	7.0	6.3	6.3	5.3	4.0	5.3	5.3	5.3	5.3
CAS-157	31.7	7.0	6.0	6.0	5.7	4.3	5.3	5.3	5.3	5.3
CAYENNE	40.0	7.0	6.0	6.0	5.7	4.3	5.0	5.3	5.3	5.3
DAYTONA (MRF 23)	35.0	7.0	5.7	6.0	5.3	4.3	5.3	5.3	5.3	5.3
JT-18	31.7	7.3	7.0	6.7	5.3	4.0	5.3	5.3	5.3	5.3
JT-6	35.0	7.7	7.0	6.3	5.3	4.0	5.3	5.3	5.3	5.3

Tall Fescue Cultivar	GRCOVFAL	GENCOLOR	LEAFTEX	MAY	JUN	JUL	AUG	SEP	OCT	MEAN
MAGELLAN (OD-4)	35.0	7.7	6.3	6.0	5.7	4.3	5.0	5.3	5.3	5.3
MASTERPIECE	41.7	6.3	7.0	5.7	6.0	4.0	5.3	5.3	5.3	5.3
PICK ZMG	41.7	7.0	6.7	6.3	5.3	4.7	5.0	5.3	5.3	5.3
PST-5A1	41.7	6.3	6.7	6.7	5.3	4.3	5.0	5.3	5.3	5.3
PST-5JM	26.7	7.7	6.3	6.3	5.7	4.3	5.0	5.3	5.0	5.3
PST-5NAS	38.3	7.0	7.0	7.3	4.7	4.0	5.0	5.3	5.3	5.3
PST-DDL	38.3	7.3	7.0	7.3	5.3	4.0	5.3	5.0	5.0	5.3
REBEL SENTRY	36.7	7.3	6.0	5.7	5.3	4.3	5.3	5.3	5.7	5.3
ROBERTS-L1Z	38.3	7.3	7.0	6.0	5.3	4.3	5.7	5.3	5.3	5.3
CIS-TF-60	45.0	7.3	7.0	6.0	5.0	4.3	5.7	5.0	5.0	5.2
CIS-TF-67	41.7	7.3	7.0	6.3	4.7	4.0	5.3	5.3	5.3	5.2
JT-99	53.3	6.7	7.3	6.0	5.0	4.0	5.3	5.3	5.3	5.2
K01-8007	50.0	7.0	7.0	6.0	5.7	4.0	5.3	5.0	5.0	5.2
KITTY HAWK 2000	43.3	6.7	6.7	6.7	5.0	4.3	5.3	5.0	5.0	5.2
PROSPECT	41.7	7.0	6.7	6.3	5.3	4.0	5.0	5.3	5.3	5.2
PST-5FZD	43.3	7.0	6.7	6.7	4.7	4.0	5.3	5.3	5.3	5.2
PST-5KI	36.7	7.3	7.0	5.3	5.7	4.3	5.0	5.3	5.3	5.2
SRX 8BE4	35.0	7.3	7.3	6.0	5.3	4.3	5.3	5.0	5.0	5.2
WATCHDOG	36.7	7.0	6.7	6.0	5.7	4.0	5.3	5.0	5.0	5.2
ATF 799	35.0	7.0	6.7	5.3	5.3	4.0	5.3	5.3	5.3	5.1
ATF 802	35.0	7.3	7.3	5.7	5.3	4.0	5.0	5.0	5.3	5.1
CIS-TF-64	33.3	7.3	6.7	5.3	5.0	4.0	5.3	5.3	5.3	5.1
JT-13	40.0	7.3	7.3	6.0	5.3	4.0	5.0	5.0	5.0	5.1
JT-9	33.3	7.0	6.7	6.3	4.7	4.0	5.0	5.3	5.3	5.1
K01-WAF	48.3	7.0	6.3	6.0	4.7	4.3	5.0	5.3	5.3	5.1
MRF 26	36.7	7.3	6.7	6.0	5.3	4.0	5.7	4.7	4.7	5.1
RENDITION	35.0	6.7	7.0	6.3	5.0	4.3	5.0	5.0	5.0	5.1
T991	30.0	7.0	6.3	6.3	5.0	4.0	5.0	5.0	5.0	5.1
CAS-MC1	38.3	7.3	6.3	5.7	5.0	4.3	5.0	5.0	5.0	5.0
JT-12	36.7	7.3	7.0	5.3	5.7	4.0	5.0	5.0	5.0	5.0
K01-8015	35.0	7.3	6.7	6.0	4.7	4.0	5.3	5.0	5.0	5.0
MRF 29	33.3	7.7	7.0	5.7	5.0	4.0	5.0	5.0	5.3	5.0
ROBERTS DOL	33.3	7.3	6.7	5.7	5.7	4.0	4.7	5.0	5.0	5.0
TF66	38.3	7.0	6.7	6.0	5.3	4.0	4.7	5.0	5.0	5.0
ATF 707	40.0	7.3	6.0	5.7	5.0	4.0	5.0	5.0	5.0	4.9
DYNASTY	31.7	7.3	6.3	5.7	4.7	4.0	4.7	5.3	5.3	4.9
GO-SIU2	43.3	6.7	6.7	6.3	4.7	4.0	4.7	5.0	5.0	4.9
JT-15	23.3	7.0	7.3	5.7	4.7	4.7	5.0	4.7	4.7	4.9
K01-E03	30.0	7.3	7.0	5.7	5.3	4.0	4.7	5.0	5.0	4.9
KALAHARI	40.0	7.0	7.0	6.0	4.3	4.0	5.0	5.0	5.0	4.9
MRF 24	35.0	7.3	6.0	5.7	4.7	4.3	4.3	5.0	5.3	4.9
NA-TDD	38.3	7.7	7.0	6.0	4.3	4.0	5.0	5.0	5.0	4.9
PST-5TUO	36.7	7.0	7.0	6.0	4.7	4.0	5.0	5.0	5.0	4.9
IGNIA	38.3	7.7	6.7	5.7	5.3	4.0	4.7	5.0	5.0	4.9
BAR FA 1CR7	33.3	8.0	7.3	5.3	5.0	3.7	5.0	5.0	5.0	4.8
GO-OD2	35.0	7.3	6.3	5.7	4.7	4.0	4.7	5.0	5.0	4.8
LARAMIE	38.3	7.0	6.7	5.7	4.7	4.0	5.0	4.7	5.0	4.8
PURE GOLD	40.0	7.0	6.7	6.0	4.7	4.0	4.7	4.7	4.7	4.8
ATF 806	33.3	7.3	7.0	5.3	4.7	4.0	5.0	4.7	4.7	4.7
MRF 27	43.3	7.3	7.3	5.7	5.0	4.0	4.3	4.7	4.7	4.7
PST-53T	36.7	8.0	6.7	5.7	5.3	3.3	4.0	4.7	5.0	4.7
ATF 586	36.7	7.0	7.3	4.7	4.7	4.0	4.3	5.0	5.0	4.6
KY-31 E+	40.0	4.0	4.7	6.0	5.0	3.0	3.7	3.7	3.7	4.2
LSD	34.2	1.2	1.0	3.1	5.9	2.7	2.3	1.7	1.7	1.8

1998 Fine Fescue Cultivar Trial

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

This was the fourth full year of data from the 1998 Fineleaf Fescue National Turfgrass Evaluation Program (NTEP) trial. It is being conducted at many locations around the U.S. The purpose of the trial is to study the regional adaptation of 79 fineleaf fescue selections. Cultivars are evaluated for quality each month of the growing season through October. The study is conducted in full sun. The plot size for each cultivar was 3 x 5 ft (15ft^2). The plots were randomly arranged and replicated three times and were established in October 1998. The trial has been maintained at a 2-inch mowing height, fertilized with 3.5 lbs N/1000 ft^2 during the growing season, and has been irrigated when needed to prevent drought. Preemergent herbicide was applied once in the spring of each year.

The visual quality was evaluated monthly in 2002 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 2002 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 data were taken in April 2002 and were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf.

This trial will be replaced with a new Fine Fescue Cultivar Trial in the Fall of 2003.

Table 1. The 2002 visual quality and other turf attribute ratings for cultivars in the 1998 Fineleaf Fescue Cultivar Trial.

				Quality						
Fine Fescue Cultivar	**GREENUP**	**GENCOLOR**	**LEAFTEX**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
	9-1; 9 Best									
ABT-HF1	6.0	7.7	7.0	6.3	8.0	7.3	7.0	7.0	6.7	7.1
SRX3961	6.7	7.7	7.7	5.7	7.7	7.7	7.0	7.3	6.0	6.9
BERKSHIRE(4001)	6.3	7.7	7.0	6.3	7.3	7.3	6.3	7.0	6.7	6.8
CHARIOT(CISFL12)	6.0	7.3	7.3	6.3	7.7	7.7	6.0	6.3	7.0	6.8
NORDIC(E)	6.7	8.3	7.7	6.3	8.3	7.7	6.0	6.3	5.3	6.7
OXFORD	6.0	8.0	7.3	6.0	7.3	7.0	6.3	7.0	6.3	6.7
PST-4HM	7.0	8.0	6.7	6.7	7.3	7.3	6.3	6.7	5.7	6.7
RELIANTII	6.0	8.0	6.7	6.0	7.3	7.3	6.7	6.3	6.7	6.7
ABT-HF-2	5.3	7.3	6.3	6.3	7.0	7.7	6.3	6.0	6.0	6.6
DISCOVERY	5.3	7.7	7.3	6.3	7.3	7.3	6.3	6.3	6.0	6.6
OSPREY	4.3	7.7	6.7	6.0	8.0	6.7	6.7	6.3	6.0	6.6
PICKFFA-97	5.7	7.3	6.7	6.3	7.0	7.7	6.0	6.0	6.0	6.5
EUREKAII(CISFL11)	5.0	7.0	6.7	6.3	7.0	6.7	6.0	6.0	6.3	6.4
SALSA	6.3	7.3	7.0	5.3	6.3	5.3	7.7	7.0	6.7	6.4
SCALDISII(AHF008)	5.0	7.0	6.3	5.7	7.0	7.3	6.0	6.7	6.0	6.4
DEFIANT	6.3	7.7	6.7	6.3	6.3	6.7	6.3	6.0	6.0	6.3
HARDTOP(BARHF8FUS)	6.0	7.3	7.0	6.0	7.3	6.3	5.7	6.0	6.3	6.3
PST-4MB	4.3	6.0	6.0	6.7	6.3	6.3	6.3	6.0	6.0	6.3
SCALDIS	6.0	6.7	6.3	6.0	7.0	6.7	6.0	6.3	6.0	6.3
STONEHENGE(AHF009)	6.0	7.3	6.7	6.0	6.7	6.0	6.7	6.3	6.3	6.3
ABT-HF-3	5.0	6.0	6.0	6.0	6.7	6.3	6.0	6.0	6.3	6.2
MB-82	5.0	7.7	7.3	5.7	7.3	6.3	5.7	6.0	6.3	6.2
ABT-CR-2	6.0	6.0	6.7	5.7	6.0	5.3	7.0	6.0	6.3	6.1
ABT-HF-4	4.0	6.0	6.3	6.3	6.3	6.7	6.0	5.3	6.0	6.1
ATTILAE	6.3	7.7	6.3	5.3	6.7	7.0	6.0	6.3	5.3	6.1
MINOTAUR	4.7	6.0	6.0	6.0	6.3	6.7	5.7	5.7	6.0	6.1
PST-4FR	6.0	6.7	6.3	5.3	6.0	5.3	7.0	6.3	6.0	6.0
SRX52961	6.0	6.3	6.7	5.7	5.3	5.7	6.7	6.3	6.3	6.0
WRIGLEY(ACF092)	7.0	6.0	7.0	5.7	5.7	5.7	6.7	6.3	6.0	6.0
LONGFELLOWII	5.7	5.7	6.7	6.0	5.7	5.3	6.3	6.0	6.0	5.9

ABT-CHW-3	5.0	7.0	7.0	6.0	5.7	5.3	6.0	5.7	6.0	5.8
Fine Fescue Cultivar	**GREENUP**	**GENCOLOR**	**LEAFTEX**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
AMBASSADOR	6.3	6.3	7.0	6.3	6.0	5.3	5.7	5.7	5.7	5.8
BIGHORN	5.0	6.0	6.3	5.7	6.3	5.7	5.7	5.3	6.0	5.8
PATHFINDER	6.3	6.3	6.7	5.7	5.0	5.3	6.7	5.7	6.3	5.8
ABERDEEN(PST-EFL)	6.3	7.0	6.7	4.7	6.0	5.3	7.0	5.3	6.0	5.7
ABT-CR-3	6.0	6.0	7.0	5.0	5.7	4.7	6.7	6.3	6.0	5.7
CINDYLOU(CISFRR7)	5.0	6.3	6.3	5.0	6.0	5.3	6.7	6.0	5.3	5.7
DGSC94	6.3	6.3	6.7	5.7	5.0	4.7	6.7	6.0	6.0	5.7
JASPERII	5.7	6.0	6.7	5.0	5.0	5.0	6.7	6.3	6.3	5.7
TREAZURE(E)	7.3	6.7	6.7	5.0	5.3	5.3	6.3	5.7	6.3	5.7
BRIDGEPORT	5.7	5.3	6.7	4.3	5.7	6.0	5.7	5.7	6.0	5.6
INTRIGUE	4.7	6.7	6.7	4.7	5.7	5.3	6.7	5.7	5.7	5.6
JAMESTOWNII	6.0	6.3	6.7	5.3	6.0	5.3	6.0	5.7	5.3	5.6
MAGIC	5.0	6.0	6.7	5.7	6.0	5.0	5.7	5.7	5.3	5.6
NAVIGATOR(CISFRR5)	5.3	6.7	7.0	4.7	5.0	5.0	7.0	5.7	6.3	5.6
QUATRO	5.7	7.3	7.3	5.7	6.3	6.0	5.3	5.0	5.3	5.6
ROSE(ASC087)	6.3	7.0	6.0	5.0	5.3	4.7	6.3	5.7	6.3	5.6
SHADEMASTERII	6.0	6.7	6.7	5.0	5.0	5.0	6.7	5.7	6.0	5.6
SR3200	5.3	6.0	6.0	5.3	6.0	5.7	5.3	6.0	5.3	5.6
SR5100	6.3	5.7	6.7	5.7	5.0	5.7	5.7	5.7	5.7	5.6
ABT-CHW-1	6.7	6.0	7.0	6.0	5.0	5.3	5.7	5.3	5.7	5.5
ASC172	4.0	6.0	6.0	6.0	5.7	4.7	5.7	5.3	5.7	5.5
BARCHF8FUS2	5.7	5.7	6.3	5.3	4.7	5.0	7.0	5.0	6.0	5.5
CULOMBRA	5.3	6.0	7.3	5.0	6.0	5.3	6.0	5.0	5.7	5.5
INVERNESS(PST-47TCR)	4.7	6.0	6.3	5.0	5.3	4.0	6.3	6.0	6.3	5.5
ABT-CHW-2	4.7	6.3	6.7	5.3	5.7	5.3	5.3	5.3	5.7	5.4
ACF083	7.0	5.7	6.7	5.7	4.7	5.0	6.7	5.0	5.7	5.4
ASR049	5.3	6.7	6.7	4.3	4.3	5.0	5.7	6.0	7.3	5.4
BARGENAIII(BARCF8FUS1)	6.0	6.0	6.3	4.3	4.7	4.3	6.7	6.3	6.3	5.4
BOREAL	4.0	6.0	6.3	5.0	5.0	4.3	6.7	5.3	6.0	5.4
COMMONCREEPINGRED	4.7	7.0	6.0	4.3	5.7	5.0	6.7	5.0	5.7	5.4
FLORENTINE	5.0	5.3	6.3	4.7	4.7	4.3	7.0	6.0	6.0	5.4
MB-63	7.0	5.7	6.7	5.7	5.0	5.0	5.7	5.3	5.7	5.4
RESCUE911	4.7	7.0	7.0	5.3	6.0	5.3	5.0	5.0	6.0	5.4
SEABREEZE	7.0	6.7	6.0	4.3	5.0	5.0	6.3	5.3	6.7	5.4
SHADOWII	7.0	6.3	7.0	5.7	5.0	5.0	5.7	5.7	5.7	5.4
TIFFANY	6.3	6.0	7.0	4.7	5.0	5.3	5.7	6.0	6.0	5.4
DAWSONE+	4.7	6.7	7.0	4.3	5.0	4.3	5.7	6.0	6.7	5.3
SR5210(SRX52LAV)	6.0	6.0	6.0	5.3	4.7	4.3	6.3	5.3	5.7	5.3
ASC08	5.7	6.0	6.0	5.0	5.0	4.3	5.7	5.7	5.7	5.2
BARSCF8FUS3	4.7	6.7	7.0	4.3	5.0	4.3	6.0	5.3	6.0	5.2
PICKFRCA-93	5.3	5.7	7.0	5.3	4.7	5.3	5.3	5.3	5.3	5.2
SILHOUETTE(PICKFRC4-92)	5.0	6.3	6.7	5.0	5.0	5.3	5.0	5.3	5.3	5.2
BRITTANY	4.7	6.3	7.0	5.7	5.7	4.7	4.7	4.7	5.3	5.1
HERON	5.7	5.7	6.7	4.7	5.0	4.7	4.7	5.3	6.0	5.1
SANDPIPER	6.0	6.0	6.0	4.0	4.7	4.7	6.0	6.3	5.0	5.1
SHADEMARK	6.3	5.3	6.7	5.0	4.7	4.0	6.3	5.0	5.7	5.1
BANNERIII	6.0	6.0	6.7	5.0	4.3	4.7	4.7	4.7	5.3	4.8
SR6000	3.0	7.0	4.7	4.7	4.7	4.0	4.3	4.0	4.3	4.3
LSD	2.7	0.9	1.2	1.1	1.0	1.1	1.7	1.9	2.1	0.6

1998 Fairway Height Bentgrass Cultivar Trial

N.E. Christians and Rodney St. John

This is the fourth full year of data from the fairway height bentgrass Cultivar trial established in the fall of 1998. The area was maintained at a 0.5 in. mowing height. This is a National Turfgrass Evaluation (NTEP) trial and is being conducted at several research stations in the U.S. It contains 26 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 also are applied as needed.

The visual quality was evaluated monthly in 2002 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 2002 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 2002 and were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf. This trial will be replaced with a new fairway height bentgrass trial in 2003.

