2001
Iowa Turfgrass Research Report

IOWA STATE UNIVERSITY
University Extension
Ames, Iowa

FG-466/July 2001

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

In Cooperation with the
Iowa Turfgrass Institute

Field Day Program - August 2, 2001

8:45 a.m. **Introductory Remarks** - Registration Tent

9:00 a.m. **CHOICE OF FOUR TOURS**

All tours start from registration area. See following two pages for specific topics, speakers, times, and locations.

Tour #1 **Lawn Care & Grounds** -- *Aeration and Related Applications.* Equipment demonstrations sponsored by the Iowa Professional Lawn Care Association. Research presentations include: herbicide trials, shade-tolerant grass trials, traffic-tolerant grass trials, NTEP variety trials -- Kentucky bluegrass and tall fescue.

Tour #2 **Golf Course** -- *Fairway Core Processing.* Equipment demonstrations sponsored by the Iowa Golf Course Superintendents Association. Research presentations include: NTEP variety trial --creeping bentgrass, sloped green amendment study, pesticide trials, remote sensing for golf courses.

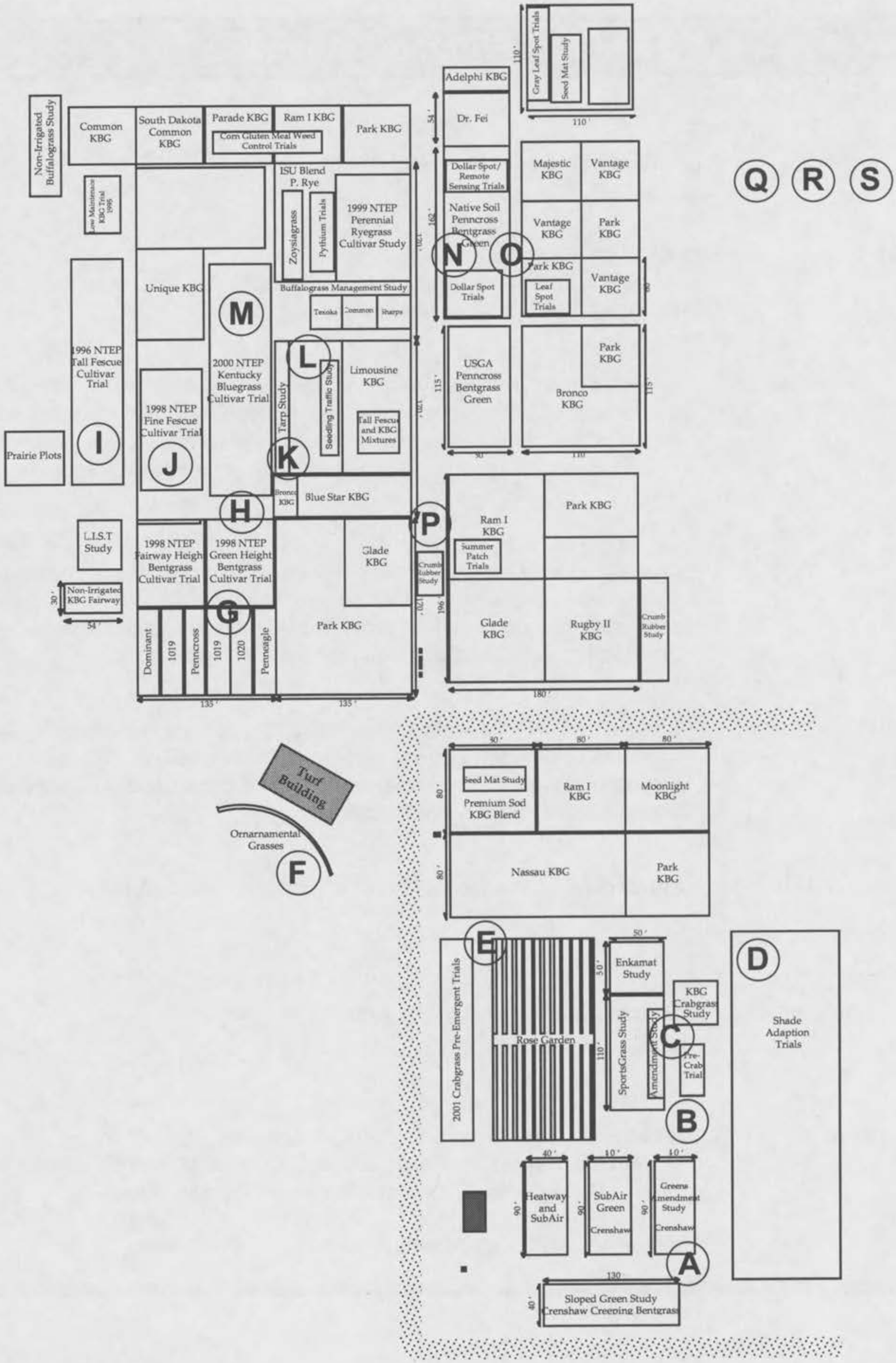
Tour #3 **Sports Turf** -- *Fall Seeding Alternatives.* Equipment demonstrations sponsored by the Iowa Sports Turf Managers Association. Research presentations include: soil amendments, sand stability trial, summer seeding bermudagrass, seedling traffic tolerance.

Tour #4 **Landscape** -- Selection and care of landscape plants for Iowa.

12:00 p.m. **Lunch (Served in Exhibit Area)**

1:00 p.m. **Educational Sessions and Demonstrations**

- **Pesticide Recertification Cont. Ed. Course (2 hours)** -- Main Building
- **Turf I.D. and Weed, Disease & Insect Control Tour** -- Dr. Dave Minner and Dr. Nick Christians
- **Vendors and Equipment/Products** -- Exhibit Area



Non-Irrigated Buffalograss Study
Common KBG
South Dakota Common KBG
Parade KBG
Ram I KBG
Corn Gluten Meal Weed Control Trials
Park KBG
Adelphi KBG
Gray Leaf Spot Trials
Seed Mat Study
110'
Dr. Fei
34'
Low Maintenance KBG Trial 1995
ISU Blend P. Rye
Zoysiagrass
Pythium Trials
1999 NTEP Perennial Ryegrass Cultivar Study
Dollar Spot/ Remote Sensing Trials
Native Soil Penncross Bentgrass Green
162'
Majestic KBG
Vantage KBG
Vantage KBG
Park KBG
Park KBG
Vantage KBG
Leaf Spot Trials
Q
R
S
N
O
Unique KBG
M
Buffalograss Management Study
Texoka
Common
Sharps
Dollar Spot Trials
1996 NTEP Tall Fescue Cultivar Trial
2000 NTEP Kentucky Bluegrass Cultivar Trial
L
Seedling Traffic Study
Limousine KBG
USGA Penncross Bentgrass Green
115'
Park KBG
Bronco KBG
115'
1998 NTEP Fine Fescue Cultivar Trial
Tarp Study
Tall Fescue and KBG Mixtures
Prairie Plots
I
J
K
50'
110'
Bronco KBG
Blue Star KBG
H
P
Ram I KBG
Park KBG
L.I.S.T Study
1998 NTEP Fairway Height Bentgrass Cultivar Trial
1998 NTEP Green Height Bentgrass Cultivar Trial
Glade KBG
Summer Patch Trials
Crumb Rubber Study
Non-Irrigated KBG Fairway
30'
54'
G
196'
Glade KBG
Rugby II KBG
Crumb Rubber Study
Dominant
1019
Penncross
1019
1020
Penneagle
Park KBG
135'
135'
180'
30'
80'
80'
Turf Building
Seed Mat Study
Premium Sod KBG Blend
Ram I KBG
Moonlight KBG
80'
Ornamental Grasses
Nassau KBG
Park KBG
80'
F
E
50'
D
2001 Crabgrass Pre-Emergent Trials
Enkamat Study
50'
KBG Crabgrass Study
Rose Garden
SportsGrass Study
110'
Amendment Study
C
Pre-Crab Trial
Shade Adaption Trials
B
40'
10'
10'
Heatway and SubAir
SubAir Green
Crenshaw
Greens Amendment Study
Crenshaw
90'
90'
90'
A
130
Sloped Green Study
Crenshaw Creeping Bentgrass
40'

<table>
<tr><th>Time</th><th>Lawn Care/Grounds Tour</th><th>Golf Course Tour</th><th>Sports Turf Tour</th><th>Landscape Tour</th></tr>
<tr><td>9:00</td><td>F- Ornamental grasses
Mark Helgeson and Nick Christians</td><td rowspan="4">R – Fairway core processing
Panel Discussion</td><td rowspan="2">C – Stand stability on sports fields
Deying Li and Dave Minner</td><td rowspan="12">Selection and care of landscape plants for Iowa

Jeff Iles
Eldon Everhart
Patrick O'Malley</td></tr>
<tr><td>9:15</td><td rowspan="2">J – Kentucky bluegrass and fine fescue
Nick Christians and Shui-Zhang Fei</td></tr>
<tr><td>9:30</td><td rowspan="2">L – Seeding and species trial to reestablish intense traffic areas
Federico Valverde and Dave Minner</td></tr>
<tr><td>9:45</td><td>I – Tall fescue and perennial ryegrass
Nick Christians and Shui-Zhang Fei</td></tr>
<tr><td>10:00</td><td rowspan="4">Q – Aeration and related applications
Gary Peterson</td><td>E – Grass and broadleaf weed control
Barbara Bingaman</td><td>M – Kentucky bluegrass variety trial
Dave Minner</td></tr>
<tr><td>10:15</td><td>B – Calcium nutrition of bentgrass
Rodney St. John</td><td>K – Tarp study
D. Minner, Deying Li, Federico Valverde</td></tr>
<tr><td>10:30</td><td rowspan="2">A – Properties and performance of inorganic topdressing materials
Deying Li and Dave Minner</td><td>P – Crumb rubber and Bermuda
Daniel Oschner and Dave Minner</td></tr>
<tr><td>10:45</td><td>E – Grass and broadleaf weed control
Barbara Bingaman</td></tr>
<tr><td>11:00</td><td rowspan="2">D – Shade trial for turf and hostas
Mark Gleason and Gary Peterson</td><td>H – Bentgrass and bluegrass varieties
Nick Christians and Shui-Zhang Fei</td><td rowspan="4">S – Fall seeding alternatives
Dale Getz</td></tr>
<tr><td>11:15</td><td>G – PGRs and mowing quality
Mark Howieson</td></tr>
<tr><td>11:30</td><td rowspan="2">E – Grass and broadleaf weed control
Barbara Bingaman</td><td>N – Remote sensing of turf diseases
Troy Oster</td></tr>
<tr><td>11:45</td><td>O – Remote sensing of moisture & nutrition
Jason Kruse</td></tr>
</table>

Station	Speaker	Topic
A	Deying Li and Dave Minner	Properties and performance of inorganic topdressing materials.
B	Rodney St. John	Calcium nutrition of bentgrass.
C	Deying Li and Dave Minner	Sand stability on sport fields.
D	Mark Gleason and Gary Peterson	Shade trial for turf and hostas.
E	Barbara Bingaman	Pre- and Post- grass and broadleaf weed control.
F	Mark Helgeson and Nick Christians	Ornamental grasses.
G	Mark Howieson	Plant growth regulators and mowing quality.
H	Nick Christians and Shui-Zhang Fei	Bentgrass and bluegrass varieties.
I	Nick Christians and Shui-Zhang Fei	Tall fescue and perennial ryegrass varieties.
J	Nick Christians and Shui-Zhang Fei	Kentucky bluegrass and fine fescue varieties.
K	Dave Minner, Deying Li, and Federico Valverde	The effect of tarp material and color on turf establishment.
L	Federico Valverde and Dave Minner	Seeding and species trial to reestablish intense traffic areas.
M	Dave Minner	Kentucky bluegrass variety trial.
N	Troy Oster	Remote sensing of turf diseases.
O	Jason Kruse	Remote sensing of moisture and nutrition.
P	Daniel Oschner and Dave Minner	Crumb rubber and bermuda for sport fields.
Q	Gary Peterson	Aeration and related applications.
R	Panel Discussion	Fairway core processing.
S	Dale Getz	Fall seeding alternatives.

Introduction

Nick E. Christians and David D. Minner

The following research report is the 22nd yearly publication of the results of turfgrass research projects performed at Iowa State University. Copies of information in earlier reports are available from most of the county extension offices in Iowa. This is the fourth year that the entire report is available on the Internet. This report and the previous years' reports can be accessed at:

http://www.hort.iastate.edu/pages/pubs/p_frame.html

Several new projects were started in the 2000 season. The Kentucky bluegrass trial was replaced with a new trial that includes the latest cultivars. A new non-irrigated fairway-height Kentucky bluegrass trial was also established. This is in addition to the irrigated fairway height bluegrass study that was established in 1998. *Poa supina* and seeded bermudagrass continue to be evaluated as alternative grasses for athletic turf. A new project was started in 2000 to evaluate traffic tolerance of several grass species in the seedling and early establishment stage. The Heatway study which was established in 1997 is also being used to evaluate bermudagrass survival in winter conditions.

We would like to acknowledge Will Emley, superintendent of the ISU Horticulture Research Station; Rod St. John, manager of the turf research area; Barbara Bingaman, Postdoctoral researcher; Federico Valverde, research associate; Dr. Young Joo, visiting scientist; Deying Li, Mark Howieson, Troy Oster, Natalie Canier, 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 Lois Benning for her work in typing and helping to edit this publication.

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

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Table of Contents

Weather Data for the Iowa State University Research Station January 1 to December 31, 2000

January	High (F°)	Low (F°)	Rainfall (in)
1	40	27	0.00
2	39	32	0.00
3	32	24	0.00
4	24	6	0.00
5	35	3	0.00
6	36	22	0.00
7	41	8	0.00
8	47	27	0.00
9	45	33	0.00
10	46	29	0.00
11	31	18	0.00
12	36	22	0.00
13	27	9	0.00
14	43	9	0.00
15	51	26	0.00
16	27	12	0.00
17	27	24	0.00
18	36	15	0.00
19	28	1	0.00
20	16	-6	0.00
21	16	-5	0.00
22	32	10	0.00
23	20	-7	0.00
24	39	-8	0.00
25	26	1	0.00
26	17	-8	0.00
27	20	-6	0.00
28	23	-8	0.00
29	27	19	0.00
30	25	7	0.00
31	28	5	0.00

February	High (F°)	Low (F°)	Rainfall (in)
1	26	7	0.00
2	40	8	0.00
3	40	22	0.00
4	29	20	0.00
5	39	12	0.00
6	45	27	0.00
7	37	15	0.00
8	46	12	0.00
9	49	28	0.00
10	35	22	0.00
11	28	13	0.00
12	33	16	0.00
13	31	23	0.00
14	34	20	0.00
15	55	25	0.00
16	35	16	0.00
17	33	23	0.00
18	30	24	0.00
19	32	17	0.00
20	44	4	0.00
21	52	31	0.00
22	56	38	0.00
23	63	47	0.00
24	56	44	0.00
25	62	47	0.00
26	51	41	0.00
27	53	29	0.00
28	66	28	0.00
29	61	40	0.00

March	High (F°)	Low (F°)	Rainfall (in)
1	50	31	0.00
2	46	24	0.00
3	52	23	0.00
4	70	31	0.00
5	69	40	0.00
6	73	44	0.00
7	77	57	0.00
8	71	48	0.00
9	49	28	0.00
10	39	25	0.00
11	46	18	0.00
12	44	21	0.00
13	50	30	0.00
14	60	32	0.00
15	46	29	0.00
16	41	20	0.00
17	46	19	0.00
18	39	31	0.00
19	35	32	0.00
20	45	33	0.00
21	49	40	0.00
22	59	42	0.00
23	67	41	0.03
24	65	44	0.10
25	64	35	0.00
26	70	33	0.00
27	59	27	0.00
28	55	26	0.00
29	59	24	0.00
30	62	29	0.00
31	65	32	0.00

April	High (F°)	Low (F°)	Rainfall (in)
1	60	41	0.00
2	68	36	0.00
3	No data available.		
4	58	35	0.00
5	86	38	0.00
6	65	38	0.00
7	50	22	0.14
8	54	23	0.00
9	58	36	0.00
10	48	40	0.03
11	47	28	0.00
12	54	24	0.00
13	73	42	0.00
14	80	50	0.00
15	52	39	0.00
16	55	38	0.06
17	52	38	0.00
18	73	41	0.09
19	74	53	0.03
20	55	42	0.03
21	65	33	0.00
22	76	38	0.00
23	77	47	0.00
24	70	48	0.00
25	72	39	0.00
26	76	33	0.09
27	68	52	0.04
28	72	48	0.00
29	69	41	0.00
30	81	44	0.00

May	High (F°)	Low (F°)	Rainfall (in)
1	78	50	0.00
2	82	39	0.00
3	81	55	0.00
4	87	57	0.00
5	86	58	0.00
6	83	60	0.00
7	87	63	0.11
8	70	58	0.06
9	66	46	0.00
10	73	42	0.02
11	95	58	0.02
12	74	48	0.00
13	61	40	0.00
14	74	38	0.02
15	72	54	0.00
16	79	52	0.00
17	84	65	0.00
18	72	51	1.13
19	64	47	0.00
20	74	40	0.05
21	82	56	0.00
22	86	60	0.04
23	81	56	0.00
24	81	52	0.00
25	81	43	0.07
26	64	54	1.47
27	62	52	0.05
28	64	52	0.00
29	74	54	0.04
30	88	64	0.41
31	79	62	0.17