Table 1. The 2002 ratings for cultivars in the 1998 Fairway Height Bentgrass Trial

				Quality						
Bentgrass Cultivar	**GREENUP**	**GENCOLOR**	**LEAFTEX**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
	9-1; 9 Best									
IMPERIAL	7.3	6.3	7.0	7.0	7.3	8.0	8.3	8.3	7.0	7.7
BRIGHTON (SRX 1120)	7.0	6.0	7.3	5.7	6.7	7.3	8.0	8.7	8.3	7.4
PENN G-6	6.7	7.0	7.0	6.0	7.3	6.7	7.7	8.3	8.0	7.3
CENTURY	7.0	7.3	7.3	6.3	7.0	6.7	7.3	8.0	7.3	7.1
GRAND PRIX	6.7	6.7	7.0	6.3	7.0	7.3	7.0	7.0	8.0	7.1
PST-0VN	6.0	6.7	6.7	5.7	7.0	7.7	7.3	7.3	7.7	7.1
SRX 1BPAA	5.3	6.7	7.0	6.0	6.0	7.0	7.7	8.0	7.3	7.0
BACKSPIN	7.3	6.7	7.0	6.0	6.0	6.7	7.7	7.7	7.7	6.9
L-93	6.0	7.0	7.3	5.7	7.0	6.3	7.7	8.0	7.0	6.9
PENNCROSS	5.7	6.7	6.3	6.3	8.0	7.0	7.0	6.0	6.3	6.8
TRUELINE	6.0	6.7	6.3	6.0	5.3	5.7	7.3	8.3	8.0	6.8
SEASIDE II	6.3	6.3	6.7	5.0	5.3	6.7	8.3	7.0	8.0	6.7
SR 1119	6.7	6.7	6.3	5.7	5.7	6.3	7.3	7.7	7.3	6.7
PROVIDENCE	5.7	6.0	6.0	5.0	4.3	6.0	7.3	7.7	8.0	6.4
PENNEAGLE	6.3	7.3	7.3	5.0	7.3	5.7	6.0	7.0	6.0	6.2
PRINCEVILLE	6.0	6.7	6.7	5.3	6.7	6.0	6.7	6.0	6.7	6.2
GLORY (PST-9HG)	5.3	7.0	6.7	5.3	5.7	5.3	5.0	5.0	6.0	5.4
GOLFSTAR	5.0	7.0	6.0	5.0	4.0	5.7	5.7	6.0	5.7	5.3
PST-9PM	4.7	6.3	6.3	5.3	4.0	4.7	5.7	5.3	5.7	5.1
ABT-COL-2	4.7	6.7	7.0	4.7	5.0	4.3	5.7	4.7	5.3	4.9
SRX 7MOBB	5.3	7.0	7.3	4.7	4.3	4.7	5.0	4.7	6.0	4.9
TIGER	4.3	7.0	7.3	5.0	4.3	4.3	4.7	5.0	5.3	4.8
SRX 7MODD	4.3	7.0	7.0	4.3	3.7	5.0	4.7	4.3	5.3	4.6
SR 7100	5.0	7.0	6.0	4.7	4.0	4.0	4.7	5.0	4.7	4.5
TIGER II (CIS AT-5)	5.3	6.7	5.7	5.0	4.0	4.3	4.7	4.0	5.0	4.5
SEASIDE	4.7	6.0	6.3	3.7	4.0	4.3	4.3	4.3	4.7	4.2
LSD	1.9	2.3	2.9	0.9	1.2	1.8	1.4	1.6	1.2	0.8

1998 Green Height Bentgrass Cultivar Trial

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

This is the fifth year of data from the green height bentgrass trial established in the fall of 1998. 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 29 seeded cultivars, including a number of experimentals. Most of the plots are creeping bentgrass , but two, Pick MVB and Bavaria, 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 ft^2/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 2002 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 2002 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 spring greenup (Greenup) and for genetic color (Gencolor) were also collected in April 2002 and June 2002, respectively. Spring greenup data were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green. This trial will be replaced with a new green height bentgrass trial in 2003.

Table 1. The 2002 visual ratings for cultivars in the 1998 Green Height Bentgrass Trial.

			Quality						
Bentgrass Cultivar	**GENCOLOR**	**GREENUP**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**MEAN**
	9-1; 9 Best								
CENTURY	6.7	6.3	6.0	7.0	8.0	8.3	7.7	7.7	7.4
IMPERIAL	7.0	6.7	5.3	7.0	8.0	8.3	6.3	8.0	7.2
PENN G-6	6.7	6.3	6.0	6.7	7.0	8.0	8.0	7.7	7.2
BENGAL (BAR AS 8FUS2)	7.0	7.7	6.0	7.7	6.7	8.0	6.7	7.7	7.1
L-93	7.7	5.7	6.3	7.7	7.3	7.0	7.0	7.3	7.1
CRENSHAW	7.3	6.7	6.0	7.3	6.7	7.3	7.0	7.7	7.0
ABT-CRB-1	6.3	6.7	5.7	6.3	7.0	8.0	6.7	8.0	6.9
PENN A-1	6.3	7.3	4.7	6.0	7.0	8.3	7.3	8.3	6.9
PENN A-2	7.0	6.3	5.7	7.0	6.3	8.3	6.3	8.0	6.9
PENN A-4	7.0	6.0	5.3	6.3	7.7	8.3	7.0	7.0	6.9
SYN 96-1	7.3	7.0	5.7	7.7	7.0	7.3	6.3	7.7	6.9
SYN 96-2	7.3	7.7	6.3	6.7	7.0	6.7	7.3	7.3	6.9
PST-A2E	7.3	6.7	5.3	6.3	7.0	7.3	7.3	7.7	6.8
SRX 1NJH	6.7	6.0	5.3	7.0	7.7	7.3	6.7	7.0	6.8
BAR CB 8US3	6.3	6.0	5.3	6.0	6.7	7.7	7.0	7.7	6.7
PENN G-1	7.3	5.7	5.7	6.7	6.7	7.0	6.7	7.3	6.7
BRIGHTON (SRX 1120)	6.3	5.7	5.0	5.7	6.7	7.7	6.7	7.7	6.6
ISI AP-5	6.3	5.7	5.7	6.0	6.7	7.0	6.3	7.7	6.6
SR 1119	6.7	5.7	5.7	6.7	6.7	7.3	6.7	6.7	6.6
SYN 96-3	6.3	7.0	6.7	6.3	6.3	7.0	6.7	6.3	6.6
PICK CB 13-94	7.0	6.0	4.7	6.3	6.7	7.0	6.3	7.0	6.3
PROVIDENCE	6.3	6.0	4.7	5.3	6.3	7.0	7.3	7.3	6.3
SRX 1BPAA	6.7	5.7	5.0	5.7	6.7	6.7	6.7	6.7	6.2
BACKSPIN	6.3	6.0	5.0	6.3	6.0	6.3	6.0	6.3	6.0
PENNLINKS	6.7	5.7	4.7	5.3	6.3	6.7	5.0	6.0	5.7
BAVARIA (Velvet bent)	6.3	4.0	4.7	4.7	5.7	5.7	5.0	5.7	5.2
PENNCROSS	6.0	5.0	4.3	5.3	5.0	5.3	5.0	5.7	5.1
VESPER (PICK MVB) (Velvet bent)	6.3	5.3	4.3	4.3	4.7	5.3	6.0	6.0	5.1
SR 7200	6.7	4.3	4.3	4.3	5.0	5.3	5.0	5.3	4.9
LSD	2.4	1.5	1.1	1.2	1.2	1.7	1.3	1.3	0.6

1999 Fairway Height Bluegrass Trial

Nick Christians and Luke Dant

The fairway height Kentucky bluegrass trial was established in Sept. 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.

Table 1. Visual quality [1] for cultivars in the 2002 non-irrigated fairway high Kentucky bluegrass cultivar trial.

	Quality						
Kentucky Bluegrass Cultivar	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Mean**
	9-1; 9 Best						
Award	6.3	8.0	5.7	4.3	6.0	5.7	6.0
Bluechip	5.7	5.3	6.0	5.7	6.0	6.7	5.9
Sure Shot Mix [2]	6.0	7.3	5.0	4.7	6.3	6.0	5.9
Absolute	6.7	7.3	4.7	4.3	5.7	6.0	5.8
Midnight	6.3	7.3	4.7	4.7	5.7	5.7	5.7
Total Eclipse	6.3	7.7	4.0	5.0	5.3	6.0	5.7
Rugby II	6.0	7.0	4.3	5.7	5.0	5.7	5.6
Bluemoon	5.3	6.7	4.7	4.7	5.3	6.0	5.4
Nuglade	6.0	7.0	3.3	5.3	5.0	5.0	5.3
Rambo	5.3	5.3	4.7	4.7	6.0	6.0	5.3
Nublue	5.0	5.3	5.3	4.3	5.0	6.0	5.2
SodGrower II Mix [3]	5.0	5.3	5.0	4.7	5.3	6.0	5.2
Limosine	5.3	6.0	4.0	4.3	5.7	4.3	4.8
Park	3.7	3.7	4.0	5.0	4.0	3.7	4.0
Kenblue	3.3	3.7	3.7	4.0	4.0	5.0	3.9
$LSD_{0.05}$	1.02	1.28	NS	NS	NS	1.30	0.85

[1] Visual quality was assessed using a scale of 9 to 1 with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
[2] Includes Nuglade, Bluemoon, Award, Rugby II, and Rambo
[3] Includes Bluechip, Nustar, Rambo, and Rugby II

Shade Adaptation Study

Nick E. Christians and Deying Li

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.

Monthly quality data are collected from April through October (Tables 1). Visual quality is based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality.

Victor (C.F.) and Waldina (H.F.) received the highest quality ratings in 2002. Bristol and Glade (K.B.) were the lowest rated.

Table 1. 2002 Visual quality data for cultivars in the 1987 Shade Trial in descending order for mean quality

Cultivar [1]	Quality						
	May	Jun	Jul	Aug	Sep	Oct	Mean
	-9-1; 9 Best-						
Victor (C.F.)	7.0	7.3	6.3	6.7	7.0	7.7	7.0
Waldina (H.F.)	6.3	6.7	6.7	7.0	6.7	7.7	6.9
Mary (C.F.)	7.0	7.0	6.0	6.3	6.7	7.0	6.7
Atlanta (C.F.)	6.7	7.0	6.0	6.7	6.0	7.3	6.6
St-2(SR3000) (H.F.)	6.3	6.3	6.7	6.7	6.3	7.0	6.6
Shadow (C.F.)	6.3	6.7	6.0	6.3	6.3	7.3	6.5
BAR Fo 81-225 (H.F.)	5.3	6.3	7.0	6.3	6.7	7.3	6.5
Biljart (H.F.)	6.0	6.7	6.0	6.0	6.3	6.7	6.3
Agram ((C.F.)	5.7	6.3	6.0	6.3	6.0	7.3	6.3
Banner (C.F.)	6.0	6.7	6.0	5.7	6.3	6.7	6.2
Waldorf (C.F.)	6.0	6.3	5.7	6.3	6.3	6.7	6.2
Jamestown (C.F.)	6.0	6.3	6.0	5.7	6.3	7.0	6.2
Reliant (H.F.)	6.0	6.0	6.0	6.0	6.3	6.7	6.2
Pennlawn (C.R.F.)	6.0	6.3	5.3	5.0	6.0	6.3	5.8
Ensylva (C.R.F.)	5.3	5.0	5.3	6.3	5.7	7.3	5.8
Rebl (T.F.)	5.0	4.7	5.3	5.0	6.0	6.0	5.3
Koket (C.F.)	4.7	5.7	5.0	5.0	5.3	6.0	5.3
Rebel II (T.F.)	4.3	4.7	4.7	5.3	6.0	6.0	5.2
Wintergreen (C.F.)	4.3	5.0	5.0	5.3	5.0	6.0	5.1
Estica (C.R.F.)	4.7	5.3	5.0	5.0	5.3	5.3	5.1
Spartan (H.F.)	4.3	5.0	5.3	5.0	5.3	5.3	5.0
Scaldis (H.F.)	4.0	4.7	4.7	3.7	5.0	5.7	4.6
Highlight (C.F>)	5.0	4.7	4.3	4.0	4.3	4.7	4.5
Arid (T.F.)	4.3	3.3	4.0	4.7	4.7	5.0	4.3
Falcon (T.F.)	3.3	3.7	4.0	4.3	4.7	5.0	4.2
Apache (T.F.)	3.7	2.7	4.0	4.0	5.3	5.0	4.1
Bonanza (T.F.)	2.7	2.7	3.3	3.7	4.7	4.7	3.6
Midnight (KGB)	1.3	2.0	3.0	3.0	3.0	3.3	2.6
Ram I (KGB)	1.7	2.3	2.7	2.7	2.7	2.7	2.5
Nassau (KGB)	2.3	1.7	2.0	4.0	2.3	2.3	2.4
Coventry (KGB)	2.0	2.0	2.0	2.7	2.3	2.0	2.2
Chateau (KGB)	1.7	1.7	2.3	2.0	3.0	2.3	2.2
Sabre (Poa trivialis)	1.3	2.7	2.3	1.7	2.0	2.0	2.0
Bristol (KGB)	1.7	2.0	1.7	2.0	2.3	2.0	2.0
Glade (KGB)	1.7	1.3	1.3	2.0	2.0	3.3	1.9
$LSD_{0.05}$	1.66	1.87	1.43	1.80	1.54	1.90	

[1] C.F. = chewings fescue, C.R.F. = creeping red fescue, H.F. = hard fescue, KGB = Kentucky blue grass, T.F. = tall fescue.

Ornamental Grasses Project 2000-2002

Nick Christians

Purpose:

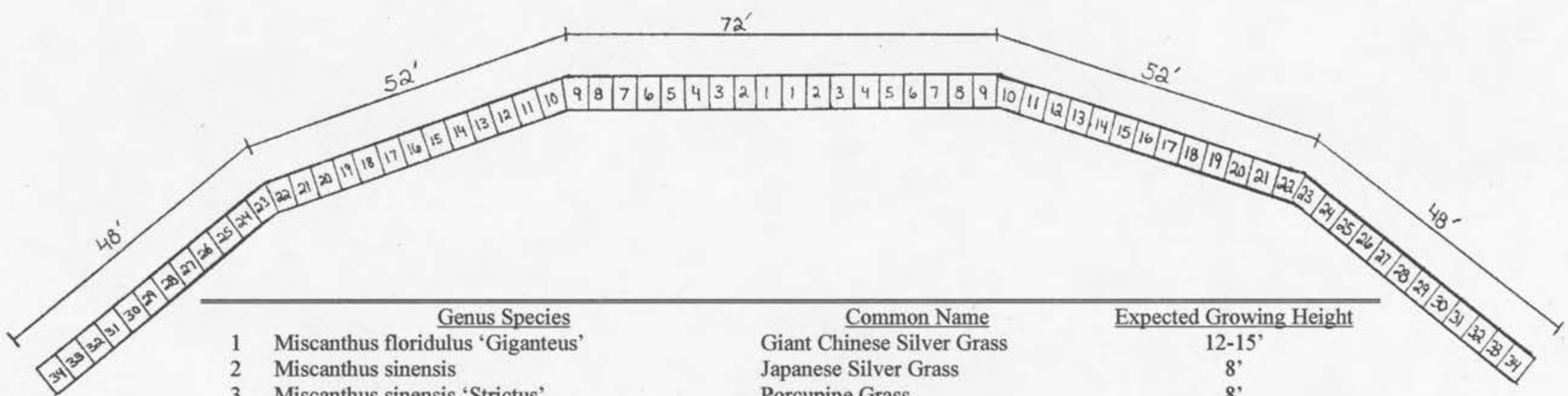
The purpose of the ornamental grass project is to evaluate 34 ornamental grasses for their adaptation to Iowa conditions. The study is located south of the turfgrass research building. Grasses 1 and 2 were established in 1989. Grasses 3-5, 11-15, 17-18, 20-21, and 33 were established in 2000. The remaining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

Each plot on this site has a 4 x 5 ft spacing. The grasses 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.

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 the 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.



	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"

Preemergence Crabgrass Control Trial 2002

Nick E. Christians and Luke Dant

This study was conducted to evaluate the efficacy of several preemergence crabgrass herbicides. The research was completed at the Iowa State University Turfgrass Research Facility on 'Moonlight' Kentucky bluegrass. The designated plot area was seeded with crabgrass in April 2002 in order to make the trial as uniform as possible. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 3.0 % organic matter, 22 ppm P, 71 ppm K, and a pH of 7.95.

The trial was conducted using a randomized complete block design. Each treatment was replicated three times with plots being 5 x 5 ft. The Scotts Company supplied treatments 2-8, treatments 9-11 were screened for Dow AgroSciences, treatments 12-17 for BASF and 18 and 19 for Syngenta. Treatment 1 was an untreated control. 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 sq. ft. Granular materials were applied using 'shaker dispensers' in order to provide uniform application. All treatments were applied on April 22, 2002. The second application of treatment 9 was made on June 3.

Turf quality was taken on June 11 and 23 on a scale of 9-1 with 9 being excellent, 6 being lowest acceptable turf and 1 being the worst. Crabgrass cover was recorded on July 23 and again on August 23. This is reported as the percentage of the plot covered by crabgrass (0% = No crabgrass present and 100% = the plot was entirely covered with crabgrass).

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

There was no damage to the Kentucky bluegrass from any of the treatments during the study. The differences in quality recorded on May 11 and May 23 were due to differences in plant response to materials that contained nitrogen.

The crabgrass population was very high due to the sowing of crabgrass seed before treatments were applied. The control plots averaged 95% crabgrass cover at the August 23 rating date. Due to the very high crabgrass pressure, none of the treatments provided complete crabgrass control. The most effective materials were Dimension Ultra 40WP at 0.5 lbs ai/A, Barricade 65 WG at 0.5 lbs ai/A, and Barricade 4 FL at 0.65 lbs ai/A.

Table 1. Quality ratings and % crabgrass cover in the 2002 preemergence weed control study.