June	High (F°)	Low (F°)	Rainfall (in)
1	87	60	0.16
2	70	53	0.00
3	77	48	0.25
4	72	55	0.16
5	65	52	0.00
6	75	45	0.00
7	86	54	0.00
8	95	66	0.00
9	90	65	0.00
10	89	74	0.38
11	82	67	0.36
12	76	64	0.00
13	84	65	1.54
14	71	61	0.10
15	83	54	0.19
16	73	53	0.00
17	70	46	0.05
18	78	48	0.00
19	83	63	0.51
20	82	64	0.01
21	82	57	0.00
22	88	58	0.01
23	84	64	0.12
24	82	68	0.00
25	83	62	0.58
26	79	63	0.00
27	80	54	0.71
28	75	59	0.07
29	81	54	0.00
30	84	61	0.00

July	High (F°)	Low (F°)	Rainfall (in)
1	83	62	0.00
2	90	68	0.18
3	78	70	0.00
4	82	72	0.30
5	81	71	0.04
6	87	69	0.00
7	86	69	0.00
8	91	74	0.00
9	89	72	0.59
10	83	72	0.02
11	81	71	0.13
12	83	67	0.00
13	88	64	0.00
14	90	64	0.00
15	85	64	0.00
16	86	66	0.20
17	81	66	0.00
18	67	58	0.00
19	70	58	0.00
20	76	56	0.00
21	76	49	0.00
22	80	49	0.00
23	81	52	0.00
24	83	62	0.00
25	83	66	0.75
26	82	60	0.03
27	86	66	0.00
28	82	61	0.00
29	77	61	0.00
30	81	62	0.00
31	88	66	0.00

August	High (F°)	Low (F°)	Rainfall (in)
1	88	64	0.00
2	84	63	0.00
3	80	58	0.00
4	82	64	0.35
5	85	67	0.00
6	84	67	0.00
7	90	67	0.21
8	88	67	0.00
9	88	68	0.00
10	88	59	0.00
11	87	62	0.00
12	90	67	1.30
13	87	68	0.00
14	91	72	0.00
15	84	66	0.00
16	80	61	0.00
17	71	61	0.00
18	77	56	0.00
19	76	58	0.03
20	75	62	0.00
21	79	66	0.00
22	81	67	0.42
23	80	66	0.17
24	85	60	0.00
25	87	66	0.00
26	No data available.		
27	No data available.		
28	83	63	0.00
29	77	62	0.00
30	88	62	0.00
31	97	68	0.00

September	High (F°)	Low (F°)	Rainfall (in)
1	85	69	0.00
2	98	68	0.00
3	90	68	0.24
4	74	56	0.00
5	75	50	0.00
6	82	50	0.00
7	78	58	0.01
8	87	58	0.00
9	88	67	0.00
10	93	65	0.00
11	98	58	0.00
12	81	42	0.00
13	91	55	0.00
14	78	52	0.08
15	72	40	0.00
16	80	41	0.00
17	93	49	0.00
18	90	61	0.00
19	79	56	0.11
20	63	42	0.00
21	66	33	0.00
22	64	51	0.52
23	56	49	0.01
24	50	42	0.00
25	67	34	0.00
26	76	39	0.00
27	79	39	0.00
28	78	41	0.00
29	81	54	0.00
30	81	59	0.00

October	High (F°)	Low (F°)	Rainfall (in)
1	80	58	0.00
2	75	48	0.00
3	73	46	0.11
4	61	45	0.06
5	51	36	0.24
6	43	29	0.03
7	41	25	0.00
8	49	21	0.00
9	58	23	0.00
10	65	29	0.00
11	70	30	0.00
12	74	52	0.04
13	80	50	0.30
14	77	54	0.00
15	64	43	0.05
16	63	40	0.00
17	68	46	0.00
18	82	41	0.00
19	83	52	0.00
20	73	9	0.00
21	77	50	0.00
22	62	55	0.16
23	68	57	0.02
24	74	55	0.04
25	75	62	0.52
26	73	55	0.02
27	54	46	0.00
28	57	49	0.00
29	57	50	0.03
30	73	54	0.00
31	71	51	0.00

November	High (F°)	Low (F°)	Rainfall (in)
1	72	56	0.39
2	61	40	0.00
3	55	36	0.00
4	60	40	0.00
5	56	40	0.36
6	48	42	0.86
7	42	28	0.00
8	32	27	0.00
9	31	27	0.00
10	38	24	0.00
11	35	24	0.30
12	37	24	0.00
13	31	23	tr - snow
14	32	18	0.00
15	45	18	tr - snow
16	40	21	tr - snow
17	29	16	0.00
18	31	18	0.00
19	37	17	0.00
20	21	7	0.00
21	35	7	0.00
22	32	12	0.00
23	50	18	0.00
24	50	16	0.00
25	48	26	0.00
26	32	26	0.00
27	51	27	0.00
28	45	22	tr - snow
29	38	32	0.00
30	37	30	2" snow

December	High (F°)	Low (F°)	Rainfall (in)
1	34	12	0.00
2	32	2	0.00
3	34	3	0.00
4	37	11	0.00
5	14	5	0.00
6	29	11	0.06
7	43	28	0.00
8	24	12	0.00
9	35	20	0.00
10	35	2	4" snow
11	5	-4	5" snow
12	-7	-13	0.5" snow
13	14	-2	2" snow
14	18	0	0.00
15	26	10	0.00
16	28	2	0.00
17	10	-6	3" snow
18	11	3	5" snow
19	8	-6	1" snow
20	20	2	0.00
21	3	-7	0.00
22	8	-14	0.00
23	14	-4	0.00
24	0	-23	0.00
25	12	-19	0.00
26	18	-2	0.00
27	17	-4	0.00
28	19	-4	5" snow
29	16	6	0.00
30	12	3	0.00
31	20	9	2" snow

Results of Regional Kentucky Bluegrass Cultivar Trials

Rodney A. St. John, Nick E. Christians, and David D. Minner

The National Turfgrass Evaluation Program (NTEP) has sponsored several regional Kentucky bluegrass cultivar trials conducted at most of the northern agricultural experiment stations. Two high-maintenance trials were underway during the 2000 season. The first, a high-maintenance study, was established in 1995 and completed in July of 2000. The second is a new high-maintenance study that was established in fall 2000. It contains 173 cultivars. Both studies received or will receive 4 lb N/1000 ft^2/yr, and were irrigated as needed. The objective of these high-maintenance, irrigated studies is to investigate cultivar performance under a cultural regime similar to that used on irrigated home lawns in Iowa.

The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots for the first study. Visual quality was based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality. Yearly means of monthly data were taken and are listed in the last column. The first cultivar received the highest average rating for the entire 2000 season. The cultivars are listed in descending order of average quality.

Data for genetic color (Gcol) and leaf texture (Leaf) also are included for the 1995 high-maintenance trial. 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.

Data for the 2000 high-maintenance study are included in Table 2. The cultivars are listed in descending order according to percentage bluegrass cover in October, 2000.

Table 1. 2000 visual quality[1] and other ratings[2] for the 1995 High-maintenance Kentucky Bluegrass Trial.

				Visual quality		
	Cultivar	Gcol	Leaf	June	July	Mean
1	Award	8.7	8.7	8.7	8.7	8.7
2	Midnight	8.7	8.3	9.0	8.3	8.7
3	Total Eclipse (TCR-1738)	8.7	8.7	8.7	8.7	8.7
4	Absolute (MED-1497)	8.3	8.7	9.0	8.0	8.5
5	Impact (J-1576)	8.7	8.3	8.7	8.3	8.5
6	Liberator (ZPS-2572)	8.3	8.7	8.3	8.3	8.3
7	North Star (PST-A7-60)	9.0	9.0	7.7	9.0	8.3
8	Quantum Leap (J-1567)	8.7	8.7	8.0	8.7	8.3
9	NuGlade	8.7	8.7	7.7	8.7	8.2
10	Arcadia (J-1936)	8.0	8.3	8.0	8.0	8.0
11	Dragon (ZPS-429)	8.7	8.7	7.3	8.7	8.0
12	NJ 1190	8.0	9.0	7.0	9.0	8.0
13	Seabring (Ba 79-260)	8.7	8.7	8.0	8.0	8.0
14	Ba 73-373	8.7	8.7	7.3	8.3	7.8
15	Ba 75-163	7.7	8.3	7.3	8.3	7.8
16	Ba 81-220	8.3	8.7	7.3	8.3	7.8
17	Brilliant (PST-B2-42)	8.0	8.3	7.0	8.7	7.8
18	H86-690	8.0	8.3	7.3	8.3	7.8
19	Pick 8	8.7	8.3	8.0	7.7	7.8
20	Showcase (PST-BO-141)	8.0	8.0	7.7	8.0	7.8
21	Wildwood	7.7	7.7	7.3	8.3	7.8
22	Abbey	8.3	8.3	7.0	8.3	7.7
23	Apollo (PST-B3-180)	8.0	8.0	7.3	8.0	7.7
24	Ba 70-060	8.0	8.3	7.7	7.7	7.7
25	Ba 81-270	7.7	8.0	7.3	8.0	7.7
26	Conni	8.0	8.7	6.7	8.7	7.7
27	Glade	7.7	8.0	7.3	8.0	7.7
28	Lipoa	8.3	8.3	7.3	8.0	7.7
29	Moonlight (PST-A418)	7.7	8.0	8.0	7.3	7.7
30	NuStar	7.7	8.0	7.0	8.3	7.7
31	Odyssey (J-1561)	8.0	8.3	8.0	7.3	7.7
32	Pepaya (DP 37-192)	7.7	7.7	8.0	7.3	7.7
33	Rugby II (MED-18)	8.0	8.0	7.7	7.7	7.7
34	Sidekick	8.7	9.0	7.0	8.3	7.7
35	SR 2000	8.7	8.3	7.3	8.0	7.7

	Cultivar	Gcol	Leaf	Visual quality June	July	Mean
36	Unique	7.3	8.3	7.3	8.0	7.7
37	ZPS-2183	8.7	8.0	7.7	7.7	7.7
38	Ba 77-702	8.7	8.3	7.0	8.0	7.5
39	Ba 81-113	7.7	8.3	7.0	8.0	7.5
40	Chateau	8.0	8.3	7.3	7.7	7.5
41	Fortuna	7.7	8.0	7.7	7.3	7.5
42	Haga	7.0	7.3	7.0	8.0	7.5
43	Jewel (Ba 81-227)	8.3	8.3	7.0	8.0	7.5
44	Livingston	8.0	8.7	6.3	8.7	7.5
45	Pick-855	7.3	7.7	7.0	8.0	7.5
46	PST-P46	7.3	8.3	7.7	7.3	7.5
47	Sodnet	7.7	8.7	7.0	8.0	7.5
48	A88-744	8.0	8.3	7.0	7.7	7.3
49	Ba 81-058	7.3	8.0	7.0	7.7	7.3
50	Challenger	7.7	8.7	7.0	7.7	7.3
51	Rambo (J-2579)	8.3	8.3	7.0	7.7	7.3
52	SR 2100	8.0	8.0	7.0	7.7	7.3
53	SR 2109	7.7	8.7	6.3	8.3	7.3
54	Ba 75-490	6.7	8.0	6.7	7.7	7.2
55	Ba 76-197	7.3	8.3	6.7	7.7	7.2
56	BAR VB 3115B	7.3	8.3	6.0	8.3	7.2
57	BAR VB 6820	7.0	7.7	7.7	6.7	7.2
58	Baronie	7.3	8.0	6.7	7.7	7.2
59	Bartitia	7.0	7.7	7.7	6.7	7.2
60	Blacksburg	7.0	7.7	8.3	6.0	7.2
61	Champagne (LTP-621)	7.3	8.0	7.0	7.3	7.2
62	Explorer (Pick-3561)	7.0	8.0	7.3	7.0	7.2
63	Goldrush (Ba 87-102)	8.3	8.3	7.0	7.3	7.2
64	HV 130	7.0	8.0	7.3	7.0	7.2
65	LTP-620	7.3	7.7	6.7	7.7	7.2
66	Misty (Ba 76-372)	8.3	8.3	6.3	8.0	7.2
67	PST-BO-165	7.7	8.0	6.7	7.7	7.2
68	America	7.0	8.0	7.0	7.0	7.0
69	Ascot	7.3	8.3	7.0	7.0	7.0
70	Chicago (J-2582)	7.0	7.7	7.3	6.7	7.0
71	Nimbus	7.7	8.3	7.0	7.0	7.0
72	NJ-54	7.3	7.7	7.0	7.0	7.0
73	Serene (PST-A7-245A)	7.3	8.3	6.3	7.7	7.0
74	VB 16015	7.3	7.7	7.0	7.0	7.0
75	Bluechip (MED-1991)	7.0	8.0	7.0	6.7	6.8
76	Classic	6.7	8.0	6.0	7.7	6.8
77	Eclipse	6.7	8.0	6.3	7.3	6.8
78	Jefferson	7.0	7.7	6.0	7.7	6.8
79	LKB-95	7.0	8.0	6.0	7.7	6.8
80	NJ-GD	7.0	8.0	6.3	7.3	6.8
81	Princeton 105	7.3	7.3	6.0	7.7	6.8
82	Bariris (BAR VB 5649)	7.0	8.3	7.0	6.3	6.7
83	Baron	6.7	8.0	7.0	6.3	6.7
84	Baruzo	6.7	7.7	6.7	6.7	6.7
85	Blackstone (PST-638)	6.0	8.3	8.0	5.3	6.7
86	Envicta (Ba 75-173)	6.7	7.3	6.7	6.7	6.7
87	SRX 2205	7.0	7.3	7.0	6.3	6.7
88	Caliber	6.3	7.0	6.3	6.7	6.5
89	Cardiff	7.0	7.3	7.0	6.0	6.5
90	Coventry	6.7	8.0	7.0	6.0	6.5
91	Marquis	6.7	8.0	7.0	6.0	6.5
92	Raven	6.7	7.3	7.7	5.3	6.5
93	BAR VB 233	6.7	8.0	7.3	5.3	6.3
94	HV 242	7.0	8.0	6.3	6.3	6.3

	Cultivar	Gcol	Leaf	Visual quality		
				June	July	Mean
95	J-1555	6.0	8.0	6.7	6.0	6.3
96	Kenblue	6.3	7.0	6.3	6.3	6.3
97	Shamrock	7.0	7.7	6.3	6.3	6.3
98	Allure	5.3	7.7	7.3	5.0	6.2
99	Compact	6.3	7.7	6.7	5.7	6.2
100	MED-1580	5.0	7.7	7.0	5.0	6.0
101	Limousine	6.3	8.0	7.0	4.7	5.8
102	Platini	6.0	8.0	5.7	5.3	5.5
103	ZPS-309	4.7	8.0	6.0	4.0	5.0
	$LSD_{0.05}$	2.7	1.4	1.1	2.8	1.6

[1]Visual quality was assessed using a scale of 9 to 1 with 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality.
[2]Genetic color (Gcol) was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Leaf texture (Leaf) was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture.

Table 2. Establishment year percentage turf coverage[1] data for the 2000 NTEP High-maintenance Kentucky Bluegrass Trial.

	Cultivar	% turf cover		Cultivar	% turf cover
1	Midnight	53.3	39	A97-1432	60.0
2	Baron	60.0	40	HV 238	53.3
3	Lily	66.7	41	Pick-232	60.0
4	Limerick	60.0	42	A97-1567	66.7
5	Bodacious	50.0	43	PST-1804	63.3
6	Bedazzled	56.7	44	B3-185	53.3
7	Boomerang	56.7	45	B5-43	56.7
8	Eagleton	66.7	46	B5-45	46.7
9	HV 140	63.3	47	IB7-308	40.0
10	Pp H 6370	53.3	48	H92-203	50.0
11	Pp H 6366	56.7	49	B3-171	56.7
12	Pp H 7929	53.3	50	B5-144	50.0
13	Pp H 7832	50.0	51	PST-B4-246	53.3
14	Pp H 7097	53.3	52	PST-H6-150	53.3
15	A96-402	60.0	53	Alpine	53.3
16	A97-1336	60.0	54	Pick 453	63.3
17	Shamrock	56.7	55	Pick 417	53.3
18	Wellington	60.0	56	Limousine	63.3
19	Wildwood	70.0	57	Quantum Leap	50.0
20	Hallmark	70.0	58	Envicta	66.7
21	A93-200	60.0	59	Goldrush	63.3
22	H94-293	56.7	60	Misty	63.3
23	Coventry	60.0	61	Ascot	53.3
24	PST-1701	56.7	62	BH 00-6002	56.7
25	PST-B5-125	63.3	63	Fairfax	53.3
26	PST-604	60.0	64	Abbey	63.3
27	PST-108-79	53.3	65	BH 00-6003	46.7
28	PST-1QG-27	66.7	66	Ba81-058	66.7
29	PST-161	53.3	67	Raven	70.0
30	PST-B5-89	53.3	68	Ba83-113	50.0
31	Brilliant	60.0	69	Marquis	60.0
32	PST-222	50.0	70	Ba 84-140	56.7
33	A98-739	53.3	71	Ba 82-288	60.0
34	PST-York Harbor 4	63.3	72	Chateau	46.7
35	PST-1BMY	66.7	73	Ba 00-6001	46.7
36	A97-1439	63.3	74	CVB-20631	46.7
37	A97-1449	60.0	75	Chelsea	56.7
38	Apollo	66.7	76	A97-1409	63.3