Trt.	Material	Active Ingredient	Rate *lb a.i./A*	Quality		% Crabgrass cover	
				5/11	5/23	7/23	8/23
1	Untreated Control	N/A	NA	5	4	88	95
2	Scotts Turf Builder with Halts	Pendimethalin (1.29%)	1.5	6	6	28	40
3	Sta-Green Premium Crab-Ex	Dithiopyr (0.17%)	0.252	6	7	43	57
4	Vigoro Ultra Turf Crabgrass Preventer	Dithiopyr (0.17%)	0.252	6	6	21	40
5	Schultz Expert Gardener	Prodiamine (0.20%)	0.314	7	7	50	77
6	Sam's Choice Crabgrass Preventer	Prodiamine (0.28%)	0.39	6	7	28	44
7	Preen'n Green Lawns	Total a.i. =1.93%*	3.03	6	6	31	53
8	Lesco Dimension + Fertilizer	Dithioipyr (0.07%)	0.128	6	6	28	67
9	Dimension Ultra 40 WP (Split Applications)	Dithiopyr	0.25	4	4	20	43
10	Dimension Ultra 40 WP	Dithiopyr	0.5	5	4	5	11
11	Barricade 65 WG	Prodiamine	0.5	4	4	13	32
12	Pendulum 3.3 EC	Pendimethalin	1.5	5	5	75	88
13	Pendulum 3.3 EC	Pendimethalin	2.0	5	4	72	92
14	Pendulum 3.8 CS	Pendimethalin	1.5	5	4	53	83
15	Pendulum 3.8 CS	Pendimethalin	2.0	5	5	65	78
16	Pendulum 2 G	Pendimethalin	1.5	5	4	43	62
17	Pendulum 2 G	Pendimethalin	2.0	5	4	22	23
18	Barricade 4 FL	Prodiamine	0.5	5	4	33	57
19	Barricade 4 FL	Prodiamine	0.65	6	5	5	14
20	Untreated Control	N/A	NA	5	4	93	94
	LSD 0.05			.94	.94	25	33

*Active ingredients include: Benefin (0.82%), Trifluralin (0.43%), Triclopyr (0.5%), Clopyralid (0.18%)

Postemergence Annual Grass Control Trial 2002

Nick E. Christians and Luke Dant

This study was conducted in order to evaluate the effectiveness of and turf safety of Acclaim herbicide. The study was conducted at the Iowa State University Turfgrass Research Facility on 'Moonlight' Kentucky bluegrass. In order to maximize crabgrass germination, the plot area was overseeded with crabgrass in April 2002.

All treatments were replicated three times and the experimental design was a randomized complete block. Individual plots were 5 ft by 5 ft in size. All treatments were diluted to a total spray volume 3 gal per 1000 sq ft and applied using a carbon dioxide backpack sprayer with #8002 flat fan TeeJet nozzles at 30-40 psi. All treatments were applied on June 15. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 3.0 % organic matter, 22 ppm P, 71 ppm K, and a pH of 7.95.

Turfgrass phytotoxicity was reported on June 20, June 26 and again on July 22 using a scale of 1-9 (1 = significant visual damage and 9 = no visual damage). In addition, crabgrass phytotoxicity was recorded on June 20 and 26 using the same scale as previously mentioned. On July 23 and again on August 23 crabgrass cover was estimated on a percentage of the plot covered by crabgrass with 0% being no crabgrass present and 100% being completely covered with crabgrass.

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

No damage was observed on the Kentucky bluegrass on June 20 or 26, but by July 22 each of the 3 Acclaim EW treatments were observed to discolor the bluegrass. All treatments significantly damaged crabgrass compared to the control on June 26. The Drive 75 DF caused the most visual damage to the crabgrass. All treatments significantly reduced crabgrass populations on July 23 and August 23, although there had been considerable recovery of crabgrass populations by August 23. While there were no statistically significant differences among treatments in crabgrass control, the Drive 75 DF at 0.75 lbs ai/A provided the greatest numeric reduction in crabgrass populations compared to the other treatments.

Table 1. Postemergence crabgrass control study 2002.

	Material	Rate *lb a.i./A*	Rate Product/A	Turfgrass Phytotoxicity			Crabgrass Phytotoxicity		% Crabgrass Cover	
				6/20	6/26	7/22	6/20	6/26	7/23	8/23
1	**Untreated control**	N/A	NA	9	9	9	9	9	83	88
2	**Acclaim EW**	0.089	20 oz	9	9	5	8	5	33	60
3	**Acclaim EW**	0.124	28 oz	9	9	4	7	4	19	55
4	**Acclaim EW**	0.174	39 oz	9	9	3	4	2	16	50
5	**Drive 75DF**	0.75	1 lb	9	9	8	3	1	9	36
	LSD 0.05			NS	NS	1.2	1.3	1.8	22	25

Fairway Height Preemergence Herbicide Trial 2002

Nick Christians and Luke Dant

The 2002 fairway height preemergence trial was conducted at the Iowa State University Turfgrass Research Facility on an area of 'Quantum Leap' Kentucky bluegrass maintained as a golf course fairway at 0.5 in. mowing height. The area for the trial was limited and the study was conducted with two replications instead of the standard three replications. The herbicides were applied on May 14 with a CO_2 backpack sprayer with #8002 flat fan TeeJet nozzles at 30-40 psi and diluted to a total spray volume of 3 gal per 1000 sq. ft. The second application of treatment 1 was made on July 1 using the same procedure as described above. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 3.3 % organic matter, 7 ppm P, 50 ppm K, and a pH of 6.65.

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

Crabgrass populations were variable on the site. Treatment 1 (low rate of Dimension Ultra) had higher crabgrass populations than that of the control plots. This is most likely due to great variability of crabgrass populations at the site. However, it was clear that the 0.25 lb ai/A rate of Dimension was not sufficient to control crabgrass on this site, whereas the 0.5 rate was effective. The Barricade at 0.5 lbs ai/A was also effective in this test. No damage from the treatments was observed on the Quantum Leap bluegrass at anytime during the study.

Table 1. Fairway height bluegrass preemergence trial 2002.

	Material	Rate lb a.i./A	% Crabgrass Cover		
			7/23	8/19	9/23
1	**Dimension Ultra 40 WP2 (Split Applications)**	0.25	6	28	20
2	**Dimension Ultra 40 WP2**	0.5	1	1	0
3	**Barricade 65 WG2**	0.5	0	1	1
4	**Untreated Control**	NA	6	14	11
	LSD 0.05		NS	17	NS

The Effects of Preemergence Herbicides on Sod Tensile Strength 2002

Nick E. Christians and Luke Dant

The objective of this study was to evaluate sod tensile strength and quality of turf treated with preemergence herbicides. The study was conducted at the Iowa State University Turf Research Facility on 'Glade' Kentucky bluegrass. Treatments included Barricade (Prodiamine) 4FL at 0.5, 0.75, and 1 lb a.i./acre and Barricade 65 WG at 1.0 lb a.i./acre.

The study was conducted as a randomized complete block. Each treatment was replicated four times with plots being 5 ft by 15 ft. All treatments were applied on April 26 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 sq. ft. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.0 % organic matter, 11 ppm P, 90 ppm K, and a pH of 6.75.

Sod harvest dates were approximately 30, 60, 90 and 120 days after application of the herbicides. Sod was harvested from a subsection of each plot using an 18" sod cutter set at a cutting depth of 1/2-inch. The sod was then placed in a clamp that was attached to a hydraulic jack. A gauge placed in the hydraulic system recorded the pressure in pounds per square inch (psi) needed to break each piece of sod. Sod harvested from each plot was broken 4 times. One outlying data point was dropped and the remaining three were averaged. The mean of the three numbers were recorded as a single data point for that date and treatment. An analysis of variance was performed on the data using SAS (Statistical Analysis System).

The herbicide treatments had no effect on turf quality at any time during the study. There were no significant differences in sod tensile strength on any of the four testing dates (Table 1).

Table 1. Sod tensile strength study 2002. Data are lbs/in2 required to break 18 inch sod pieces.

	Material	Rate lb a.i./A	Sod Tensile Strength psi			
			5/28	6/26	7/25	8/31
1	**Untreated Control**	NA	430	400	330	279
2	**Barricade 4 FL**	0.5	408	411	318	234
3	**Barricade 4 FL**	0.75	413	433	300	216
4	**Barricade 4 FL**	1.0	348	416	306	216
5	**Barricade 65 WG**	1.0	404	464	284	214
	LSD 0.05		NS	NS	NS	NS

Postemergence Broadleaf Control Trial I 2002

Nick E. Christians and Luke Dant

The purpose of this study was to evaluate weed control and turf phytotoxicity of Scotts Weed-B-Gone and other competitive broadleaf herbicide formulations. The research was conducted at the Iowa State University Turfgrass Research Facility on 'Parade' Kentucky bluegrass.

The trial was arranged as a randomized complete block. Each treatment was replicated three times with plots being 5 ft x 5 ft. All products were supplied by Scotts Company. Non-Scotts products were applied at label rates. All treatments were applied using a carbon dioxide backpack sprayer with #8002 flat fan nozzles at 30-40 psi and diluted to a total spray volume of 3 gal per 1000 sq. ft. The herbicide application was made on May 14, 2002. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.9 % organic matter, 6 ppm P, 171 ppm K, and a pH of 7.05.

Ratings of damage to dandelions were made at 1 and 3 days after application and at 1 and 3 weeks after application with a percentage scale ranging from 0 to 100. On June 4, five weeks after application, a percentage of dandelion coverage was taken. Turfgrass phytotoxicity was monitored at one and three weeks after application on a scale ranging from 9-1, with 9 being no damage and 1 being complete turf death.

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

No damage was observed on the Kentucky bluegrass turf at any time during the study (Table 1). All materials caused significant damage to weeds at 1 day after treatment. By the second day, the Trimec + Sulfentrazone was showing the most damage on weeds, followed by the Spectracide Weed Stop. All materials provided significant reduction in dandelion cover compared to the control. However, none of the treatments provided 100% control. There were no significant differences among the herbicide treatments in dandelion control, although WBG S-10304 provided the greatest numerical reduction.

Table 1. Postemergence control of dandelion by various broadleaf weed herbicides in 2002.

Material	Rate *Product/A* *(ounces)*	Dandelion Phytotoxicity				% Dandelion Cover	Turf Phytotoxicity	
		5/15	5/17	5/21	6/04	6/18	5/21	6/4
Untreated Control	NA	0	0	0	0	57	9	9
Trimec + Sulfentrazone	65.34	12	30	33	37	8	9	9
S-10448 (Horsepower Conc.)	141.57	12	23	23	22	9	9	9
WBG FA Conc. S-10300	217.8	8	22	22	18	7	9	9
WBG FA Conc. S-10301	217.8	10	17	25	23	6	9	9
WBG S-10304	217.8	10	18	23	32	4	9	9
WBG Weed Killer Conc.	217.8	12	15	23	15	5	9	9
Spectracide Weed Stop Weed Killer Conc.	174.24	15	28	33	33	5	9	9
Bayer All-In-One Weed Killer Conc.	217.8	8	20	27	30	10	9	9
LSD 0.05		7	6	8	NS	9	NS	NS

Postemergence Broadleaf Control Trial II 2002

Nick E. Christians and Luke Dant

The purpose of this study was to evaluate weed control and turf phytotoxicity of Scotts Turf Builder with Plus 2 Weed Control to other competitive granular broadleaf herbicides. The research was conducted at the Iowa State University Turfgrass Research Facility on 'Park' Kentucky bluegrass.

The trial design was a randomized complete block. The plots were 10 ft x 5 ft and each treatment was replicated 3 times. The Scotts Company provided all products and each product was applied per the instructions on the label. The application was made when dandelions were flowering but before they had produced "puff-balls". All treatments were applied on May 14 while there was still dew on the weed foliage. All products were applied using 'shaker dispensers'. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.6 % organic matter, 6 ppm P, 169 ppm K, and a pH of 7.05.

Weed phytotoxicity was reported two weeks after application on June 28. This was reported on a percent scale, 0% being no damage and 100% being dead. Dandelion and clover cover was recorded 4 and 8 weeks after application on June 11 and July 9. These data were reported on a percentage basis with 0% meaning there were no weeds present and 100% meaning the entire plot was covered by weeds. Turf Quality was taken 2, 4 and 8 weeks after application on a scale of 9-1 (9 = Excellent, 6 = Acceptable, 1 = Worst).

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

Weeds treated by all materials showed some damage two weeks after the application. However, none of the damage was statistically significant between the treatments. All of the herbicides used in the study reduced dandelion populations in comparison with the control. No particular product appeared to have greater activity on dandelions than any other product. As with dandelions, all the treatments reduced clover populations significantly. Preen'n Green Lawns provided the best clover control on June 11, 4 weeks after application By July 9, both Preen'n Green Lawns and S-10218 exhibited the best numerical control of clover but there were no statistically significant differences among herbicide treatments. There was not a large differences in turf quality among the treated plots at any time during the study.

Table 1. 2002 Postemergence broadleaf control trial II treatments.

	Material	Total Active Ingredients	Active Ingredients
1	**Untreated control**	NA	NA
2	**Scotts Turf Builder with Plus 2 Weed Control S-10219**	1.81%	2,4-D (1.21%) MCPP-p (0.6%)
3	**S-10218**	1.89%	2,4-D (1.21%) MCPP-p (0.6%) Dicamba (0.08%)
4	**Vigoro Weed & Feed**	0.85%	2,4-D (1.21%) MCPP (0.27%) Dicamba (0.03%)
5	**Sta-green 200 + Weed & Feed**	0.98%	2,4-D (0.64%) MCPP (0.31%) Dicamba (0.03%)
6	**Sam's Choice Weed & Feed**	1.14%	2,4-D (0.56%) MCPP (0.29%) 2,4-DP (0.29%)
7	**Preen'n Green Lawns**	1.93%	Benefin (0.82%) Trifluralin (0.43%) Triclopyr (0.5%) Clopyralid (0.18%)
8	**Lesco Weed & Feed**	1.14%	2,4-D (0.56%) MCPP (0.29%) 2,4-DP (0.29%)

Table 2. Quality ratings and broadleaf cover in the 2002 postemergence broadleaf control trial II.

	Material	Rate *lb a.i./A*	Weed Phytotoxicity	% Dandelion Cover		% Clover Cover		Turf Quality		
			5/28	6/11	7/09	6/11	7/09	5/28	6/11	7/09
1	**Untreated control**	NA	0	38	19	38	21	4	4	5
2	**Scotts Turf Builder with Plus 2 Weed Control S-10219**	2.25	12	8	2	25	6	6	6	6
3	**S-10218**	2.25	12	8	3	13	1	6	5	6
4	**Vigoro Weed & Feed**	1.18	13	12	3	17	7	6	6	6
5	**Sta-green 200+ Weed & Feed**	1.37	12	17	7	23	4	6	7	6
6	**Sam's Choice Weed & Feed**	1.79	7	17	5	37	6	6	7	6
7	**Preen'n Green Lawns**	3.03	8	8	2	4	1	6	6	6
8	**Lesco Weed & Feed**	1.99	10	13	3	25	8	5	6	6
	LSD 0.05		NS	9	9	17	7.2	NS	1.2	NS

Postemergence Broadleaf Control Trial III 2002

Nick E. Christians and Luke Dant

The purpose of this study was to evaluate the effectiveness of several broadleaf herbicides, specifically for control of wild violet, but also for control of other broadleaf weeds that may be present in the plot. The study was conducted at the Iowa State University arboretum.

The experimental design was a split plot design with main plots being the control and 10 herbicide treatments as the sub-plots. Some treatments were applied as a single application of the materials (App 1) and other treatments had repeat applications made 21 days following the first application (App 2). The main plots were 10 ft x 5 ft and were split in half into 2 sub-plots measuring 5 ft x 5ft. Each treatment was replicated three times. All of the main plot treatments were applied on May 9 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 1000 sq. ft.. The first application was made to the entire 10 ft x 5 ft plot. The second application was made on May 30, 21 days after the first application, however, only one half of the plot was sprayed. Treatment numbers 2 and 3 only required one application; therefore, they were not sprayed a second time. The sub-plots were randomly assigned within the main plots.

Both wild violet and ground ivy damage was reported 2, 7, 14, 21 and 28 days after the first application and again 5 and 7 days after the second application (Tables 1-4). This was reported on a percent scale of 0% being no damage and 100% being dead. The percent wild violet and ground ivy cover was estimated 14, 21, 28 and 35 days after the second application based on a percent scale (0% = No weeds and 100% being complete covered by weeds).

On the 2nd day after application (5/11), there were only minor differences in weed damage on wild violets among the treatments (Table 1). The EH1349 had the least effect on weeds at that time. By 7 days after treatment (5/16), Speed Zone and Power Zone showed a clear advantage over the other treatments in weed damage. This is likely due to the presence of carfentrazone in these product, which is added to speed their activity on weeds. The effect of the second application can be seen on 6/6, when several of the treatments showed a distinct advantage over the single application alone. Power Zone at 6 pt/A and Millennium Ultra were showing the greatest effect on that date. The herbicides that provided the best overall control of wild violets on 7/3 were Speed Zone at 4.5 pt/A, Confront at 1 pt/A, and EH1349 at 4 pt/A. All materials tested significantly reduced wild violet numbers from the control.

Weed damage on ground ivy was much better with Speed Zone and Power Zone at days 7 and 14 following application. As was the case with wild violet, repeat applications showed a distinct advantage for most treatments on 6/6. All treatments significantly reduced ground ivy cover at all observation dates during the study (Table 4). There was not as great of a difference between 1 and 2 applications on the ground ivy control as was observed on the wild violet control.

Table 1. Initial damage to wild violets following herbicide application. (0 = no damage and 100=dead)

	Material	Rate Product (pt)/A	Initial Cover	Weed Phytotoxicity					
				5/11	5/16	5/23	6/4	6/6	
				App 1	App 1	App 1	App 2	App 1	App 2
1	**Untreated Control**	NA	38	0	0	0	0	0	0
2	**Speed Zone**†	5.0	14	10	20	32	13	10	10
3	**Power Zone**†	6.0	13	15	32	27	20	18	40
4	**Speed Zone**	4.5	18	15	33	40	33	7	10
5	**Speed Zone**	5.0	34	10	30	33	37	7	25
6	**Power Zone**	5.0	24	15	23	17	27	5	20
7	**Millennium Ultra**	2.5	23	15	7	5	37	5	40
8	**Confront**	1.0	22	10	5	5	12	5	5
9	**Trimec Classic**	4.0	8	10	8	5	30	5	30
10	**EH1349**	4.0	6	5	5	8	15	10	27
11	**NB30165**	4.0‡	34	15	5	5	18	5	30
	LSD			1	1	1	10	4	4

† Single application
‡ 4.0 qt/A

Table 2. Wild Violet control by postemergence herbicides.

	Material	% Weed Cover							
		6/13		6/20		6/27		7/3	
		App 1	App 2	App1	App2	App 1	App 2	App 1	App 2
1	**Untreated Control**	33	27	22	22	27	27	36	36
2	**Speed Zone**†	17	9	18	18	5	13	17	9
3	**Power Zone**†	28	18	16	19	17	14	15	12
4	**Speed Zone**	37	6	14	3	23	3	14	4
5	**Speed Zone**	36	14	25	10	17	20	18	15
6	**Power Zone**	37	5	23	9	25	12	26	12
7	**Millennium Ultra**	35	16	22	9	15	7	18	9
8	**Confront**	26	28	10	7	14	6	13	5
9	**Trimec Classic**	8	19	5	10	3	6	4	8
10	**EH1349**	17	5	11	9	7	4	7	4
11	**NB30165**	34	10	21	15	20	16	21	15
	LSD	17	17	11	11	10	10	11	11

† Single application

Table 3. Initial damage to ground ivy following herbicide application.

	Material	Rate Product (pt)/A	Weed Phytotoxicity				
			5/16	5/23	6/4	6/6	
			App 1	App 1	App 2	App 1	App 2
1	**Untreated Control**	NA	0	0	0	0	0
2	**Speed Zone**†	5.0	28	27	5	10	10
3	**Power Zone**†	6.0	35	47	5	18	40
4	**Speed Zone**	4.5	22	25	45	7	10
5	**Speed Zone**	5.0	27	28	50	7	25
6	**Power Zone**	5.0	25	32	45	5	20
7	**Millennium Ultra**	2.5	3	5	43	5	40
8	**Confront**	1.0	2	3	10	5	5
9	**Trimec Classic**	4.0	3	5	28	5	30
10	**EH1349**	4.0	8	8	12	10	27
11	**NB30165**	4.0‡	10	8	23	5	30
	LSD		1	1	13	3	3

† Single application
‡ 4.0 qt/A

Table 4. Ground ivy control by postemergence herbicides.

	Material	% Weed Cover							
		6/13		6/20		6/27		7/03	
		App 1	**App 2**	**App1**	**App2**	**App 1**	**App 2**	**App 1**	**App 2**
1	**Untreated Control**	47	47	47	47	32	32	20	23
2	**Speed Zone**†	3	3	6	5	4	2	1	1
3	**Power Zone**†	3	3	4	4	3	3	4	4
4	**Speed Zone**	6	1	4	1	2	1	3	0
5	**Speed Zone**	7	3	9	2	9	2	11	2
6	**Power Zone**	4	3	3	2	3	1	2	2
7	**Millennium Ultra**	6	2	9	1	4	1	4	0
8	**Confront**	7	6	8	6	3	1	2	1
9	**Trimec Classic**	3	2	2	2	1	1	1	1
10	**EH1349**	7	2	6	3	2	1	2	1
11	**NB30165**	6	2	4	2	3	2	3	2
	LSD	3	3	3	3	4	4	3	3

† Single application

Non-selective Herbicide Study I 2002

Nick E. Christians and Luke Dant

This study was conducted to evaluate the efficacy and speed of kill of several non-selective herbicides. This study was conducted at the Iowa State University Turfgrass Research Facility on 'Ram I' Kentucky bluegrass. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.1 % organic matter, 11 ppm P, 96 ppm K, and a pH of 6.75.

All treatments were replicated three times and the experimental design was a randomized complete block. Individual plots were 5 ft by 5 ft in size. Each treatment was diluted to a total spray volume of 3 gal per 1000 sq ft and applied using a carbon dioxide backpack sprayer with #8002 flat fan TeeJet nozzles at 30-40 psi. All treatments were applied on July 17.

Turfgrass phytotoxicity was observed on 1, 2, 5, 7, 14, 21, 28 and 45 days after application. Phytotoxicity was reported on a scale ranging from 9-1, with 9 being no damage and 1 being complete death of the turf.

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

Grass treated with Reward 2 SL was the only turf that showed significant damage on the first and second day after treatment (Table 1). By day 5, all treated turf was showing significant damage, with Reward 2 SL still showing the greatest effect. By the 7th day, Roundup RTU and A13693 applied at the high rate had equaled the effect of the Reward 2 SL. Although Reward 2 SL had quick activity, by 8/7, 21 days after application, the turf had almost completely recovered. On 8/31, 45 days after treatment, Touchdown RTU and A13693 applied at the high rate had completely killed all of the turf.

Table 1. Comparison of the time required to kill Kentucky bluegrass among several non-selective herbicides. (9=no damage and 1=dead turf)

	Material	Rate qt/A	Turfgrass Phytotoxcity							
			7/18	7/19	7/22	7/24	7/31	8/7	8/14	8/31
1	**Untreated control**	NA	9	9	9	9	9	9	9	9
2	**Touchdown RTU YF11614**	36	9	9	7	7	4	3	2	1
3	**Touchdown 13.4% (152 AE)**	2	9	9	8	7	4	4	2	2
4	**Roundup RTU (AE)**	48.2	9	9	7	6	4	3	3	3
5	**Roundup Conc. 18% Al (13.4% AE)**	1.41	9	9	8	7	5	4	3	2
6	**Reward 2 SL**	0.5	7	7	6	6	7	8	8	9
7	**A13693**	17.8	9	9	8	7	4	4	3	3
8	**A13693**	35.6	9	9	7	6	3	3	2	1
9	**A13692**	0.98	9	9	8	8	6	6	4	5
10	**A13692**	2	9	9	8	6	4	4	3	2
11	**Roundup Conc. 18%Al (13.4% AE) & Reward 2 SL**	0.7 0.032	9	9	8	8	6	6	5	5
12	**Roundup Conc. 18% Al (13.4% AE) & Reward 2 SL**	0.032 0.066	9	9	8	8	5	5	3	3
	LSD 0.05		0.5	0.3	0.6	1.1	0.9	0.9	0.9	1.5

Non-selective Herbicide Study II 2002

Nick E. Christians and Luke Dant

The purpose of this study was to compare the speed of activity and length of control of Monsanto's QuikPRO and Roundup ProDry. This study was conducted at the Iowa State University Turfgrass Research Facility on 'Ram I' Kentucky bluegrass. The soil on the area is a Nicollett (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.1 % organic matter, 11 ppm P, 96 ppm K, and a pH of 6.75.

The trial design was a randomized complete block. The plots were 5 ft x 5 ft and each treatment was replicated three times. Each treatment was diluted to a total spray volume of 3 gal per 1000 sq ft and applied using a carbon dioxide backpack sprayer with #8002 flat fan TeeJet nozzles at 30-40 psi. All treatments were applied on July 17.

Turfgrass phytotoxicity was monitored at approximately 1, 2, 3, 7, 28, 56, and 84 days after application on a scale ranging from 9-1, with 9 being no damage and 1 being complete death of the turf.

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

The QuikPRO treated plots were showing significant damage on the first day after treatment (Table 1). The Roundup ProDry treated plots did not show damage until the 5th day after treatment. QuikPRO had completely killed the grass by day 7, whereas, it was 14 days following treatment before Roundup ProDry completely killed the turf. None of the treated grass showed any sign of recovery at the end of the season.

Table 1. Comparison of the time required to kill Kentucky bluegrass of QuikPro and Roundup ProDry. (9=no damage and 1=dead turf)

	Material	Rate lb ai/A	Turfgrass Phtyotoxicity										
			7/18	7/19	7/20	7/22	7/24	7/31	8/7	8/14	8/28	9/13	10/14
1	**Untreated Control**	NA	9	9	9	9	9	8	8	9	9	9	9
2	**QuikPro (66.6% glyphosate)**	6	6	4	4	2	1	1	1	1	1	1	1
3	**Roundup ProDry (64.9% glyphosate)**	6	9	9	9	7	4	1	1	1	1	1	1
	LSD 0.05		0.8	0.8	0.8	0.8	1.2	0.8	0.8	1.0	1.0	1.0	1.0

Broadleaf Herbicide Study 2002

D.D. Minner, F. Valverde, and S.K. Lee

Introduction
Broadleaf weeds such as white clover (Trifolium repens) and dandelion (Taraxicum officinale) are a problem on many turf sites. These problem weeds are seldom controlled with a single application of currently available broadleaf herbicides.
The purpose of this study was to evaluate the efficacy of several post-emergency broadleaf weed control herbicides applied in a single application.

Materials And Methods
This study was conducted in Ames, Iowa at the Iowa State University Horticulture Research Station from July 10 to August 29, 2002. Following the recommendations on the suitable area for the study, the trial was set on a mature stand of Kentucky bluegrass (*Poa pratensis*) infested with a uniform population of white clover and a very low population of Dandelion. The turf was routinely irrigated and mowed at 2.5 inches. Urea-nitrogen was applied at 1.0 lb N/1000 sq.ft. two weeks prior to herbicide treatment.
Treatments were arranged in a Randomized Complete Block design with 3 replications and 14 treatments (Table 1). Each replication had 14 individual 6 x 4-ft plots including a non-treated control. Treatments were applied using a CO2 backpack sprayer on July 16, 2002. The delivery rate of the sprayer was 125 gallons/A. Control plots only received a water spray.

Table 1. Treatment description and rate of application.

1-RIV 01-02 1.6 oz./M	8-RIV 10-02 1.1 oz./M
2-RIV 02-02 1.3 oz./M	9-RIV 11-02 1.1 oz./M
3-RIV 03-02 1.1 oz./M(not applied)	10-RIV 12-02 1.1 oz./M
4-RIV 04-02 1.1 oz./M	11-RIV 13-02 1.1 oz./M
5-RIV 05-02 .9 oz./M	12-RIV 20-02 .9 oz./M
6-RIV 06-02 .9 oz./M	13-RIV 21-02 1.1 oz./M
7-RIV 07-02 1.1 oz./M	14-Control

Treatment three was listed on protocol, but was not received in shipment. However, it was treated (just water) and evaluated as any other treatment.

Data collection involved a visual estimation of the percent of the plot area covered by white clover at 9 and 29 days after treatment (DAT). When rating at 9 DAT some plants of white clover did not die completely; therefore weed color was used to further evaluate herbicidal activity on a scale of 1 to 9, where 9 is a healthy green weed and 1 was a necrotic brown weed. Turf phytotoxicity was visually assessed on a color scale; data for this variable were collected prior to treatment and at 29 DAT. A similar scale was used for this purpose, where 9 is a healthy green grass plant and 1 is completely brown.

Even though no initial data was collected on dandelions due to its scarce presence, the population of this weed increased abruptly in several plots after treatment. A visual estimation of the percent ground coverage of this species was done at 44 DAT.
Data were analyzed with Statistical Analysis System (SAS, Version 8.0) and Analysis of Variance procedure (ANOVA).
Treatment effects were tested using Fisher's Least Significant Difference (LSD) mean separation test.

Results
The study area had a uniform stand of white clover as evident from non-significant differences between plots prior to treatment. Statistically significant differences in coverage and color of white clover occurred on July 25 and August 14, 2002, respectively (Table 2).

Table 2. Analysis of variance for turf broadleaf herbicide study.

	Before treatment (July 10)	**9 DAT (July 25)**	**29 DAT (August 14)**
Coverage of White Clover	NS	**	**
Color of White Clover	n/a	**	**

** Significant at the $\alpha = 0.01$ probability level, NS = not significant.

Compared to the control, all broadleaf herbicides significantly reduced the amount of white clover (Table 3). There were few differences among herbicides and rates with the exception of RIV03-02 (as expected), which resulted in less control of white clover. Treatments RIV4-02, RIV7-02 and RIV20-02 showed the minimum coverage of white clover by the end of the study. However, those that showed a greater reduction (based on initial and final population) were RIV04-02 and RIV07-02.

Table 3. Percentage of White Clover (*Trifolium repens*) coverage on 2 different dates after herbicide application.

Treatments	Coverage of White Clover (%)			Change of % cover	
	Before treatment (July 10)	9 DAT (July 25)	29 DAT (August 14)	July16–July25	July16–Aug.14
RIV 01-02 1.6 oz./M	23.330	10.67cd	16.667b	-12.67	-6.67b
RIV 02-02 1.3 oz./M	33.330	16.00cd	20.00b	-17.33	-13.33b
RIV 03-02 1.1 oz./M[z]	23.330	26.67b	73.33a	3.33	50.00a
RIV 04-02 1.1 oz./M	36.670	10.67cd	11.67b	-26.00	-25.00b
RIV 05-02 0.9 oz./M	40.000	12.33cd	18.33b	-27.67	-21.67b
RIV 06-02 0.9 oz./M	30.000	10.67cd	13.33b	-19.33	-16.67b
RIV 07-02 1.1 oz./M	40.000	15.67cd	11.67b	-24.33	-28.33b
RIV 10-02 1.1 oz./M	36.670	18.33bc	20.00b	-18.33	-18.67b
RIV 11-02 1.1 oz./M	26.670	8.67d	20.00b	-18.00	-6.67b
RIV 12-02 1.1 oz./M	30.000	11.33cd	16.67b	-18.67	-13.33b
RIV 13-02 1.1 oz./M	33.330	13.33cd	16.67b	-20.00	-16.67b
RIV 20-02 0.9 oz./M	26.670	11.67cd	11.67b	-15.00	-15.00b
RIV 21-02 1.1 oz./M	30.000	14.33cd	15.00b	-15.67	-15.00b
Control	26.670	36.67a	86.67a	10.00	60.00a
LSD($\alpha = 0.05$)	22.66 NS	8.45 **	14.88 **	NS	**

** Significant at the $\alpha = 0.01$ probability level, NS = not significant.

[z] Treatment not applied

When evaluating the weed plants that survived treatments (Table 4), it is observed that RIV13-02 caused greater damage to white clover although not statistically different than 4 other treatments.

Table 4. Color of White Clover (*Trifolium repens*) on 2 different dates after herbicide application.

Treatment	9 DAT (July 25)	29 DAT (August 14)
RIV 01-02 1.6 oz./M	7.33b	7.67a
RIV 02-02 1.3 oz./M	7.00bc	7.67a
RIV 03-02 1.1 oz./M[z]	9.00a	7.67a
RIV 04-02 1.1 oz./M	5.67cde	6.67bc
RIV 05-02 0.9 oz./M	5.00de	6.33cd
RIV 06-02 0.9 oz./M	5.00de	6.33cd
RIV 07-02 1.1 oz./M	6.00bcde	6.67bc
RIV 10-02 1.1 oz./M	7.33b	7.00abc
RIV 11-02 1.1 oz./M	6.33bcd	7.00abc
RIV 12-02 1.1 oz./M	7.00bc	7.00abc
RIV 13-02 1.1 oz./M	4.67e	5.67d
RIV 20-02 0.9 oz./M	7.00bc	7.33ab
RIV 21-02 1.1 oz./M	6.33bcd	6.67bc
Control	9.00a	7.67a
LSD($\alpha = 0.05$)	1.49 **	0.88 **

** Significant at the $\alpha = 0.01$ probability level, NS = not significant.

[z] Treatment not applied

None of the herbicide treatments resulted in visible phytotoxicity that caused turfgrass browning or necrosis; however, there were slight differences in turf color (Table 5). Although the differences were slight, RIV20-02 had a significantly lower turf color than the control.

The Kentucky bluegrass turf remained actively growing during the entire study with no evidence of grass injury by treatments or environmental conditions.

Table 5. Color of Kentucky bluegrass (*Poa pratensis*) on 2 different dates.

	Before treatment (July 10)	29 DAT (August 14)
RIV 01-02 1.6 oz./M	6.67	8.00a
RIV 02-02 1.3 oz./M	6.00	8.00a
RIV 03-02 1.1 oz./M[z]	7.00	8.00a
RIV 04-02 1.1 oz./M	6.33	8.00a
RIV 05-02 0.9 oz./M	6.67	7.67ab
RIV 06-02 0.9 oz./M	6.33	7.67ab
RIV 07-02 1.1 oz./M	6.67	8.00a
RIV 10-02 1.1 oz./M	6.33	8.00a
RIV 11-02 1.1 oz./M	6.33	7.67ab
RIV 12-02 1.1 oz./M	6.00	8.00a
RIV 13-02 1.1 oz./M	6.00	7.67ab
RIV 20-02 0.9 oz./M	6.33	7.33b
RIV 21-02 1.1 oz./M	6.00	8.00a
Control	6.33	8.00a
LSD($\alpha = 0.05$)	1.44 NS	0.5879

NS = not significant.

[z] Treatment not applied

The dandelion population was not prevalent in the study area during treatment; however, treatment differences were noticeable after completion of the study. Therefore, a final rating of dandelion was conducted 44 DAT.

Table 6. Percent ground coverage of Dandelion observed 44 DAT.

Treatment	Percent coverage 44 DAT
RIV 01-02 1.6 oz./M	5.67d
RIV 02-02 1.3 oz./M	13.33bcd
RIV 03-02 1.1 oz./M[z]	22.67ab
RIV 04-02 1.1 oz./M	7.33d
RIV 05-02 0.9 oz./M	7.33d
RIV 06-02 0.9 oz./M	14.00bcd
RIV 07-02 1.1 oz./M	14.00bcd
RIV 10-02 1.1 oz./M	20.67abc
RIV 11-02 1.1 oz./M	5.00d
RIV 12-02 1.1 oz./M	13.33bcd
RIV 13-02 1.1 oz./M	21.33abc
RIV 20-02 0.9 oz./M	9.67cd
RIV 21-02 1.1 oz./M	10.67bcd
Control	29.33a
LSD($\alpha = 0.05$)	12.07

[z] Treatment not applied

Postemergence Annual Bluegrass Control Trial 2002

Nick Christians and Luke Dant

The purpose of this study is to evaluate the effectiveness of varying rates of Velocity (bispyrobac-sodium) herbicide. The study is being conducted at Veenker Memorial Golf Course on 'Cato' creeping bentgrass maintained at fairway height.

All plots in the trial were 5 ft by 5 ft and organized in a randomized complete block design. The initial treatments of Velocity herbicide were made on August 1, 2002. They 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 sq. ft. For the treatments of Velocity herbicide requiring split applications, the second treatment was made on August 14. Prograss was applied per label instructions at a rate of 0.75 lb per acre. Prograss was applied on October 8 and again on October 30.

The phytotoxic effects of Velocity were recorded two weeks after each herbicide application. A scale from 1 to 9 with 1 being complete turfgrass death and 9 being no damage was used. Beginning September 5, turfgrass quality was observed to track the recovery of damaged turf. Turfgrass quality was rated on a scale of 9-1 with 9 being excellent, 6 being acceptable and , 1 being the worst. On May 20, 2003 when *Poa annua* was most visible, the percentage of *Poa annua* covering each plot was recorded.

Data were analyzed using Statistical Analysis System and the Analysis of Variance procedure. Treatments effects were tested using Fisher's Significant Difference (LSD) test.

Table 1.