	Cultivar	% turf cover
77	A96-451	56.7
78	Julius	56.7
79	Allure	50.0
80	A97-1330	66.7
81	H92-558	66.7
82	Julia	63.3
83	Brooklawn	53.3
84	Boutique	63.3
85	NA-K991	46.7
86	NA-K992	56.7
87	Showcase	56.7
88	Arcadia	56.7
89	SRX 2394	60.0
90	SRX 26351	56.7
91	SRX 27921	53.3
92	Sonoma	53.3
93	Bordeaux	53.3
94	Cabernet	60.0
95	Champagne	56.7
96	A96-427	60.0
97	A97-1715	63.3
98	Jewel	56.7
99	Unknown	56.7
100	Blue Knight	53.3
101	DLF 76-9032	53.3
102	DLF 76-9034	50.0
103	DLF 76-9036	60.0
104	DLF 76-9037	63.3
105	SI A96-386	53.3
106	SRX 2114	60.0
107	SRX 2284	60.0
108	Pro Seeds-453	53.3
109	SRX OG245	56.7
110	99AN-53	66.7
111	A98-881	56.7
112	Jefferson	63.3
113	A98-407	43.3
114	A98-1028	50.0
115	A98-183	50.0
116	A98-1275	46.7
117	A98-296	66.7
118	A98-304	60.0
119	A98-139	66.7
120	A98-365	46.7
121	Kenblue	70.0
122	Princeton 105	60.0
123	Impact	63.3
124	Total Eclipse	56.7
125	Odyssey	56.7
126	Chicago II	53.3

	Cultivar	% turf cover
127	NuGlade	56.7
128	J-1515	53.3
129	J-2487	56.7
130	J-1368	66.7
131	J-1838	56.7
132	J-2561	53.3
133	J-2885	50.0
134	J-1513	50.0
135	Everest	53.3
136	J-1420	50.0
137	J-1648	56.7
138	J-2890	50.0
139	Everglade	56.7
140	J-2695	56.7
141	J-1665	56.7
142	J-1880	56.7
143	Rugby II	53.3
144	Award	56.7
145	Rambo	60.0
146	Freedom II	53.3
147	Liberator	63.3
148	GO-9LM9	66.7
149	Pick 113-3	60.0
150	Langara	63.3
151	A96-739	60.0
152	PST-H5-35	60.0
153	PST-B3-170	56.7
154	B4-128A	60.0
155	PST-731	56.7
156	Washington	76.7
157	A96-742	46.7
158	A97-857	56.7
159	BAR Pp 0468	53.3
160	BAR Pp 0471	53.3
161	BAR Pp 0566	60.0
162	BAR Pp 0573	63.3
163	Bartitia	66.7
164	Baritone	66.7
165	Bariris	60.0
166	Barzan	43.3
167	Baronie	73.3
168	Unique	60.0
169	Serene	70.0
170	Moonlight	60.0
171	Blackstone	63.3
172	Rita	70.0
173	Northstar	60.0
	$LSD_{0.05}$	13.6

These data represent the percentage area covered by turf in October, 2000.

Fairway Height Kentucky Bluegrass Cultivar Trial

Nick E. Christians and Barbara R. Bingaman

This is the third year of data from the Fairway Height Kentucky Bluegrass Cultivar trial established in the fall of 1998. Data collection began after the cultivars were fully established in April, 1999. The area was maintained at a 0.5 in. mowing height. Four bluegrass cultivars were included. The cultivars were maintained with 4 lbs of N/1000 ft^2/growing season. Fungicides are used as needed in a preventative program. Herbicides and insecticides were applied as needed.

Visual quality ratings were taken from April through June, 2000 (Table 1). Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. It was determined after the June rating that the plots had become heavily infested with creeping bentgrass and data collection was suspended.

Table 1. Visual quality[1] of Kentucky bluegrass maintained at fairway height for the 1998 Fairway height Kentucky bluegrass cultivar trial.

Cultivar	April	May	June	Mean
1. Bluemoon	6.7	5.7	6.0	6.1
2. Award	5.3	5.0	6.3	5.6
3. Rambo	6.0	6.0	6.7	6.2
4. Nuglade	5.3	5.3	7.7	6.1
$LSD_{(0.05)}$	NS	NS	NS	NS

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

Perennial Ryegrass Studies - 2000 Progress Report

Rodney A. St. John and Nick E. Christians

This was the first 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 ft^2/yr. The area received herbicide treatments as required.

Cultivars were evaluated for turf quality April through October of 2000. Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. The values listed under each month in Table 1 are the averages of ratings made on three replicated plots for the three studies. Yearly means of data from each month are listed in the last column. The cultivars are listed in descending order of average quality.

Data for genetic color (Gcol) and spring greenup (Grn) also are included. The cultivars were rated for genetic color in July and the values were made using a 9 to 1 scale with 9 = dark and 1 = light green. Spring greenup data were taken in April and were estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf.

Table 1. 2000 visual quality[1] and other ratings[2] for the 1999 National Perennial Ryegrass Study.

				Visual quality						
	Cultivar	Gcol	Grn	May	June	July	Aug	Sep	Oct	Mean
1	CIS-PR-78	3.3	7.0	7.3	7.3	3.7	4.3	4.3	7.0	5.7
2	Exacta	2.7	7.7	7.3	7.0	4.0	3.7	5.0	7.0	5.7
3	MP107	3.3	8.0	8.0	7.7	4.0	4.0	4.3	6.0	5.7
4	Pick MDR	3.7	8.0	7.7	7.3	3.3	4.0	5.0	6.7	5.7
5	PST-2CRR	3.3	7.0	7.3	7.3	3.3	4.3	5.0	6.7	5.7
6	Roberts-627	2.7	7.0	7.3	7.7	4.0	3.7	4.3	7.3	5.7
7	BAR 9 B2	3.3	7.7	7.7	7.3	3.7	3.7	4.3	6.7	5.6
8	Pick RC2	2.7	8.0	7.3	6.7	4.0	4.7	4.7	6.3	5.6
9	Pizzazz	3.3	8.0	7.3	7.3	4.0	3.7	4.3	6.7	5.6
10	PST-2L96	3.7	7.3	7.3	7.3	4.0	4.3	4.0	6.3	5.6
11	ABT-99-4.965	3.0	8.0	7.7	7.3	3.3	4.0	4.0	6.7	5.5
12	CIS-PR-80	4.0	7.3	7.3	7.7	3.7	4.3	4.0	6.0	5.5
13	APR 1237	2.7	6.7	6.3	6.7	4.0	4.7	4.3	6.7	5.4
14	Cathedral II	2.7	6.7	6.7	6.7	3.7	5.0	4.3	6.0	5.4
15	CIS-PR-84	2.7	7.7	8.0	7.7	3.7	3.0	4.0	6.3	5.4
16	LPR 98-143	3.0	7.7	6.7	6.3	3.7	5.0	4.7	6.0	5.4
17	LTP-ME	3.3	7.3	7.3	6.7	3.7	3.7	4.0	7.0	5.4
18	Pick PR QH-97	2.7	7.7	8.0	7.0	3.3	3.0	4.0	7.0	5.4
19	Pick Prngs	2.3	7.0	7.0	6.7	3.7	4.7	4.3	6.0	5.4
20	Premier II	2.7	6.7	7.0	6.3	4.0	4.3	4.7	6.0	5.4
21	Promise	3.0	7.7	7.3	7.0	3.3	3.7	4.3	6.7	5.4
22	PST-2BR	3.0	7.7	7.7	7.3	3.7	3.7	4.0	6.3	5.4
23	PST-2LA	3.3	6.7	7.0	7.3	3.3	4.0	4.3	6.3	5.4
24	Radiant	3.0	7.7	7.7	7.0	3.0	3.7	4.3	7.0	5.4
25	SRX 4820	3.0	7.7	7.3	6.7	4.0	4.0	4.0	6.3	5.4
26	ABT-99-4.633	3.7	7.7	7.3	7.7	3.3	3.0	4.7	6.0	5.3
27	ABT-99-4.753	3.3	7.0	7.3	7.3	3.7	3.7	4.3	5.7	5.3
28	ABT-99-4.815	3.0	7.0	7.0	6.7	3.7	4.0	4.0	6.7	5.3
29	Affirmed	3.0	6.0	6.3	6.7	3.7	4.7	4.3	6.0	5.3
30	APR 1235	2.7	6.7	6.7	6.3	3.3	4.7	4.7	6.0	5.3
31	APR 1236	3.0	7.7	7.0	6.3	4.0	4.3	4.0	6.0	5.3
32	CIS-PR-75	3.0	7.0	7.7	7.3	3.3	4.0	4.0	5.7	5.3
33	CIS-PR-85	3.0	7.0	7.3	7.3	4.0	3.0	4.0	6.3	5.3
34	Fiesta 3	3.0	7.0	7.0	6.7	3.7	4.0	4.0	6.3	5.3
35	Headstart	2.7	7.3	7.0	6.7	4.0	3.7	4.3	6.0	5.3
36	MP 103	2.7	7.3	7.0	6.3	3.7	3.0	4.0	6.5	5.3
37	MP 58	3.0	7.0	7.0	6.7	3.7	4.0	4.0	6.7	5.3