Trt	Material	Rate *g a.i./A*	Rate *lb a/i. A*	Turfgrass Phytotoxicity 8/6/02	8/14/02	8/22/02	8/29/02	Turf Quality 9/5/02	9/20/02	10/4/02	10/25/02	% *Poa Annua* Coverage 5/20/03
1	**Untreated Control**	N/A	N/A	9	9	8	9	9	9	9	9	23
2	**Velocity 80WP**	30	0.066	6	8	7	7	9	9	9	9	20
3	**Velocity 80WP (Split Application)**	30	0.066	6	7	8	7	8	8	9	9	15
4	**Velocity 80WP**	45	0.099	6	7	9	9	9	9	9	9	17
5	**Velocity 80WP (Split Application)**	45	0.099	6	6	6	5	5	6	7	9	17
6	**Velocity 80WP**	60	0.132	6	6	8	8	9	9	9	9	15
7	**Velocity 80WP (Split Application)**	60	0.132	6	6	4	3	4	5	7	8	20
8	**Velocity 80WP**	90	0.198	6	4	8	8	8	9	9	9	17
9	**Prograss 1.5EC**	N/A	0.75	9	9	9	8	9	9	9	9	1
	LSD			0	1.2	2.0	2.5	0.83	0.57	0.63	NS	9.25

Analysis of Genetic and Morphological Variation of Colonial and Velvet Bentgrass

Shanmugam Rajasekar, Shui-Zhang Fei snd Nick Christians

Colonial bentgrass is a cool-season, sod-forming perennial primarily grown in northeastern and northwestern regions of the United States. This fine textured grass spreads by short rhizomes and stolons to form close tight turf. Colonial bentgrass is better adapted to mowing height of 0.5 inch and is best suited to golf course fairways and tees rather than greens. It requires low maintenance and low fertility, and it is also more cold tolerant than Kentucky bluegrass.

Velvet bentgrass, the finest textured of all bentgrasses, is adapted to cool, moist areas of coastal regions of the United States. It is primarily used on putting greens, where it forms an attractive, low-growing, compact turf with a high-quality putting surface. It is also the most shade-tolerant of all the bentgrasses and is used on fairways where nitrogen levels are kept low.

Despite the advantages of these two bentgrasses, they are not well utilized by the turf industry because of their unknown genetic diversity. This creates a great obstacle in the improvement of these species. Since these species are not exploited to the level of creeping bentgrass, there is little information available on their genetic diversity. Therefore, this needs to be explored to exploit their potential.

The objectives of this research are to: 1. Use AFLP (Amplified Fragment Length Polymorphism) markers to evaluate the genetic diversity of (USDA) accessions and estimate the genetic distance of the different accessions and varieties for improving the germplasm potential, and 2. evaluate the morphological variations under greenhouse and field conditions. AFLP markers are a powerful, consistent tool for evaluating genetic diversity and for DNA fingerprinting. The results are highly repeatable and contain a very low error rate of less than two percent.

This research involves 34 accessions, including 27 accessions of colonial bentgrass and 7 accessions of velvet bentgrass that were obtained from the Western Regional Plant Introduction Station (USDA) at Pullman, WA. All of the seeds are sown in cell packs and DNA will be extracted from young leaves after one month in the greenhouse or until it reaches a desirable height. After the seedlings reach a desirable height, they will be transplanted to the Iowa State Horticulture Research Farm for further studies on morphological characteristics under field conditions. All accessions will be planted in a randomized complete block design with a maximum of eighteen replications for each accession.

We expect to obtain reliable information on the extent of genetic variation and genetic distances among different accessions from molecular analysis. We also expect to obtain information on morphological variations among different accessions from our field studies. Based on the data that we expect to obtain on the range of morphological variations and genetic diversity among all accessions, we will be able to select plants with desirable traits for our breeding programs. Data on morphological and genetic variations is not available at present.

Analysis of Genetic Factors Associated with Winter Hardiness in Perennial Ryegrass

*Yanwen Xiong, Shui-zhang Fei and Reed Barker**

In recent decades, the use of perennial ryegrass has seen significant increases, largely due to its improved genetic color, texture, density, and environmental stress tolerance. The fast establishment rate, excellent seedling vigor, and good wear tolerance make it a good choice for use on golf course fairways and athletic fields. One disadvantage of using perennial ryegrass, however, is that it does not have adequate cold hardiness to survive severe winters in the northern part of USA including Iowa. Therefore, development of improved cultivars or germplasm of perennial ryegrass with enhanced winter hardiness would greatly benefit the turfgrass industry in Iowa as well as in northern USA.

Winter hardiness of perennial ryegrass is a complex trait that is controlled by multiple quantitative genes with each gene having minor phenotypic effects. Because of the environmental effect and the interaction between genes controlling winter hardiness and the environment, it would be difficult to identify these quantitative genes through conventional genetic methods. DNA molecular markers, however, offer a great promise to identifying genes responsible for winter hardiness. There are abundant DNA marker variations that exist in natural plant populations; some of these markers are in the same chromosome as the genes that are responsible for winter hardiness. Often these markers transmit together with the winter hardiness genes into their progenies. Unlike the winter hardiness genes that may be difficult to identify due to the environmental influence, DNA molecular markers are stable and relatively easy to identify. The long-term goal of this project is to efficiently select winter hardy perennial ryegrass germplasm with marker-assisted selection (MAS). The objective of this research is to use molecular biology tools to identify molecular markers that are closely associated with winter hardiness in perennial ryegrass. In addition, molecular markers that are closely associated with other important agronomic traits including rooting, growth habit, etc., will also be investigated.

Research methods

Plant materials A segregating population of 174 genotypes was created by crossing a perennial ryegrass cultivar 'Manhattan' with an annual ryegrass cultivar 'Floregon'. While 'Manhattan' has good winter hardiness, 'Floregon' is very sensitive to winter killing. This population was maintained in our research greenhouse at 20-21^{0}C and fertilized with Miracle Gro to prevent nutrient deficiency. Irrigation was provided as needed. Four clones of each genotype were planted within each replication in an α lattice design with three replications. The distance between individual clones of a genotype is 30cm, and the distance between each genotype is 60 cm. The distance between rows is 90 cm.

Measurements Component traits of winter hardiness will be measured. These will include traits such as fall growth after the last cutting, LT50 (the temperature at which half of the plants die), visual scores for winter injuries, tiller angles, root morphology including depth, root dry weight, the ratio of root dry weight / shoot dry weight and other chemical components. DNA marker profiles for each genotype have been obtained at Oregon State University.

Data analysis This project was started in the spring of 2003. Single factor analysis of variance will be computed for each marker and trait combination once data for each measurement becomes available. The trait values of all individuals having a marker will be compared with those without this marker by using an F-test. Multiple regression analysis will be performed with data for all markers to identify the best polygenic models for each trait.

*Reed Barker, Research Geneticist, USDA-ARS, Oregon State University, Corvallis, OR

Determination of Reproductive Mode of a USDA Core Collection of Kentucky Bluegrass

Robert Wieners and Shui-zhang Fei

Introduction

Kentucky bluegrass (*Poa pratensis*) is an important turf species with a rather unique reproductive process. The ability of certain plants of Kentucky bluegrass to reproduce via seed asexually is called apomixes. Highly apomictic cultivars are very desirable to reduce plant-to-plant variation within a turf stand. Therefore, the ability to identify apomictic plants for breeding purposes is important. In this study, we chose a USDA core collection, which contains germplasm from many locations that have been shown to be genetically diverse. These collections could prove to be a useful source of genetic diversity for desired traits in breeding programs.

Materials and Methods

A USDA core collection with 38 accessions from 14 different countries was selected for analysis. The procedure for analysis comes from Matzk et.al. (2000.) A flow cytometer was used to determine DNA content in picograms for somatic tissue (leaf tissue). Reproductive mode was determined by analysis of mature seed. By comparing the relative positions and amplitude of the means of the nuclei peaks from the flow cytometry data, a model can be constructed based on known reproductive processes within Kentucky bluegrass. These models appear in Table 1. The data from the flow cytometry measurements appear in Table 2. After analysis, plants were planted during October 2002 at the ISU Horticulture Research Farm for further evaluation of breeding potential.

Table 1. Pathways of recombination that could be constructed from the C values of embryo and endosperm nuclei of Kentucky bluegrass.

	Female gametes		Embryo		Endosperm		Male gametes		
C values in histogram [1]	Reduced	Unreduced	Zygotic	Parthenogenic	Fertilized	Autonomous	Reduced	Unreduced	Seed formation
2C + (3C)	X		X		X		X		Sexual, reduced sperms
2C + (5C)		X		X	X		X		Pseudogamous, reduced sperms
1C + (3C)	X			X	X		X		Reduced, Parthenogenic

[1] Endosperm values in parentheses.

From Matzk et. al. (2000)

Results

Several reproductive modes are present within the 38 accessions tested. The majority of accessions possess both sexual and apomictic seed. Sexual reproduction and Pseudogamous seed formation were the most prevalent, however, some accessions did exhibit parthenogenic seed formation. The mean DNA content of the accessions also confirms that the collection is relatively genetically diverse.

Works cited

Matzk, F. Meister, A. Schubert, I. *An efficient screen for reproductive pathways using mature seeds of monocots and dicots.* The Plant Journal, 2000. 21 (1), 97-108.

Table 2. DNA content and reproductive model of the accessions of the core collection.

Accession	Origin	Mean DNA content [1] (pg)	Reproductive Model [2] (c values)
1	Switzerland	2.74	2c (3c)
2	Turkey	6.02	2c (3c) (5c)
3	Iran	7.25	2c (3c) (5c)
4	Iran	10.97 (16.56)	2c (3c) (5c)
5	Spain	7.30 (11.82)	2c (3c) (5c)
6	Canada	11.40 (9.20)	2c (3c) (5c)
7	Iran	7.37 (10.97)	2c (3c) (5c)
8	Czech Republic	6.92 (10.26)	2c (3c) (5c)
9	Hungary	4.85 (6.29)	2c (3c)
10	Spain	7.30 (9.76)	2c (3c) (5c)
11	Sweden	10.79 (5.34)	2c (3c) (5c)
12	Norway	9.33	2c (3c) (5c)
13	USA (Alaska)	10.73	1c 2c (3c)
14	USA (Alaska)	9.18 (11.59)	2c (3c) (5c)
15	USA (Alaska)	8.07 (12.49)	2c (3c) (5c)
16	USA (Alaska)	10.18	2c (3c) (5c)
17	USA (Alaska)	9.41	2c (3c) (5c)
18	USA (Alaska)	8.89 (14.57)	2c (3c) (5c)
19	USA (Alaska)	7.22	2c (3c) (5c)
20	USA (Alaska)	8.39	1c 2c (3c)
21	USA (Alaska)	8.32	2c (3c) (5c)
22	USA (Alaska)	8.42 (15.16)	2c (3c) (5c)
23	India	9.28 (14.54)	1c 2c (3c)
24	USA (Alaska)	7.37	2c (3c) (5c)
25	Netherlands	9.32 (13.07)	1c 2c (3c) (5c)
26	USA (Alaska)	10.79 (15.70)	2c (3c) (5c)
27	USA (Alaska)	9.75	2c (3c) (5c)
28	USA (Alaska)	8.09 (11.75)	2c (3c) (5c)
29	USA (Alaska)	9.73	2c (3c) (5c)
30	Spain	10.11	2c (3c)
31	Kazakhstan	9.27	2c (5c)
32	Russia	6.60 (9.92)	2c (3c) (5c)
33	Russia	7.19	2c (3c) (5c)
34	Russia	6.74	2c (3c) (5c)
35	USA	6.24	2c (3c) (5c)
36	USA	6.36 (11.12)	2c (3c) (5c)
37	USA	9.73	2c (3c) (5c)
38	USA	7.8	2c (3c) (5c)

[1] DNA content of majority (minority) of plants sampled.

[2] Observed peaks from flow cytometry histogram embryo (endosperm).

Perennial Ryegrass Breeding Research 2001-2002

Robert Wieners and Shui-zhang Fei

Objective

The use of perennial ryegrass has seen significant increases in recent decades, largely due to its improved genetic color, texture, density and environmental stress tolerance. The fast establishment rate, excellent seedling vigor, good wear tolerance and the ability of perennial ryegrass to compete with *Poa annua* makes it a good choice for use on golf course fairways and athletic fields in Iowa. However, most of the elite perennial ryegrass cultivars do not have adequate winter hardiness to survive severe winters in the northern USA, including Iowa. The goal of this research was to develop new perennial ryegrass germplasm with improved cold tolerance for better persistence in northern climates. The specific objectives of this project were to: 1. screen a USDA perennial ryegrass collection for stress tolerance, and 2. make crosses between improved varieties and wild materials possessing desirable traits and select superior individual plants within the progeny. By utilizing the diversity present in USDA collections, unique germplasm may be created for utilization in turfgrass breeding programs.

Research progress

Field research
One hundred and five accessions of perennial ryegrass collected primarily from temperate regions worldwide and two improved cultivars of "Accent" and "Caddieshack' were planted at the ISU Horticulture Research Farm in 2001. Each accession was sown in a 4ft by 4ft plot with three replicated blocks. In the following spring (2002), cold hardiness was assessed by visually evaluating the stand persistence. Although the 2001 winter was considered mild in Ames, some accessions were winter-killed. Sixty-seven out of 105 wild accessions survived and appeared to possess adequate cold tolerance for further investigation. The 67 accessions were scored based on color, texture, and density and then compared to the cultivars Caddieshack and Accent. As a result, plants from 14 accessions with superior traits were selected and taken to the greenhouse for crossing.

Meanwhile, the 67 accessions in the field were allowed to grow to maturity in order to evaluate seed production potential. The plots were then gradually mowed down to a normal turf height of 2.75 inches. After a month of regrowth, opportunistic traits were scored which included rust and leaf spot infestation. Each trait was scored once at the height of infestation and compared to the improved cultivars of Accent and Caddieshack. In addition to disease screening, mowing quality data was obtained. Plots were allowed to grow per typical turf conditions and mowed to approximately 2.75 inches. The amount of leaf tearing was scored and compared to Accent and Caddieshack. From this data, more selections were made. Five additional accessions that exhibited good mowing quality were selected and taken to the greenhouse.

Greenhouse research
Four individual seeds from each accession were also grown in the ISU horticulture greenhouse to screen for seed germination time, shoot development, density and regrowth potential in 2001. In 2002, individual plants were cut several times to score regrowth again. Plants were also screened during the summer of 2002 for heat tolerance. The data obtained from greenhouse experiments resulted in the selection of seven additional accessions for further research.

Each of the original 14 selected accessions were crossed with either Accent or Caddieshack in controlled-pollination. Seeds were then harvested and three progeny of each cross were grown in the greenhouse and transferred to the field for evaluation on cold hardiness, persistence, color, texture, and density.

Conclusions

As a result of the data obtained to present, 26 of the original 105 accessions were chosen for further research. Plants are chosen based upon cold tolerance first, then by three additional criteria. The first group consists of 14 accessions selected based upon color, texture, and density. The second group consists of 5 additional accessions selected based upon mowing quality. The third group consists of another set of accessions selected based upon heat tolerance and regrowth potential. Although most of the accessions that were chosen appeared to have lower quality than Caddieshack and Accent, some accessions had a trait that was comparable. This, however, is not surprising, because most of the accessions, if not all, had never been subjected to human selection, but these accessions may have better cold tolerance that can be incorporated into existing elite perennial ryegrass germplasm.

Changes in Carbohydrate Metabolism in Response to Mowing

Mark Howieson and Nick Christians

Mowing is a common cultural practice essential to maintain dense, uniform, and appealing turfgrass. Mowing is defoliation, and therefore, removes leaf tissue that plants use to capture light energy from the sun. Captured light provides energy for the production of organic molecules, such as proteins and carbohydrates. Regrowth and initiation of new leaf tissue after defoliation is important to develop a new photosynthetic surface required for the production of carbohydrates. Carbohydrate and nitrogen reserves provide energy and raw materials for shoot and leaf regeneration. The most abundant carbohydrates in creeping bentgrass are fructose, glucose, sucrose, and fructan. Fructose and glucose can be consumed to provide energy or incorporated into reserve carbohydrates when energy is abundant. Sucrose is transported via the phloem from source to sink tissues and it is broken down into one fructose and one glucose. Fructan is a reserve carbohydrate found in creeping bentgrass and is composed primarily of fructose molecules. The objective of this study was to determine how fructose, glucose, sucrose, and fructan concentrations change over time in response to defoliation.

Creeping bentgrass seeds were planted in 14 x 20 inch flats filled with sand and grown in a greenhouse. High-pressure sodium lamps provided a 16-hour photoperiod. The sand was fertilized weekly with a modified Hoagland's solution that supplied 0.75 lbs of nitrogen per 1000 ft^2 per month. Grass was clipped three times a week at a height of 0.5 inch with an electric reel mower prior to the initiation of the study.

There were four mowing height treatments. Grasses were clipped at 0.50, 0.35, 0.20 inches and not mown. Following mowing treatments, approximately 1.5 grams of stubble tissue were collected every 24 hours for 72 hours. A subsample was dried at 68°C for three days for dry weight analysis, the remaining tissue was frozen and ground in liquid nitrogen. Ground samples were stored at -20°C until further analysis.

Carbohydrates were extracted by placing the frozen tissue into 8 mL of boiling 80% ethanol for one hour. The supernatant was poured off and 5 mL of boiling water was added to the grass tissue. The tissue was extracted in the water for 1 hour and the aqueous supernatant was poured off and pooled with the ethanolic supernatant. The pooled supernatants were evaporated to dryness using a rotary evaporator and the insoluble residue was dissolved in 5 mL of water.

Carbohydrate concentration was determined by high performance liquid chromatography (HPLC) using a Sugar Pak I column and a refractive index detector. The mobile phase was 0.1 mM CaEDTA in water. The flow rate was 0.5 mL/minute and the column was heated to 90°C. Inulin, sucrose, fructose, and glucose were used as standards.

The study was in a completely randomized design with three replications per treatment. Fisher's LSD ($p=0.05$) was used to separate means.

Fructan concentration declined in grass clipped at 0.35 and 0.50 inches for 48 hours after mowing (Figure 1). Fructan concentrations 72 hours after mowing were similar to those observed at the start of the study. Grasses clipped at 0.20 inch had the lowest fructan concentration at all sampling times and fructans did not accumulate 48 hours after mowing as they did in grasses mown at 0.50 and 0.35 inches (Figure 1). No differences were observed in sucrose concentration among the four mowing treatments (Figure 2). Grasses mown at 0.20 inches consistently had the lowest glucose and fructose concentrations over the 72-hour study (Figure 2 and 3).

These results emphasize the importance of not removing more than 1/3 of shoot tissue in a single mowing. Grasses mown at 0.20 had approximately 60% of above ground tissue removed and remained chlorotic for several weeks after mowing. These plants consumed large quantities of carbohydrates to recover from mowing stress. Grasses mown at 0.35 inches had 30% of above ground tissue removed by mowing. These plants were able to recover rapidly from the mowing stress by consuming stored carbohydrates to provide energy for regrowth. Future research will examine the quantities and activities of enzymes responsible for synthesis and catabolism of fructan, sucrose, glucose, and fructose. This research will further our understanding of how mowing affects carbohydrate metabolism.