	Cultivar	Gcol	Grn	Visual quality						
				May	June	July	Aug	Sep	Oct	Mean
38	Pennant II	3.0	7.3	6.7	6.3	3.7	4.3	4.7	6.3	5.3
39	Pennington-1130	3.7	7.0	7.0	7.0	4.0	4.0	4.0	6.0	5.3
40	Phantom	3.0	7.0	7.0	7.0	3.7	3.7	4.3	6.3	5.3
41	Premier	2.7	6.3	6.7	6.7	3.7	4.7	3.7	6.3	5.3
42	PST-2RT	2.7	7.0	6.7	6.0	3.7	4.3	4.3	6.7	5.3
43	SRX 4801	3.3	7.3	7.0	7.0	3.7	3.7	4.0	6.3	5.3
44	SRX 4RHT	3.3	7.0	7.0	7.0	3.7	3.3	4.3	6.3	5.3
45	Wilmington	3.3	7.0	7.0	7.0	3.3	3.3	4.3	6.7	5.3
46	ABT-99-4.629	2.7	7.3	7.3	6.7	3.7	3.0	4.0	6.3	5.2
47	ABT-99-4.721	3.3	7.0	7.0	7.0	3.3	3.3	4.0	6.3	5.2
48	ABT-99-4.903	2.7	7.7	7.3	6.7	3.7	4.0	4.3	5.3	5.2
49	ABT-99-4.960	3.3	6.7	7.0	7.0	3.0	3.3	4.0	6.7	5.2
50	Allsport	2.7	6.7	6.7	6.7	3.7	3.7	4.0	6.7	5.2
51	APR 777	2.7	6.3	6.7	6.3	3.3	3.7	4.3	6.7	5.2
52	Brightstar II	2.7	6.7	7.0	7.3	3.3	3.0	4.0	6.3	5.2
53	Calypso II	2.7	6.3	6.7	6.7	3.7	3.3	4.0	6.7	5.2
54	CAS-LP84	3.0	7.3	7.0	7.0	3.7	4.3	4.0	5.3	5.2
55	Charger II	2.3	6.0	6.3	6.7	3.3	4.3	4.3	6.3	5.2
56	Churchill	3.3	6.3	6.7	7.0	3.7	3.3	4.3	6.0	5.2
57	CIS-PR-69	3.3	6.7	6.7	7.0	3.7	3.3	4.0	6.7	5.2
58	Elfkin	2.3	7.3	7.0	6.7	3.3	3.7	4.0	6.3	5.2
59	EP53	3.0	7.0	7.0	7.0	3.3	3.7	4.0	6.0	5.2
60	Jet	3.0	7.7	7.3	7.0	3.3	3.0	4.3	6.3	5.2
61	JR-151	2.3	6.0	6.3	6.0	3.7	4.3	4.0	6.7	5.2
62	LTP 98-501	3.3	7.7	7.3	7.0	4.0	3.3	4.0	5.7	5.2
63	Nexus	3.3	8.0	7.3	7.0	3.7	3.3	4.3	5.7	5.2
64	Palmer III	2.7	7.3	6.7	6.3	3.7	4.7	4.3	5.7	5.2
65	Paragon	3.3	6.7	6.7	6.7	4.0	3.3	4.0	6.3	5.2
66	Pick PR 1-94	3.3	7.3	6.7	6.3	3.7	4.3	4.3	6.0	5.2
67	Pleasure XL	2.7	6.7	6.7	6.7	3.7	4.7	4.0	5.7	5.2
68	PST-2SLX	2.7	7.0	7.0	7.0	3.0	3.7	4.0	6.3	5.2
69	R8000	3.3	7.3	7.3	7.0	3.7	3.0	4.0	6.0	5.2
70	Seville II	3.0	6.3	6.7	7.3	3.7	3.3	4.0	6.0	5.2
71	6011	3.0	7.0	7.0	6.3	3.3	3.7	4.0	6.3	5.1
72	ABT-99-4.339	3.0	6.0	6.3	6.3	3.0	4.0	4.0	6.7	5.1
73	ABT-99-4.461	3.3	7.0	7.0	7.0	3.0	4.0	4.0	5.7	5.1
74	ABT-99-4.464	3.0	7.3	7.0	6.3	3.7	3.3	4.0	6.0	5.1
75	ABT-99-4.560	3.0	6.7	6.7	7.0	3.7	3.7	4.0	5.7	5.1
76	ABT-99-4.709	3.0	7.7	7.0	6.7	3.3	3.3	4.0	6.3	5.1
77	ABT-99-4.834	3.7	6.7	6.7	7.3	3.3	3.3	4.0	6.0	5.1
78	AG-P981	3.0	7.3	7.0	6.0	3.3	4.0	4.0	6.0	5.1
79	APR 776	2.7	6.7	6.3	6.3	3.0	4.3	4.3	6.0	5.1
80	B1	2.7	7.3	7.0	6.7	3.0	3.0	4.0	6.7	5.1
81	Barlennium	2.7	6.7	6.7	6.3	3.7	3.7	4.0	6.3	5.1
82	Catalina	2.7	6.7	6.7	6.3	3.7	3.7	4.3	6.0	5.1
83	CIS-PR-72	3.0	7.3	7.0	6.7	3.3	3.7	4.0	5.7	5.1
84	DLF-LDD	3.3	6.7	7.0	6.7	3.7	3.3	3.7	6.0	5.1
85	EP57	3.0	6.7	6.7	7.0	3.7	4.0	4.0	5.3	5.1
86	EPD	3.0	6.0	7.0	7.3	3.0	3.3	4.0	6.0	5.1
87	JR-128	2.7	7.0	6.3	6.0	3.7	4.3	4.3	5.7	5.1
88	KOOS R-71	2.3	6.3	6.3	6.0	3.3	4.7	4.0	6.0	5.1
89	Line Drive	2.3	6.7	6.7	6.0	3.3	4.3	4.0	6.3	5.1
90	Majesty	2.7	6.7	6.3	6.3	3.7	4.3	4.0	6.0	5.1
91	NJ-6401	3.0	7.0	7.0	6.0	3.7	4.0	4.0	5.7	5.1

	Cultivar	Gcol	Grn	Visual quality						
				May	June	July	Aug	Sep	Oct	Mean
92	Passport	2.3	6.3	6.3	6.3	3.7	4.3	4.0	6.0	5.1
93	PST-2CRL	2.7	7.3	7.0	6.7	3.3	3.0	4.0	6.3	5.1
94	PST-2JH	2.7	6.3	6.3	6.3	3.7	4.0	4.0	6.3	5.1
95	PST-2M4	3.0	7.0	6.7	6.3	3.7	4.3	4.0	5.7	5.1
96	PST-2SBE	3.3	6.3	7.0	7.3	3.3	3.3	4.0	5.7	5.1
97	Racer	3.0	6.7	6.7	6.0	4.0	4.0	4.0	5.7	5.1
98	Secretariat	2.0	6.0	6.7	6.3	3.3	4.0	4.0	6.3	5.1
99	Skyhawk	3.3	6.3	6.7	6.7	3.7	3.7	4.0	5.7	5.1
100	ABT-99-4.724	3.0	7.0	7.0	7.0	3.0	3.0	3.7	6.3	5.0
101	APR 1232	3.0	7.0	6.7	6.0	3.3	3.3	4.3	6.3	5.0
102	APR 1233	2.3	6.3	6.0	6.0	3.7	4.3	4.3	5.7	5.0
103	APR1234	2.0	6.7	6.7	6.0	3.3	4.3	4.0	5.7	5.0
104	Ascend	3.0	6.3	6.3	6.3	3.7	4.0	4.0	5.7	5.0
105	Divine	2.7	7.0	6.3	6.0	3.3	4.0	4.0	6.3	5.0
106	PST-2A6B	2.7	7.0	6.7	6.3	3.3	3.3	4.0	6.3	5.0
107	SR 4500	2.3	7.0	6.3	6.0	3.0	3.7	4.3	6.7	5.0
108	ABT-99-4.115	2.7	6.7	6.3	6.3	3.3	3.7	4.0	5.7	4.9
109	ABT-99-4.600	2.7	6.3	6.3	6.3	3.3	3.7	4.3	5.7	4.9
110	APR 1231	2.3	6.7	6.3	6.0	3.7	3.7	4.0	6.0	4.9
111	Buccaneer	2.0	6.3	6.3	6.0	3.7	4.3	3.7	5.7	4.9
112	DP LP-1	2.3	6.7	6.7	6.0	3.3	4.3	4.0	5.3	4.9
113	JR-187	3.3	7.0	6.7	6.0	3.7	3.3	4.0	6.0	4.9
114	JR-317	2.7	6.7	6.3	6.0	3.7	3.3	4.0	6.0	4.9
115	LPR 98-144	2.3	5.3	5.7	6.3	3.0	4.0	4.0	6.3	4.9
116	Manhattan 3	2.7	6.3	6.3	6.3	3.7	4.0	4.0	5.3	4.9
117	MDP	3.7	6.7	6.7	6.7	3.0	3.3	4.0	6.0	4.9
118	MEPY	2.3	7.0	7.0	6.0	3.0	3.0	4.0	6.3	4.9
119	Panther	2.7	6.3	6.3	6.0	3.3	3.7	4.0	6.3	4.9
120	PST-CATS	2.7	7.0	6.7	6.3	3.0	3.7	4.0	6.0	4.9
121	WVPB-R-82	2.7	6.0	6.0	5.7	4.0	4.7	3.3	6.0	4.9
122	WVPB-R-84	2.3	6.0	6.0	5.7	3.7	4.3	4.0	6.0	4.9
123	Yatsugreen	2.0	6.3	5.7	4.3	4.0	5.0	4.0	6.3	4.9
124	Pick EX2	2.3	6.3	6.3	5.7	3.7	3.0	3.7	6.3	4.8
125	Pick PR B-97	2.7	6.3	6.3	6.3	3.0	3.0	4.0	6.0	4.8
126	ABT-99-4.625	2.3	6.7	6.7	6.0	2.7	3.0	4.0	6.0	4.7
127	BY-100	2.3	5.7	6.0	6.0	3.7	3.3	3.3	5.7	4.7
128	DP 17-9069	2.0	5.7	5.7	5.3	3.3	4.7	3.3	5.7	4.7
129	Edge	2.0	5.7	6.0	6.0	3.0	3.7	3.7	5.7	4.7
130	SRX 4120	2.0	6.3	6.0	5.7	3.3	3.0	4.3	6.0	4.7
131	Affinity	2.0	6.0	5.3	5.3	3.3	4.7	4.0	5.0	4.6
132	DP 17-9496	2.0	5.0	5.3	4.7	4.0	5.0	3.0	5.7	4.6
133	Linn	3.0	5.0	5.0	4.7	4.0	4.0	3.3	6.0	4.5
134	DP 17-9391	2.3	5.7	5.3	4.7	3.3	4.3	3.0	5.7	4.4
	$LSD_{(0.05)}$	1.2	NS	1.0	1.0	NS	1.9	1.3	NS	0.9

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality.
[2]Genetic color (Gcol) was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Spring greenup (Grn) was determined using a 9 to 1 scale with 9 = green and 1 = dormant.
NS = means are not significantly different at the 0.05 level.

Regional Tall Fescue Cultivar Evaluation - Established 1996

Nick E. Christians and Rodney A. St. John

This was the fourth year of data collection from the tall fescue trial. This is a 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 129 tall fescue cultivars. The study is established in full sun. Three replications of the 3 x 5 ft (15 ft^2) plots were established for each cultivar in the spring of 1996. The trial is maintained at a 2-inch mowing height, 3.5 lbs N/1000 ft^2 were applied during the growing season, and the area was irrigated when needed to prevent drought. Preemergence herbicide was applied once in the spring.

Cultivars were evaluated for turf quality each month of the growing season. Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. The values listed under each month in Table 1 are the averages of ratings made on three replicated plots for the three studies. Yearly means of data from each month are listed in the last column. The cultivars are listed in descending order of average quality.

Data for genetic color (Gcol), spring greenup (Grn), and leaf texture (Leaf) also are included. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Spring greenup was estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf. Leaf texture was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture.

Table 1. 2000 visual quality[1] and other ratings[2] for the 1996 National Tall Fescue regional cultivar trial.

					Turf quality						
	Cultivar	Gcol	Grn	Leaf	May	June	July	Aug	Sept	Oct	Mean
1	ISI-TF11	7.0	6.0	6.3	5.7	6.3	6.0	4.7	5.3	5.0	5.5
2	Wolfpack (PST-R5TK)	6.7	6.7	6.7	5.7	6.3	6.3	4.3	6.0	4.3	5.5
3	Rembrandt (LTP-4026 E+)	6.3	6.3	6.7	5.3	5.3	6.3	5.3	5.3	3.7	5.2
4	Arid	5.3	7.3	5.3	6.0	6.3	5.3	3.7	5.0	4.0	5.1
5	Axiom (ATF-192)	5.7	5.0	6.7	4.7	5.0	5.7	5.3	5.3	4.0	5.0
6	Shenandoah	6.0	6.3	6.0	6.0	5.3	5.3	4.7	4.7	4.0	5.0
7	ATF-253	6.0	5.3	6.3	5.3	5.3	5.7	4.3	5.3	3.7	4.9
8	Crossfire II	6.3	5.3	7.0	5.7	6.3	5.3	4.0	4.7	3.3	4.9
9	Dominion (PST-5M5)	6.3	6.3	6.0	5.7	6.0	5.3	4.0	5.0	3.3	4.9
10	Millennium (TMI-RBR)	5.7	5.3	6.0	5.7	5.7	5.0	4.7	4.7	3.7	4.9
11	Plantation (Pennington-1901)	6.3	5.3	6.3	5.7	5.0	5.0	4.7	5.3	4.0	4.9
12	MB 212	8.0	6.3	7.3	5.0	5.3	5.0	4.3	5.3	4.0	4.8
13	Twilight II (TMI-TW)	6.7	5.0	6.3	4.7	5.0	5.7	4.7	5.0	3.7	4.8
14	Watchdog (Pick FA B-93)	6.7	6.3	6.3	5.0	5.7	5.3	4.3	4.7	3.7	4.8
15	Aztec II (TMI-AZ)	5.3	5.3	7.0	5.0	4.7	5.7	4.7	4.7	3.3	4.7
16	Bonsai 2000 (Bullet)	7.0	6.0	6.7	5.7	5.3	5.0	4.0	4.7	3.7	4.7
17	ISI-TF9	6.7	5.7	6.3	5.0	5.0	6.0	3.7	4.7	3.7	4.7
18	Mustang II	6.0	5.7	6.3	5.7	5.3	5.0	3.3	4.7	4.0	4.7
19	Pixie E+	7.3	5.7	7.7	5.3	7.0	4.3	4.3	4.0	3.0	4.7
20	Alamo E	5.0	5.3	5.7	5.0	4.7	5.7	4.3	4.0	3.7	4.6
21	Equinox (TMI-N91)	6.0	5.7	6.3	4.7	4.3	5.7	4.3	5.0	3.7	4.6
22	Jaguar 3	6.0	6.0	6.3	6.0	5.0	5.3	3.3	4.3	3.7	4.6
23	Kentucky-31 w/endo	5.0	6.3	4.0	5.3	5.3	5.7	4.0	4.0	3.3	4.6
24	Safari	6.3	6.7	6.0	5.7	5.3	5.0	3.7	4.3	3.3	4.6
25	Titan 2	6.0	6.0	6.0	5.0	6.7	5.0	3.3	4.0	3.7	4.6
26	WX3-275	7.0	5.0	6.7	4.7	6.7	4.7	3.0	4.7	3.7	4.6
27	Anthem II (TMI-FMN)	7.0	5.7	7.0	4.3	5.7	5.7	3.7	4.3	3.3	4.5
28	ATF-257	5.7	5.7	5.3	4.7	5.3	5.0	3.7	5.0	3.3	4.5
29	Coronado	6.3	5.0	6.7	5.7	5.7	4.0	3.3	4.7	3.7	4.5
30	Coronado gold (PST-5RT)	5.7	6.0	6.7	5.7	4.7	4.7	3.7	4.7	3.7	4.5
31	Masterpiece (LTP-SD-TF)	6.7	5.3	7.3	5.7	5.7	5.0	3.3	4.3	3.0	4.5
32	PRO 8430	7.7	5.0	6.7	5.0	6.0	5.7	3.0	4.0	3.3	4.5
33	Scorpio (ZPS-2PTF)	6.0	5.7	6.7	5.3	5.0	5.0	4.0	4.0	3.7	4.5
34	Apache II	7.0	6.0	6.7	5.0	6.3	4.7	4.0	3.7	2.7	4.4