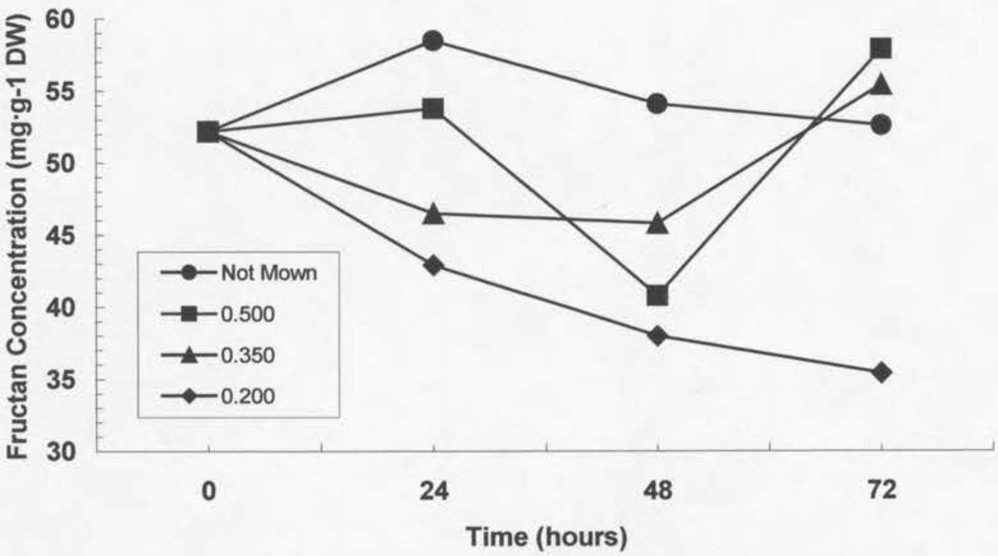


Figure 1. Fructan concentration over time of creeping bentgrass after defoliation

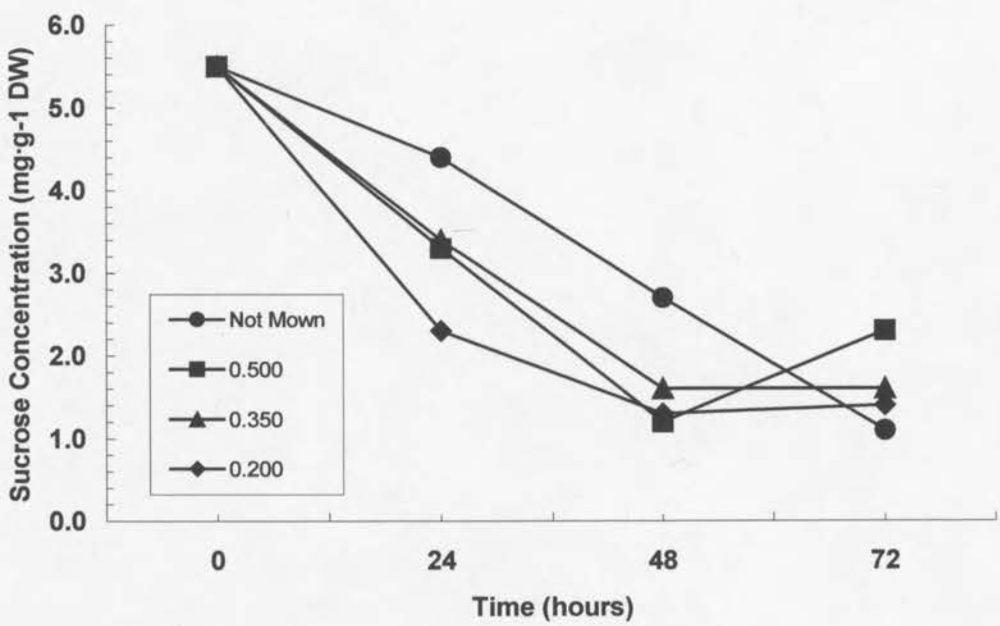


Figure 2. Sucrose concentration over time of creeping bentgrass after defoliation

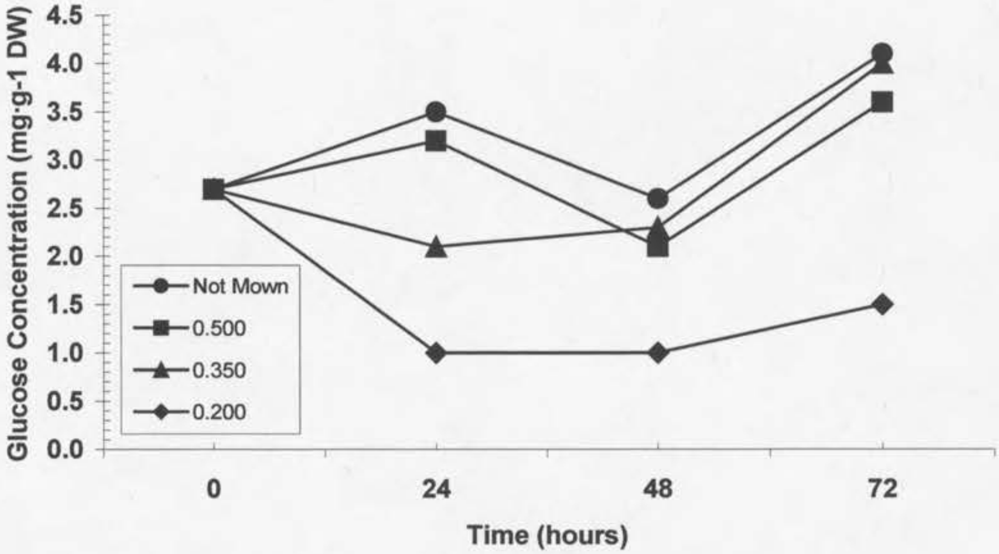


Figure 3. Glucose concentration over time of creeping bentgrass after defoliation

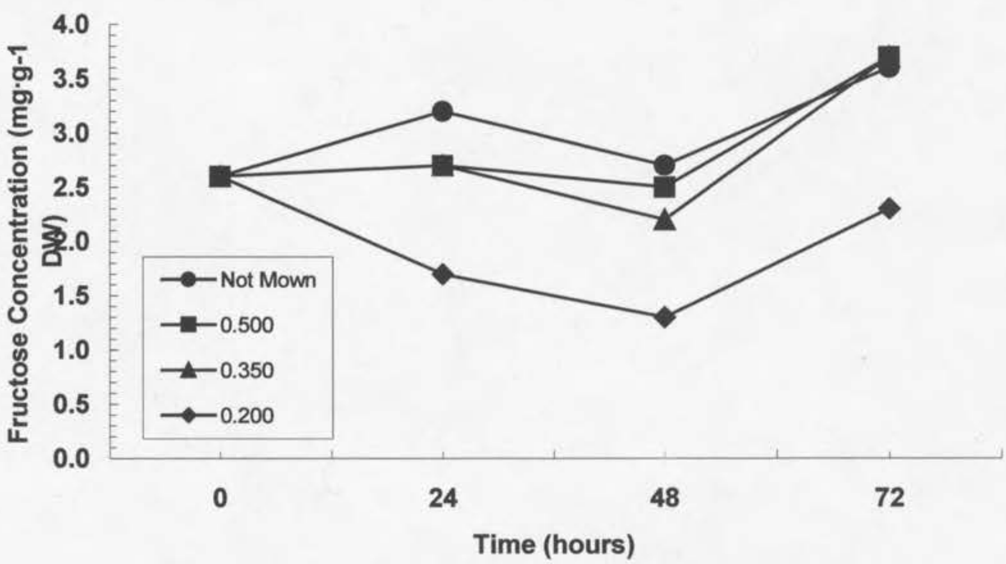


Figure 4. Fructose concentration over time of creeping bentgrass after defoliation

Timing of Roundup® Application Critical when Converting Golf Course Greens and Fairways to Roundup® Ready Creeping Bentgrass

Luke Dant, Nick E. Christians and Shui-zhang Fei

Introduction

Roundup® Ready creeping bentgrass (RRCB) could be the golf course superintendent's key to eliminating the invasion of seemingly uncontrollable weed species, particularly *Poa annua*, in golf course greens and fairways. Roundup® is considered to be a relatively safe herbicide to both the handler and the environment while at the same time providing superior weed control. Additionally, an integrated weed management program based on the use of Roundup® herbicide could be a cost effective alternative to conventional weed control methods.

Unfortunately, the complete renovation to RRCB would be costly and would render a golf course unplayable for a significant period of time. If it was possible to incorporate the overseeding of RRCB into regular maintenance processes, such as verticutting and aerification, existing greens and fairways could slowly be converted to RRCB. This would therefore eliminate costly renovation and the interruption of play.

The overall goal of this project is to determine at what time, in relation to the overseeding of RRCB, that the Roundup® susceptible turf should be removed with Roundup®, so that a successful conversion to RRCB can be achieved. This ideal time would minimize disturbance to the playing surface while still maintaining a satisfactory appearance of the golf course green or fairway.

Site

The study is being conducted at Veenker Memorial Golf Course in Ames, Iowa on one green and three fairways built on native soil. This area was built with the intent to conduct research, therefore, the research plots are not in play. The green is maintained at a height of 0.145 inches and the fairways are mown at 0.60 inches. The research area contains these existing turfgrass species:

- Green
  - 'Penncross' creeping bentgrass
- Fairway
  - 'Trueline' creeping bentgrass
  - Scotts 100-81600 perennial ryegrass mix
    - 35.77% 'Divine'
    - 32.63% 'Majesty'
    - 29.86% 'Enchanted'
  - Double Eagle Kentucky bluegrass mix
    - 29.51% 'Apollo'
    - 24.72% 'Serene'
    - 14.94% 'Coventry'
    - 14.88% 'Envicta'
    - 14.79% 'Blackstone'

Methods

The following treatments where selected in order to accomplish the goal of this study. All treatments were replicated three times on the putting green and three times on each fairway.

It should be noted that during the breeding process, a yield of only 50% RRCB is achieved, whereas the other 50% is conventional bentgrass. The Scotts Company recommends that a Roundup® application be made 4 weeks after seeding to eliminate competition from conventional bentgrass plants that are Roundup® susceptible.

Complete Renovation

Treatment 1 acted as a control in which a bare soil seedbed was prepared. As with the other treatments, RRCB seed was applied at a rate of 1.75 lb per 1000 sq. ft.

1. Apply Roundup® two weeks before seeding, remove sod and prepare seedbed, apply Roundup® again four weeks after seeding to remove Roundup® susceptible seedlings

Conversion Using Aerificaiton and Verticutting

Green

Treatments 2-11 of the green study were core aerified in two directions using 5/8-inch tines and the aerification cores were harvested. The area was then verticut and topdressed to fill all aerification holes. RRCB seed was applied at a rate of 1.75 lb per 1000 sq. ft. To obtain good soil-to-seed contact the plot was lightly verticut and spiked.

Fairways

Core aerification with 5/8 tines took place on treatments 2-11 in two directions and the cores were broken up using a verticuter. The area was then dragged and seeded at a rate of 1.75 lbs RRCB seed per 1000 sq. ft. As with the green, the plot was lightly verticut and spiked.

2. No Roundup® application treatment during current growing season
3. Apply Roundup® one week prior to seeding and apply Roundup® again four weeks after seeding
4. Apply Roundup® at time of seeding and apply Roundup® again four weeks after seeding
5. Apply Roundup® one week after seeding with no additional Roundup® applications during the same growing season
6. Apply Roundup® one week after seeding with an additional Roundup® application four weeks after seeding
7. Apply Roundup® two weeks after seeding with no additional Roundup® applications during the same growing season
8. Apply Roundup® one week after seeding with an additional Roundup® application four weeks after seeding
9. Apply Roundup® four weeks after seeding with an additional Roundup® application four weeks after seeding
10. Apply Roundup® at the end of the growing season
11. Apply at one fourth of the recommended rate of Roundup® at seedling emergence; apply three repeated applications of Roundup® at one fourth of the recommended rate at a two week intervals (to suppress and gradually remove the existing grass).

Current Status of the Study

The study was started on August 17, 2002 and was seeded on September 3, 2002. On May 7, 2003 all of the plots were sprayed with Roundup® to determine the actual population of RRCB plants in each plot. Subsequent Roundup® applications will be made to the entire study during the current growing season to remove any unwanted plant species.

This research project will conclude at the end of the 2003 growing season and the results will be placed in the 2004 Iowa State University Research Report.

Cation Ratios and Soil Testing Methods for Sand-Based Golf Course Greens

Rodney St. John, Nick Christians, Henry Taber

This research is being supported by a grant from the USGA.

Introduction:
The current recommendation for golf course greens construction is to utilize a sand root-zone mix. These sands have low cation exchange capacities (CEC), ranging from less than 1 to 6 $cmol_c \cdot kg^{-1}$. With so few cation exchange sites available, applying the correct amount of fertilizer to provide adequate plant nutrition without causing nutrient leaching can be difficult. To further complicate the problem, the sand used for greens and athletic field construction is often derived from limestone and is termed calcareous. Calcareous sands are found throughout the United States.

Calcareous soils have been extensively studied on agronomic crops established on soils with large proportions of clay, silt and organic matter and relatively high cation exchange capacities. Very little work has been done to relate turfgrass growth and development with the low CEC-sands used for golf course greens.

Goal:
To develop a set of standard methods and models to be used in analyzing turfgrass soil samples, especially for calcareous sand samples. To gain better understanding of cation ratios used for making fertilizer recommendations. Accurate recommendations will help develop best management practices that increase overall turfgrass health and protect the environment.

Objectives:
1. To evaluate and correlate several existing soil extraction methods with tissue analysis to determine which type of extractant is best for sand based turfgrass systems.
2. To modify, if necessary, existing extraction methods to better suit turfgrass soil types.
3. To better understand how the BCSR theory and Ca/Mg/K ratios apply to turfgrass systems.
4. Improve current recommendations for Ca/Mg/K fertilization of turfgrass.

Research Methodology:
***Soil Testing Methods*:**
A greenhouse experiment will be started to evaluate different extraction methods and gain further knowledge about different Ca/Mg/K ratios. Four different levels of each Ca, Mg, and K will be applied to creeping bentgrass established on calcareous or silica sand. Soil and tissue samples will be taken and analyzed for nutrient content using an Inductive Coupled Argon Plasma (ICAP) machine, which can analyze 12 different nutrient concentrations. The different extraction methods will be correlated with tissue analysis and applied fertilizers.

Moreover, tissue and soil samples will be collected from several golf courses and other turf areas with varying soil type, and the soil testing methods will be correlated with tissue tests.

Ca/Mg/K Ratios:
The same greenhouse experiment listed above will try to establish different basic cation ratios. Some preliminary work will be done to determine the best methodology for establishing and maintaining the different cation ratios. As of now, we are planning to use 4 different levels of each Ca, Mg, and K to make 12 different cation ratios. Creeping bentgrass will be established on either calcareous or silica sand. Clippings and soil samples will be collected and analyzed monthly. Tissue, soil test results, and quality ratings will be correlated to evaluate the differing cation ratios.

Treatments
- One Grass: creeping bentgrass
- Two Sand Types: calcareous and silica sand
- Three different nutrients: calcium, magnesium and potassium
- Four different levels of each nutrient: low, medium low, medium high and high

Expected Results:
Initiate or develop use of better analysis techniques for soil nutrient testing of sand-based turfgrass systems.
Improved understanding of Basic Cation Saturation Ratio Theory and Ca/Mg/K ratios used for fertilizer recommendations.

Development of Remote Sensing Techniques to Determine Moisture and Nutrition Stress

J. K. Kruse, N. E. Christians and M. H. Chaplin

Turfgrass managers must continually monitor their fertilization and irrigation programs to ensure optimal appearance while minimizing losses to the environment and maximizing profit. Characterizing the spatial variability of nutrient and moisture status across a golf course or large sports facility requires careful observation and collection of many soil and tissue samples. Optical remote sensing techniques have been shown to be valuable tools in quickly and reliably identifying stressed plants through the use of various vegetative indices derived from reflectance data collected from the crop canopy. Extensive research has been conducted investigating vegetative indices as they relate to the nutritional and moisture status of various agricultural crops with intriguing results. Handheld remote sensing systems are already being used in evaluating the chlorophyll content of turfgrass stands, which in turn is related to the quality of the turfgrass being grown. The use of remotely sensed data may prove to be a valuable tool in the modification of traditional irrigation and fertility programs to reduce inputs and improve environmental quality. The potential exists for the use of an optical remote sensing system to provide maps indicating the moisture and nutritional status of large turfgrass areas, thus enabling the use of site-specific management techniques which will reduce the application of fertilizers and irrigation.

The objectives of this research are to: 1) Evaluate various indices reported in the literature as tools for identifying moisture and nutrient stressed turf, 2) Develop new indices to be used in detection of moisture and nutrient deficiencies, and 3) Determine differences in spectral response of Creeping Bentgrass, Kentucky Bluegrass, and Perennial Ryegrass.

This interim report will focus on some of the studies conducted to date involving remote sensing of turfgrass nitrogen and potassium status. The nitrogen and potassium studies were organized in a randomized complete block design with four replications each. Each replication in the nitrogen study consisted of three treatments: 0.0, 0.5 and 1.0 lbs N/1000ft^2/30d applied as urea with all plots receiving 0.1 lbs P/1000ft^2/30d and 0.5 lbs K/1000ft^2/30d applied as phosphoric acid and potassium chloride respectively. Each replication in the potassium study consisted of three treatments: 0.0, 0.5 and 1.0 K/1000ft^2/30d applied as potassium chloride with each plot receiving 0.1 lbs P/1000ft^2/30d applied as phosphoric acid and 1.0 lbs N/1000ft^2/30d applied as urea. Treatments were split into two applications once every two weeks, and applied in solution using a CO_2 backpack sprayer calibrated to apply 3.0 gallons of water/1000ft^2. Irrigation was applied immediately following treatments to reduce the risk of fertilizer burn. The study area consisted of 'Penncross' creeping bentgrass (*Agrostis palustris* Huds.) established on a USGA sand-based green.

Evaluation of turf quality was made twice a month, coinciding with the collection of remotely sensed data. Quality was ranked on a scale of 9 to 1; with 9=best, 5=lowest acceptable and 1=worst. Optical remote sensing data was collected twice monthly using an OceanOptics SD1000 spectrometer mounted on a self contained cart equipped with a hood to block out ambient sunlight and halogen bulbs to provide a consistent source of illumination on the turf. This system was designed to eliminate the problems typically associated with differences due to shade, which is a common occurrence on many turfgrass areas. The spectrometer was calibrated to measure reflectance from 350-1150 nm with a resolution 1.0 nm. The following growth and stress indices were also evaluated:

1. NDVI growth indice computed as R850 – R680/R850 + R 680
2. SR1 stress indice computed as R950/R899
3. SR2 stress indice computed as R695/R419
4. SR3 stress indice computed as R695/R759
5. SR4 stress indice computed as R550 – R600/R800 – R899
6. SR5 stress indice computed as R630/R489
7. SR6 stress indice computed as R370/R489
8. SR7 stress indice computed as R370 + R630/R490 + R799

Tissue was harvested once monthly following collection of remotely sensed optical data and analyzed for plant nutrient content using standard Total Kejhdahl Nitrogen and Inductively Coupled Argon Plasma Spectroscopy plant analysis procedures.

Nitrogen Content vs. Reflectance

The growth and stress indices were correlated with turf quality, percent nitrogen in the tissue, and chlorophyll content to determine if there was any relationship between them. There was a strong correlation between percent nitrogen in the tissue and the Normalized Difference Vegetation Index (NDVI), SR1 and SR3 indices (r = 0.76, -0.68 and -0.79 respectively). The other indices investigated did not correlate well with percent nitrogen, though SR5, SR6 and SR7 correlated with chlorophyll content in the tissue (r = 0.67, -0.75 and -0.74 respectively). NDVI and SR3 also showed a strong correlation with quality (r = 0.80 and -0.83 respectively) (Table 1).

Table 1. Correlation coefficients for reflectance vs. quality, percent nitrogen and chlorophyll content for the nitrogen study.

Wavelength†	Quality	Chlorophyll Content	Percent Nitrogen
NDVI	0.80	-0.10	0.76
SR1	-0.58	-0.40	-0.68
SR2	0.16	-0.55	0.03
SR3	-0.83	0.22	-0.79
SR4	-0.57	-0.07	-0.60
SR5	-0.36	0.67	-0.24
SR6	-0.12	-0.75	-0.40
SR7	-0.04	-0.74	-0.36

† Percentage of reflectance at selected wavelength ratios.

Potassium Content vs. Reflectance

There was little correlation between potassium content of the tissue and the growth and stress indices investigated in this study (Table 2). However, SR1, SR2, SR5, SR6 and SR7 showed high correlation with chlorophyll content of the tissue (r = -0.61, -0.78, 0.74, -0.78 and -0.79 respectively) (Table 2).

Table 2. Correlation coefficients for reflectance vs. quality, percent potassium and chlorophyll content for the potassium study.

Wavelength†	Quality	Chlorophyll Content	Percent Potassium
NDVI	0.18	0.20	0.17
SR1	-0.20	-0.61	-0.28
SR2	0.26	-0.78	-0.03
SR3	-0.37	-0.54	-0.34
SR4	-0.11	-0.32	-0.14
SR5	-0.17	0.74	-0.12
SR6	-0.23	-0.28	-0.02
SR7	-0.31	-0.79	-0.01

† Percentage of reflectance at selected wavelength ratios.

Discussion

Spectral data appears to be able to discriminate between plots of various qualities when the visual symptoms are obvious, such as those resulting from various nitrogen treatments. It was not surprising to find little correlation between quality and the various indices due to the visual similarities between all the potassium treatments. Several indices showed a correlation with chlorophyll content in both studies, which may prove to be valuable in accessing overall turf quality due to the fact that increasing concentrations of chlorophyll result in a greener turfgrass, which is often associated with higher quality. The strong correlations between the reflectance ratios and nitrogen content indicate the possibility that this technology might be successfully utilized in managing turfgrass nitrogen programs on a site-specific basis.

In addition to the two studies whose preliminary results are discussed here, several moisture studies have been conducted investigating the use of the remote sensing equipment to evaluate the moisture status of turfgrass plants growing under fairway conditions on a golf course. Work is also being done to evaluate the influence of soil amendments on spring green-up and heat stress on the reflectance qualities of a turfgrass stand.

Evaluation of Methylene urea Rate and Mixing Depth for Growth and Establishment of *Poa pratensis* L. on Sand-based Systems

S.K. Lee, D. D. Minner, N. E. Christians and H. G. Taber

Introduction

The fundamental concept of a slow-release fertilizer is that it releases its nutrients at a more gradual rate that allows maximum uptake and use of nutrients by plants while minimizing the losses due to leaching, volatilization, or unnecessary turf growth (Sartain, 2002). This may reduce the number of fertilizer applications required to maintain plant growth at desired levels and allow greater rates of fertilizer to be applied in a single application. Slow- and controlled-release N sources reduce leaching potential under adverse climatic and edaphic conditions as well as provide other benefits such as reduced burn potential, extended release over time, and lower labor costs (Fry et al., 1993).

Methylene ureas are a class of slow-release N that were promoted during the 1960's and 1970's (Sartain, 2002). These products predominantly contain intermediate-chain-length polymers. The total N content of a methylene urea polymer is 39 to 40%, with between 25 and 60% of the N present being cold-water insoluble N (CWIN) (Christians, 1998). Unreacted urea N content generally is in the range of 15 to 30%. The objective of this study was to compare urea and methylene urea (Nutralene®) by measuring clipping dry weight, root dry weight, root organic matter, and amount of NO_3-N leached from a soil column at 146 and 293 kg•ha^{-1} and four mixing depths (0, 7.6, 15.2, and 22.9 cm) on a sand-based system.

Materials and Methods

This study was conducted for 12-weeks in a greenhouse at Iowa State University. Ames, Iowa. The experimental design was a randomized complete block with 16 treatments and four replicates. Methylene urea (Nutralene®), a slow-release N source, and urea (46-0-0), a fast-release N source, were the N sources. Both materials were evaluated with four mixing depths of 0, 7.6, 15.2, and 22.9 cm and evaluated with two application rates (146 and 293 kg•ha^{-1}). Urea for surface application was applied weekly at 12.17 and 24.42 kg•ha^{-1}, giving a total of 146 and 293 kg•ha^{-1} during the 12-week study period, respectively.

Local mason's sand that met the United States Golf Association (USGA) specification was used as the growing medium (USGA Green Section Staff, 1993). The sand was packed into a 7.62 cm diameter polyvinyl chloride (PVC) pipe lined with a clear plastic sleeve. The PVC pipe was capped at the bottom, and the plastic sleeve tied off at the bottom with fine holes punched into it facilitate drainage while keeping the sand in place. The plastic sleeve had a length of 38.1 cm, and the root zone depth was 30.5 cm. The columns were sodded with mature sod of *Poa pratensis* L. harvested and watered 300 ml each week. Greenhouse temperature during the night and day was 19.4-22.2 °C, respectively.

Modified Hoagland solution was used that enabled proper levels of nutrients to be maintained in the root zone (Pellett and Roberts, 1963). The N fertilizers were applied on 4 Nov. 2002. Grass clippings were taken from each tube at two-week intervals. At the end of the study, root dry weight and organic matter weight for roots were measured. All leachate was collected from the cup under the PVC pipe for final nutrient analysis. Nitrate-N of the leachate was analyzed by using the cadmium-reduction method (Bremner, 1965).

Data were subjected to analysis of variance by using the Analysis of Variance (ANOVA) procedure, and mean separation was performed by the least significant difference (LSD) method wit the Statistical Analysis System (SAS, 1987).

Results

Significant effects on clipping dry weight were found in all treatments and interactions with exception of N rate X mixing depth and N source X N rate X mixing depth (Table 1). For this reason, each factor was reported independently at each mixing depth of the other factors (Table 2). In 0 cm mixing depth, both of urea and Nutralene® had no difference within same rate. However, Nutralene® of 293 kg•ha^{-1} rate produced 96-437 % more clipping dry weight than urea of 293 kg•ha^{-1} rates in 7.6, 15.2, and 22.9 cm mixing depth. Nutralene® of 146 kg•ha^{-1} rate had 142 % clipping dry weight than urea of 146 kg•ha^{-1} rate in 7.6 cm mixing depth.

There were significant main effects and interaction effects of N source X mixing depth observed on root dry weight and root organic matter (Table 1). Urea at a rate of 293 kg•ha^{-1} rate resulted in more root dry weight and root organic matter than Nutralene® at the 293 kg•ha^{-1} rate applied at the 0 cm mixing depth. Conversely, Nutralene® at a rate of 293 kg•ha^{-1} rate produced more root dry weight and root organic matter than urea of 293 kg•ha^{-1} rate applied at the 7.6 cm mixing depth. Nutralene® at a rate of 146 kg•ha^{-1} rate had 72 and 63 % more root dry weight and root organic matter, respectively than urea at a rate of 146 kg•ha^{-1} rate applied at the 15.2 cm mixing depth.

No N source and rate effects for NO_3-N release was found in 0 cm mixing depth. Interestingly, the 146 kg•ha^{-1} Nutralene® rate provided less leached NO_3-N with more clipping dry weight, root dry weight, and root organic matter than plants that received urea at 146 kg•ha^{-1} applied at the 7.6 cm mixing depth. Nutralene® at a rate of 293 kg•ha^{-1} rate at the 22.9 cm mixing depth also produced 18 ppm leached NO_3-N with more clipping dry weight, root dry weight, and root organic matter compared to urea at a rate of 146 kg•ha^{-1} rate in 22.9 cm mixing depth that produced 174 ppm leached NO_3-N.

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Table 1. Summary of analysis of variance indicating significant source effects on total clipping dry weight, root dry weight, root organic matter, and amount of leached NO_3-N.

Source	df	Total clipping dry weight	Root dry weight	Root organic matter	Amount of leached NO_3-N
N-source (NSO)	1	**	*	*	**
N-rate (NRT)	1	**	**	**	NS
Mixing depth (MD)	3	**	**	**	**
NSO × NRT	1	*	NS	NS	NS
NSO × MD	3	**	**	**	NS
NRT × MD	3	NS	NS	NS	**
NSO × NRT × MD	3	NS	NS	NS	*

*, ** Significant at the 0.05 and 0.01 probability level, respectively. NS = not significant.

Table 2. Response of *Poa pratensis* 'Unique' fertilized with Nutralene® or urea at two rates and four depths of fertilizer incorporation. Values are means of four measurements.

Nitrogen source	Rate ($kg{\bullet}ha^{-1}$)	Total clipping dry weight (g/m^2)	Root dry weight (g/m^2)	Root organic matter (g/m^2)	Leached NO_3-N (ppm)
			Depth = 0 cm		
Nutralene®	146	200 cde[z]	157 ef	140 defgh	17 d
Nutralene®	293	331 ab	236 b	209 b	13 d
Urea	146	265 bc	194 bcde	169 bcde	9 d
Urea	293	385 a	305 a	265 a	13 d
			Depth = 7.6 cm		
Nutralene®	146	191 cde	135 ef	121 efgh	25 d
Nutralene®	293	322 ab	219 bcd	193 bcd	13 d
Urea	146	79 fg	136 ef	112 fgh	92 bc
Urea	293	60 g	103 f	96 h	33 cd
			Depth = 15.2 cm		
Nutralene®	146	161 def	175 cde	156 bcdef	45 cd
Nutralene®	293	208 cd	228 bcd	196 bc	115 ab
Urea	146	67 fg	102 f	96 gh	40 cd
Urea	293	106 efg	168 de	152 cdefg	167 a
			Depth = 22.9 cm		
Nutralene®	146	117 defg	150 ef	138 defgh	64 bcd
Nutralene®	293	324 ab	232 bc	212 ab	18 d
Urea	146	64 fg	148 ef	135 efgh	27 d
Urea	293	123 defg	182 bcde	165 bcdef	174 a
LSD (0.05)		99	61	56	64

[z] Values in a column followed by the same letter are not significantly different based on LSD at 0.05 probability.

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

M.L. Gleason, S.J. Helland, and J.P Newton
Department of Plant Pathology and Veenker Memorial Golf Course
Iowa State University

Trials were conducted at Veenker Memorial Golf Course in Ames, Iowa in 2002. 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 1,000 sq ft. The experimental design was a randomized complete block with four replications. All plots measured 4 ft x 5 ft. Because several treatments were added to the trial after it began, spray applications were initiated on 20 Jun, 28 Jun, and 21 Aug. These were followed by re-applications at recommended intervals until 11 Sep. 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 moderate to severe for Dollar Spot and Brown Patch. Most of the tested products suppressed both diseases significantly ($P<0.05$) in comparison to the unsprayed check. No phytotoxicity symptoms were observed during the trial.

		26 Jun		10 Jul		2 Aug		1 Sep	
Product and rate per 1,000 sq ft	Interval (days)	Brown Patch[z]	Dollar Spot[y]	Brown Patch	Dollar Spot	Brown Patch	Dollar Spot	Brown Patch	Dollar Spot
Unsprayed check..........................	---	3.5 a	16.7 a	5.0 a	34.2 a	1.0 ab	29.0 a	3.4 a	5.5 ab
Endorse WP 4 oz..........................	14	0.7 de	11.7 ab	0.0 d	15.7 ab	0.2 bc	21.4 a	0.4 f	3.2 ab
Spectro 90WDG 4 oz......................	14	2.5 a-c	0.3 c	0.0 d	0.0 c	0.0 c	0.0 b	1.0 c-f	0.0 b
3336 WP 4 oz..............................	14	0.5 de	0.5 c	0.0 d	0.0 c	0.0 c	0.0 b	0.1 f	0.5 b
Spotrete F 4 oz............................	14	3.2 a	9.0 a-c	5.0 a	8.5 b	1.5 a	2.0 b	3.2 a	4.5 ab
3336 WP 4 oz alt. w/ Spotrete F 4 oz......	7	1.0 c-e	0.8 c	4.7 a	0.2 c	0.0 c	0.7 b	1.7 b-e	0.0 b
Chipco Signature 80WDG 1.5 fl oz, etc.x..	14	0.0 e	0.5 c	0.0 d	0.0 c	0.0 c	0.0 b	0.0 f	0.0 b
Magellan SC 4.1 fl oz + Daconil Ultrex 82.5WDG 2.1 oz..........................	14	1.5 b-e	2.0 bc	2.5 b	4.0 b	0.5 bc	3.7 b	1.6 b-e	4.9 ab
Magellan SC 4.1 fl oz + Chipco 26GT 1.5 fl oz..	14	2.0 a-d	3.4 bc	1.2 c	0.4 c	0.0 c	0.1 b	1.0 c-f	0.0 b
Magellan SC 4.1 fl oz + 3336 4 oz........	14	2.7 ab	2.7 bc	0.2 d	0.0 c	0.0 c	0.0 b	0.8 ef	0.0 b
Magellan SC 4.1 fl oz + Mancozeb 75DG 4 oz..	14	1.5 b-e	2.2 bc	5.0 a	6.5 b	0.5 bc	6.2 b	2.1 b	9.5 a
Eagle DG 8 lb..............................	14	Xw	X	4.3 a	23.0 ab	0.0 c	7.0 b	1.9 b-d	0.0 b
DGPRO FVII 5.3 lb.......................	14	X	X	5.0 a	11.3 b	0.0 c	5.0 b	2.0 bc	0.0 b
AG-400 8% v/v + Latron 0.2% v/v........	14	X	X	X	X	0.3 bc	X	0.3 f	2.2 ab
AG-400 4% v/v + Latron 0.2% v/v........	14	X	X	X	X	0.3 bc	X	0.3 f	3.5 ab
AG-500 8% v/v + Latron 0.2% v/v........	14	X	X	X	X	0.7 a-c	X	0.7 ef	8.5 a
AG-500 4% v/v + Latron 0.2% v/v........	14	X	X	X	X	0.3 bc	X	0.3 f	5.7 ab

[z] Disease severity ratings on the following qualitative scale: 0 = no disease; 1 = 1-5%; 2 = 6-10%; 3 = 11-25%; 4 = 26-50%; 5 = >50% plot symptomatic.

[y] Percent plot symptomatic.

[x] Chipco Signature 80WDG + : (sequentially) Chipco 26GT2SC 4 fl oz; Triton 1.67SC 1 fl oz; Daconil Ultrex 82.5WDG 3.8 oz; Compass 50WG 0.15 oz; Triton 1.67SC 1 fl oz.

[w] Products were applied after this rating date.

1991 Corn Gluten Meal Crabgrass Control Study - Year 12 - 2002

N. E. Christians and Lukas Dant

Corn gluten meal (CGM) has been screened for efficacy as a natural product herbicide and fertilizer in turf on the same plot since 1991. 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 Hapludoll) with an organic matter content of 4.6% a pH of 6.45, 3 ppm P, and 144 ppm K.

Individual 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 each year to the same plots at 0, 20, 40, 60, 80, 100, and 120 lbs/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/1000 ft^2. The CGM is applied each year in a single early-spring preemergence application using '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 2002, applications were made on April 26.

Turf quality was monitored from May 7 through October 14 (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 of cover per individual plot. Crabgrass infestations were determined by counting the number of plants per individual plot starting on July 31 (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). Dandelion and clover data were taken from May 7 through September 10. Data were analyzed with the Statistical Analysis System (SAS) and the Analysis of Variance (ANOVA) procedure.

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 9	May 14	Jun 1	Jun 29	Aug 19	Sep 10	Sep 26	Oct 14
1	**Untreated control**	0	0	2	2	4	1	6	5	5	5
2	**Corn gluten meal**	20	2	4	4	5	2	7	7	6	6
3	**Corn gluten meal**	40	4	5	5	6	3	8	8	6	7
4	**Corn gluten meal**	60	6	6	5	7	3	8	8	7	7
5	**Corn gluten meal**	80	8	6	6	8	6	9	9	8	7
6	**Corn gluten meal**	100	10	8	8	8	6	8	8	8	8
7	**Corn gluten meal**	120	12	8	8	8	6	9	9	8	8
	$LSD_{0.05}$			2.4	1.7	1.1	1.6	1.4	1.8	1.4	NS

[1]Turf 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 31	August 19	Sept 10
1	**Untreated control**	0	0	2	5
2	**Corn gluten meal**	20	0	4	3
3	**Corn gluten meal**	40	1	0	0
4	**Corn gluten meal**	60	0	0	0
5	**Corn gluten meal**	80	1	0	0
6	**Corn gluten meal**	100	0	2	0
7	**Corn gluten meal**	120	0	0	0
	$LSD_{0.05}$		NS	NS	NS

[1]These 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 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	May 7	May 14	June 1	June 29	July 31	Aug 19	Sept 10
1	**Untreated control**	0	25	30	21	56	52	47	45
2	**Corn gluten meal**	20	15	17	11	16	19	23	23
3	**Corn gluten meal**	40	1	2	1	1	13	3	2
4	**Corn gluten meal**	60	0	1	0	1	5	2	1
5	**Corn gluten meal**	80	1	0	1	0	11	2	2
6	**Corn gluten meal**	100	0	0	0	0	0	2	1
7	**Corn gluten meal**	120	0	0	0	0	0	1	1
	$LSD_{0.05}$		14.1	20.8	14.2	NS	NS	NS	NS

[1]These 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 7	May 14	June 1	June 29	July 31	Aug 19	Sept 10
1	**Untreated control**	0	31	17	27	22	10	22	30
2	**Corn gluten meal**	20	20	20	17	3	3	10	16
3	**Corn gluten meal**	40	33	10	10	10	10	15	25
4	**Corn gluten meal**	60	27	25	8	5	2	13	22
5	**Corn gluten meal**	80	1	2	0	0	13	1	2
6	**Corn gluten meal**	100	0	17	0	0	4	1	4
7	**Corn gluten meal**	120	0	2	0	0	2	1	2
	$LSD_{0.05}$		NS	NS	NS	14.0	NS	13.2	19.1

[1]These 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 8 - 2002

N. E. Christians and Lukas Dant

Corn gluten meal (CGM) is being screened for efficacy as a natural product herbicide in 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 Hapludoll) with an organic matter content of 4.8%, a pH of 7.1, 6 ppm P, and 170 ppm K. 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). 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 application of 10 lb/1000 ft^2, and a single application of 40 lb/1000 ft^2 are included with an untreated control.

Initial applications in 2002 were made on April 26 before crabgrass germination. The second application of treatment 2 was made on June 2. The third application of treatment 2 and the second of treatments 3 and 4 were made on July 18. The final application of treatment 2 was made on August 14.

The experimental plot was checked for phytotoxicity after each treatment. Turf quality data were taken weekly from spring greenup on May 8 through October 14. Visual quality was measured using a 9 to 1 scale with 9 = best and 6 = lowest acceptable, and 1 = worst quality (Table 1).

Broadleaf data were taken from May 8 through September 10. 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 Analysis of Variance (ANOVA) procedure.

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 9	May 14	Jun 2	Jun 29	Aug 19	Sep 26	Oct 14
1	**Untreated control**	NA	4	2	6	1	6	4	7
2	**Corn gluten meal**	10 fb 10 fb 10 fb 10	7	7	7	3	8	7	8
3	**Corn gluten meal**	20 fb 20	6	7	7	2	8	7	8
4	**Corn gluten meal**	30 fb 10	7	7	7	3	8	7	8
5	**Corn gluten meal**	40	7	6	6	3	7	6	7
	$LSD_{0.05}$		1.9	1.3	NS	NS	NS	1.7	NS

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 31	August 19	Sept 10
1	**Untreated control**	NA	17	16	14
2	**Corn gluten meal**	10 fb 10 fb 10 fb 10	5	4	2
3	**Corn gluten meal**	20 fb 20	6	4	3
4	**Corn gluten meal**	30 fb 10	4	4	3
5	**Corn gluten meal**	40	9	11	8
	$LSD_{0.05}$		NS	NS	NS

[1]These 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 7	May 14	Jun 2	Jun 29	Jul 31	Aug 19	Sep 10
1	**Untreated control**	NA	37	32	19	27	81	58	58
2	**Corn gluten meal**	10 fb 10 fb 10 fb 10	18	8	4	7	23	24	15
3	**Corn gluten meal**	20 fb 20	19	6	7	11	21	24	17
4	**Corn gluten meal**	30 fb 10	17	6	3	7	27	26	18
5	**Corn gluten meal**	40	21	9	10	10	33	31	26
	$LSD_{0.05}$		NS	NS	NS	NS	33.5	NS	NS

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

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 7	May 14	June 2	June 29	July 31	Aug 19	Sept 10
1	**Untreated control**	NA	65	53	22	57	60	58	42
2	**Corn gluten meal**	10 fb 10 fb 10 fb 10	1	0	0	0	4	5	4
3	**Corn gluten meal**	20 fb 20	0	1	3	0	3	5	5
4	**Corn gluten meal**	30 fb 10	2	2	5	1	8	10	17
5	**Corn gluten meal**	40	2	2	8	0	7	8	7
	$LSD_{0.05}$		40.9	26.5	NS	40.5	32.1	21.4	NS

[1]These figures represent the percentage of each plot covered by clover.

1999 Corn Gluten Meal/Urea Crabgrass Control Study - Year 4 - 2002

Nick E. Christians and Lukas 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 Hapludoll) 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 included split applications of 2 lb N/1000 ft^2 and four applications of 1 lb N/1000 ft^2. 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 2002, initial applications of all urea and CGM treatments were made on April 26. Sequential applications of 1 lb N/1000 ft^2 were made on June 2, July 18, and August 14. The second applications of 2 lb N/1000 ft^2 for urea and CGM (Treatment 3 and 5) were made on July 18.

Turf quality was monitored from May 9 through October 14 (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 31, August 19, and September 10 (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 on May 7 and ending September 10. 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 Analysis of Variance (ANOVA) procedure.

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

	Material	Number of applications	May 9	May 14	Jun 1	Jun 29	Aug 19	Sep 10	Sep 26	Oct 14
1	**Untreated control**	NA	3.7	5.0	5.3	1.0	6.3	5.3	4.0	5.7
2	**Corn gluten meal**	4	4.0	6.0	5.0	1.3	7.7	6.7	6.3	6.3
3	**Corn gluten meal**	2	5.3	6.3	5.3	1.0	8.3	7.3	7.0	7.7
4	**Urea (46-0-0)**	4	6.3	7.0	5.7	1.3	8.0	7.3	6.7	7.0
5	**Urea (46-0-0)**	2	5.3	6.0	5.7	1.7	7.3	6.3	6.0	6.3
	$LSD_{0.05}$		1.6	NS	NS	NS	NS	1.4	0.6	NS

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
Initial applications of all treatments were made on April 21. Sequential applications of treatments 2 and 4 were made on July 7, July 27, and September 5. The second applications of treatments 3 and 5 were made on July 27.
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	Jul 31	Aug 19	Sep 10
1	**Untreated control**	NA	NA	3.7	4.3	2
2	**Corn gluten meal**	4	4	3.3	7.0	2
3	**Corn gluten meal**	4	2	3.0	4.0	0
4	**Urea (46-0-0)**	4	4	11.3	17	3
5	**Urea (46-0-0)**	4	2	2.7	6.3	1
	$LSD_{0.05}$			NS	NS	NS

[1]These 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	Number of applications	May 7	May 14	Jun 1	Jun 29	Jul 31	Aug 19	Sep 10
1	**Untreated control**	NA	18.0	10.7	7.3	11.3	3.7	21.0	19
2	**Corn gluten meal**	4	15.3	8.3	8.7	20.0	3.3	20.7	17
3	**Corn gluten meal**	2	12.7	6.7	6.3	13.3	3.0	13.3	13
4	**Urea (46-0-0)**	4	11.3	7.0	6.0	12.3	11.3	12.3	13
5	**Urea (46-0-0)**	2	17.0	13.3	7.7	17.3	2.7	17.3	18
	$LSD_{0.05}$		NS	4.8	NS	8.9	10.8	NS	NS

[1]These 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	Number of applications	May 7	May 14	Jun 1	Jun 29	Jul 31	Aug 19	Sep 10
1	**Untreated control**	NA	36.7	26.7	21.7	31.7	28.7	26.7	36.7
2	**Corn gluten meal**	4	23.7	21.7	20.0	21.7	16.0	9.0	25
3	**Corn gluten meal**	2	18.7	9.0	18.3	16.7	11.7	5.7	19
4	**Urea (46-0-0)**	4	10.0	4.0	8.3	10.0	5.7	6.7	9.3
5	**Urea (46-0-0)**	2	10.3	8.3	0.0	27.0	8.7	6.0	12.7
	$LSD_{0.05}$		NS	NS	NS	NS	NS	NS	NS

[1]These values represent the area per plot covered by clover.

NS = means are not significantly different at the 0.05 level.

Wetting Agents and Hydrophobicity of Golf Course Fairways

D.D. Minner and F. Valverde

Purpose:

To determine the effect of experimental wetting agents on soil hydrophobicity.

Methods:

This study was conducted in the summer of 2002 on the second fairway at River Bend Golf Course, Story City, IA. The study area had a segregated mixture of 50% Kentucky bluegrass and 50% perennial ryegrass that was mowed at 0.75 inches and was growing on a Nicollet (fine-loamy, mixed mesic Aquic Hapludoll) soil.

Treatments were applied using a carbon dioxide backpack sprayer equiped with Teejet® XR8002 flat fan nozzles at 30 psi. Each treatment was mixed into 400 ml water and evenly applied onto a 25 sq.ft. plot. This translates to an application volume of 4 gal/1000 sq.ft. Treatments were applied 5 days prior to each sampling date. The study area was sampled for hydrophobicity on August 24 and September 1, 8, 16, and 22, 2002.

Soil hydrophobicity was assessed following the procedure described by Kostka (2000). Two cores of soil from each plot were taken using zero contamination tubes (Clements Associates, Newton Iowa, USA). Cores were removed from tubes and air dried for 2 weeks at 23 °C. Six droplets (40 µl) of distilled water were applied to each soil core at 6 depths. Starting at depth of 0.5 cm until 6.5 cm, with 1 cm increments. Time was recorded until no free standing water was observed.

Treatments were arranged in a randomized complete block design with 7 treatments and 4 replications. All data were analyzed using the Statistical Analysis System (SAS, Version 6.12) and the Analysis of Variance Procedure (ANOVA).

Results:

Turf quality was evaluated on a scale of 9-1, 9 = best, 6 = lowest acceptable, and 1 = worst quality. Dry spot was evaluated on a percent of the area showing dry spots.

The fairway study area at River Bend Golf Course is normally irrigated during the summer. City water restrictions did not allow for summer irrigation in 2002. The only water applied to the study area came from rainfall or a 0.13-inch hand-watering-in of the entire study area after each treatment date. A 0.25-inch irrigation was applied on the last sampling date because the lack of soil moisture caused the ground to be too hard for sampling. Rainfall totals for May, June, July, August, and September were 4.12, 1.51, 3.10, 4.14, and 0.89 inches, respectively.

First sampling date 8-24-02 Wetting agent treatments had a significant effect on water absorption at the 0 to 2 cm depth. Hydrophobicity was greatest at the surface and decreased deeper in the soil profile. Aqueduct at 4 and 8 oz and ACA at 4 oz provided better soil wetting than the control or ACA 1847. No dry spots were observed on the fairway study area, and turf quality for all plots was 7.5

Second sampling date 9-8-02 Wetting agent treatments showed no significant differences; however, the same trend was observed. Water intake was nearly twice as fast for Aqueduct and ACA 1460 compared to the control and ACA 1847. Treatment rate did not affect hydrophobicity measurements.

Third sampling date 9-8-02: No treatment differences or trends were present at this sampling date. No dry spots were observed on the fairway study area and turf quality for all plots was 6.5

Forth sampling date 9-16-02: No treatment differences or trends were present at this sampling date.

Fifth sampling date 9-22-02 Wetting agent treatments had a significant affect on water absorption at the 0 and 2 cm depth. Once again, Aqueduct and ACA1460 reduced hydrophobicity more than the control and ACA 1847. Treatment rate did not affect hydrophobicity measurements. No dry spots were observed on the fairway study area and turf quality for all plots was 8.0.

Conclusions:

Aqueduct and the experimental ACA 1460 reduced hydrophobicity.
Treatment rate had no effect on hydrophobicity.
There were no visual symptoms of phytotoxicity or dry spot appearance in the study.

Reference:

Kostka, S.J. 2000. Amelioration of water repellency in highly managed soils and the enhancement of turfgrass performance through the systematic application of surfactants. Journal of Hidrology. 231-232: 359-368

Trt #	Treatment	Rate / 1000 ft^2	Rate / m^2	Rate / plot	Rate / plot + 50% water
1	**Control**	-	-	-	-
2	**Aqueduct**	4 oz.	1.25 ml	2.9	5.8
3	**Aqueduct**	8 oz.	2.5 ml	5.8	11.6
4	**ACA1847**	2 oz.	0.63 ml	1.45	2.9
5	**ACA1847**	4 oz.	1.25 ml	2.9	5.8
6	**ACA1460**	4 oz.	1.25 ml	2.9	5.8
7	**ACA1460**	8 oz.	2.5 ml	5.8	11.6

First Sampling Date 8/24/02

	Absorption time (seconds)						
Trt	**0cm**	**1cm**	**2cm**	**3cm**	**4cm**	**5cm**	**6cm**
1.Control	12.75	5.13	0.60	0.30	0.10	0.55	0.05
2. Aqdt 4oz	1.90	0.80	0.20	0.05	0.00	0.00	0.00
3. Aqdt 8oz	3.00	0.90	0.10	0.15	0.05	0.00	0.00
4. ACA1847 2oz	16.55	4.30	1.20	0.70	0.30	0.15	0.10
5.ACA1847 4oz	15.10	4.45	0.80	0.50	0.20	0.20	0.05
6.ACA1460 4oz	3.15	1.20	0.20	0.00	0.00	0.05	0.00
7.ACA1460 8oz	7.70	2.60	0.95	0.35	0.20	0.20	0.10
Average	8.59	2.77	0.58	0.29	0.12	0.16	0.04
p	0.0216	0.0487	0.0301	0.4463	0.5447	0.4602	0.6400
LSD (t 0.05)	10.0480	3.3596	0.7227				

Second Sampling Date 9/1/02

	Absorption time (seconds)						
Trt	**0cm**	**1cm**	**2cm**	**3cm**	**4cm**	**5cm**	**6cm**
1.Control	32.30	10.25	3.35	0.55	1.00	0.15	0.25
2. Aqdt 4oz	12.50	4.60	1.55	1.95	0.75	0.50	1.10
3. Aqdt 8oz	14.55	5.55	3.25	1.65	1.90	1.60	2.75
4. ACA1847 2oz	24.74	7.40	3.50	1.45	0.90	0.35	0.90
5.ACA1847 4oz	27.80	12.20	3.50	1.10	0.80	0.35	0.00
6.ACA1460 4oz	23.20	7.95	5.40	1.35	0.85	0.30	0.25
7.ACA1460 8oz	7.35	5.35	1.80	0.35	0.45	0.30	0.40
Average	20.35	7.61	3.19	1.20	0.95	0.51	0.81
p	0.4808	0.7305	0.6224	0.2968	0.7114	0.0382	0.0664
LSD (t 0.05)						1.4515	

Third Sampling Date 9/8/02

Trt	Absorption time (seconds)						
Trt	0cm	1cm	2cm	3cm	4cm	5cm	6cm
1.Control	14.30	5.40	2.80	1.80	0.75	0.95	0.40
2. Aqdt 4oz	19.85	9.25	2.90	2.40	1.00	0.90	0.25
3. Aqdt 8oz	16.55	5.70	2.90	1.35	1.20	1.30	0.75
4. ACA1847 2oz	25.40	7.60	2.75	1.35	0.85	0.50	0.30
5.ACA1847 4oz	18.20	7.70	2.90	1.90	0.80	2.00	1.35
6.ACA1460 4oz	25.55	9.90	2.65	1.35	1.90	0.40	0.35
7.ACA1460 8oz	25.50	9.30	4.00	1.85	1.55	0.60	0.45
Average	20.76	7.84	2.99	1.71	1.15	0.95	0.55
p	0.5770	0.1849	0.9285	0.7539	0.3047	0.7538	0.5836
LSD (t 0.05)							

Forth Sampling Date 9/16/02

Trt	Absorption time (seconds)						
Trt	0cm	1cm	2cm	3cm	4cm	5cm	6cm
1.Control	3.05	1.25	0.55	0.00	0.00	0.00	0.00
2. Aqdt 4oz	3.50	1.55	0.50	0.05	0.00	0.10	0.00
3. Aqdt 8oz	2.40	2.30	1.15	0.80	0.05	0.20	0.05
4. ACA1847 2oz	2.65	0.95	0.40	0.15	0.00	0.00	0.00
5.ACA1847 4oz	2.80	2.35	0.90	0.70	0.20	0.00	0.00
6.ACA1460 4oz	4.10	3.25	1.00	0.55	0.15	0.00	0.00
7.ACA1460 8oz	2.35	2.45	0.85	0.50	0.15	0.00	0.00
Average	2.98	2.01	0.76	0.39	0.08	0.04	0.01
p	0.8570	0.5389	0.3959	0.0300	0.0503	0.5622	0.4552
LSD (t 0.05)				0.9217	0.2633		

Fifth Sampling Date 9/22/02

Trt	Absorption time (seconds)						
Trt	0cm	1cm	2cm	3cm	4cm	5cm	6cm
1.Control	11.05	3.40	1.35	0.75	0.50	0.35	0.15
2. Aqdt 4oz	6.50	3.35	1.20	1.15	0.70	0.30	0.00
3. Aqdt 8oz	3.21	4.26	1.32	0.53	0.37	0.00	0.00
4. ACA1847 2oz	7.25	3.65	0.85	0.30	0.55	0.10	0.00
5.ACA1847 4oz	7.15	5.20	2.80	1.15	0.70	0.35	0.15
6.ACA1460 4oz	2.65	1.85	0.70	0.80	0.25	0.10	0.00
7.ACA1460 8oz	1.65	0.90	0.60	0.55	0.50	0.05	0.00
Average	5.64	3.23	1.26	0.75	0.51	0.18	0.04
p	0.0029	0.0918	0.0006	0.0317	0.3744	0.0810	0.0826
LSD (t 0.05)	4.0320		0.8334	0.5447			

Iowa State University Personnel Affiliated with the Turfgrass Research Program

Natalie Canier	Graduate Student, M.S. (Minner)
Nick Christians, Ph.D.	Professor, Turfgrass Science Research and Teaching, Horticulture Dept.
Luke Dant	Field Research Technician
Will Emley	Superintendent, Horticulture Research Station
Shui-Zhang Fei, Ph.D.	Assistant Professor, Turfgrass Science Research (Plant Breeding), Horticulture Dept.
Mark Gleason, Ph.D.	Professor, Extension Plant Pathologist, Plant Pathology Dept.
Mark Helgeson	Field Technician, Horticulture Dept.
Mark Howieson	Graduate Student, Ph.D. (Christians)
Jeff Iles, Ph.D.	Associate Professor, Extension, Nursery Crops/Ornamentals, Horticulture Dept.
Young K. Joo, Ph.D.	Visiting Scientist from Korea
Jason Kruse	Graduate Student, Ph.D. (Christians and Chaplin - starting Fall 2001)
Donald Lewis, Ph.D.	Professor, Extension Entomologist, Entomology Dept.
Deying Li, Ph.D.	Postdoctoral Research Associate (Christians and Minner)
David Minner, Ph.D.	Associate Professor, Turfgrass Science Research and Extension, Horticulture Dept.
David J. Minner	Field Research Technician
Meghan Minner	Field Research Technician
Sarah Minner	Field Research Technician
Hugh O'Donnell	Field Research Technician
Troy Oster	Graduate Student, M.S. (Christians)
Ryan Pertle	Field Research Technician
Rodney St. John	Superintendent, Turfgrass Research Station, Horticulture Dept.
Joe Stoeffler	Field Research Technician
Federico Valverde	Research Associate, Horticulture Dept.
Joel Vint	Field Research Technician

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