	Cultivar	Gcol	Grn	Leaf	Turf quality May	June	July	Aug	Sept	Oct	Mean
35	Brandy (J-101)	7.3	5.7	7.0	5.0	6.0	5.0	3.3	4.0	3.0	4.4
36	Bravo (RG-93)	6.7	5.7	7.0	5.0	4.7	5.3	4.0	4.3	3.3	4.4
37	Gazelle	7.0	5.3	8.3	5.3	6.3	4.0	4.0	4.0	2.7	4.4
38	Oncue (PST-523)	6.0	5.7	6.3	5.3	6.0	4.0	3.7	4.3	3.3	4.4
39	Rebel 2000 (AA-989)	6.3	5.0	6.3	4.7	4.7	5.0	4.7	4.3	3.0	4.4
40	Rebel sentry (AA-A91	6.7	5.7	6.7	5.3	5.7	4.7	3.3	4.3	3.0	4.4
41	Coyote	7.3	5.7	7.0	5.0	5.3	4.0	4.0	4.0	3.3	4.3
42	Duster	7.3	6.0	6.3	5.0	5.3	4.7	4.0	3.7	3.0	4.3
43	Finelawn Petite	6.0	5.7	5.3	4.7	5.0	5.0	5.0	3.7	2.7	4.3
44	MB 216	7.7	6.3	6.0	5.7	5.7	5.0	3.7	3.3	2.3	4.3
45	Pick RT-95	7.3	4.7	7.7	4.7	5.0	4.7	4.0	4.0	3.3	4.3
46	SRX 8084	6.0	6.0	6.7	5.0	5.0	4.7	3.3	4.7	3.0	4.3
47	Chapel Hill (TA-7)	6.7	5.7	6.0	5.3	5.0	4.3	4.0	3.3	3.0	4.2
48	Lion	7.0	4.7	6.7	5.0	6.0	3.7	3.7	4.0	2.7	4.2
49	Marksman	7.3	6.0	6.7	5.3	5.3	4.3	3.7	3.3	3.0	4.2
50	OFI-FWY	7.0	5.3	6.7	4.7	5.3	4.7	3.7	3.7	3.0	4.2
51	SRX 8500	6.7	5.0	6.3	5.3	5.3	4.3	3.3	4.0	2.7	4.2
52	Tar Heel	7.0	5.7	6.7	4.7	5.7	5.0	3.0	3.3	3.3	4.2
53	Tulsa	6.3	5.3	7.0	5.3	5.3	4.3	3.3	4.0	3.0	4.2
54	WVPB-1B	5.3	5.0	5.7	4.7	5.0	5.0	4.0	3.7	2.7	4.2
55	AV-1	7.0	5.7	6.3	4.3	5.0	4.7	3.7	4.0	2.7	4.1
56	Falcon II	7.7	6.0	6.3	5.0	6.0	4.0	3.3	3.3	2.7	4.1
57	Finelawn 5LZ (ZPS-5LZ)	6.7	5.3	6.7	4.7	5.3	4.3	3.7	4.0	2.7	4.1
58	Genesis	6.7	5.7	6.3	4.7	5.0	5.0	3.7	3.0	3.0	4.1
59	Glen Eagle (EC-101)	6.3	6.0	5.7	6.0	4.7	4.3	3.7	3.0	2.7	4.1
60	Leprechaun	7.7	6.0	6.0	4.7	5.3	5.0	3.3	3.3	3.0	4.1
61	MB 215	7.3	5.3	6.0	4.3	4.7	4.7	4.0	4.3	2.3	4.1
62	Olympic gold (PST-5E5)	6.3	5.7	5.7	5.0	5.0	4.3	3.3	3.7	3.3	4.1
63	Pedestal (PC-AO)	6.3	5.3	6.0	4.7	5.0	4.3	3.3	4.0	3.3	4.1
64	SR 8210	6.3	5.3	6.3	5.0	5.3	4.7	3.0	3.7	3.0	4.1
65	Sunpro	7.0	5.3	7.3	4.3	5.0	4.3	4.3	4.0	2.7	4.1
66	WPEZE (WVPB-1C)	7.0	6.0	5.7	4.7	6.7	4.7	3.0	3.0	2.7	4.1
67	Arid II (J-3)	7.3	4.7	7.0	5.0	5.7	4.7	2.7	3.3	2.7	4.0
68	Bulldawg (Pick GA-96)	6.3	5.0	7.0	4.0	5.3	4.7	3.3	3.7	3.0	4.0
69	CU9501T	6.7	6.0	6.3	5.0	5.0	4.7	3.3	3.3	2.7	4.0
70	EA 41	7.0	5.0	6.3	4.3	5.0	4.0	3.3	4.0	3.3	4.0
71	Helix (WVPB-1D)	7.3	6.0	5.7	5.3	5.0	4.7	3.3	3.3	2.3	4.0
72	OFI-951	6.7	5.0	7.0	5.0	5.0	5.0	3.0	3.3	2.7	4.0
73	PST-5TO	5.7	5.0	7.0	4.3	4.3	5.0	3.3	3.7	3.3	4.0
74	Bonsai	5.7	5.3	6.0	5.0	4.3	4.3	3.0	3.7	3.0	3.9
75	DP 7952	5.7	6.3	6.3	5.0	5.3	4.3	3.0	3.3	2.3	3.9
76	Empress	7.0	6.3	6.3	5.0	5.7	4.0	3.0	3.3	2.3	3.9
77	JTTFA-96	6.3	7.0	5.7	4.3	5.3	4.3	3.7	3.3	2.7	3.9
78	JTTFC-96	7.3	6.3	6.3	5.0	5.3	4.0	2.3	3.7	3.0	3.9
79	Kitty Hawk S.S.T. (SS45DW)	6.0	5.0	7.0	4.7	5.7	3.7	3.0	3.7	3.0	3.9
80	Pick FA XK-95	6.7	5.3	6.7	4.3	5.0	4.3	3.7	3.3	3.0	3.9
81	Red Coat (ATF-038)	6.3	6.0	5.7	5.0	5.7	4.0	3.0	3.7	2.3	3.9
82	Regiment	7.0	6.0	6.7	4.3	5.7	4.0	3.3	3.3	2.7	3.9
83	TF6 (BAR FA6 US6F)	6.3	5.7	5.7	4.7	4.7	4.3	4.3	3.3	2.3	3.9
84	Wyatt (ATF=188)	6.0	5.0	6.7	4.3	4.7	4.3	3.0	3.7	3.3	3.9
85	ATF-022	6.0	5.3	7.0	5.7	4.3	4.3	3.0	3.0	2.3	3.8
86	Cochise II	6.0	5.3	7.0	5.0	4.7	4.0	3.7	3.3	2.3	3.8
87	DLF-1	6.0	6.0	5.7	4.7	5.3	3.7	3.3	3.3	2.7	3.8
88	ISI-TF10	6.3	5.3	5.7	4.3	4.7	4.3	3.3	3.7	2.3	3.8

	Cultivar	Gcol	Grn	Leaf	Turf quality							
					May	June	July	Aug	Sept	Oct	Mean
89	OFI-96-31	7.3	5.7	6.3	4.7	6.0	3.7	3.3	3.0	2.0	3.8
90	PSII-TF-9	6.3	5.7	5.3	4.7	5.7	4.0	3.3	3.0	2.3	3.8
91	Reserve (ATF-182)	6.7	5.3	6.0	4.3	4.7	4.3	3.3	3.3	2.7	3.8
92	Shenandoah II (WRS2)	6.7	5.3	6.7	5.0	5.0	4.0	3.0	3.0	2.7	3.8
93	Wildfire (ATF-196)	7.3	5.0	6.7	4.3	5.3	4.3	2.7	3.7	2.7	3.8
94	ATF-020	5.7	5.3	5.7	4.7	4.0	4.0	3.3	3.3	2.7	3.7
95	Bandana (PST-R5AE)	6.7	5.0	6.7	4.3	5.7	3.3	3.0	3.3	2.3	3.7
96	Barrera (BAR FA6 US3)	6.3	4.7	6.3	5.0	5.0	3.7	3.0	2.7	2.7	3.7
97	MB 29	7.3	5.0	6.7	5.0	4.3	3.7	3.3	3.0	3.0	3.7
98	OFI-96-32	6.0	4.7	6.0	4.3	5.0	4.3	2.7	3.3	2.7	3.7
99	Pick FA 15-92	7.3	4.7	6.0	4.7	4.7	4.0	3.0	3.0	2.7	3.7
100	PSII-TF-10	7.3	5.0	6.0	4.0	5.7	4.0	3.3	3.0	2.3	3.7
101	Renegade	6.7	6.0	6.3	4.7	4.7	4.3	3.0	3.0	2.3	3.7
102	Airlie (MB 210)	6.3	5.0	6.3	5.0	4.7	3.3	2.7	3.0	2.7	3.6
103	Arabia (J-5)	6.7	5.0	6.3	3.7	4.0	4.7	3.0	3.7	2.7	3.6
104	Arid 3 (J-98)	6.3	5.3	6.7	4.0	4.7	3.0	3.3	3.7	2.7	3.6
105	Barrington (BAR FA6D USA)	7.3	4.3	7.3	3.7	5.3	4.0	3.3	3.0	2.3	3.6
106	CU9502T	5.7	5.3	6.0	4.3	4.0	3.7	3.3	3.7	2.3	3.6
107	DP 50-9011	7.0	5.0	6.3	4.0	5.3	3.7	3.3	3.3	2.0	3.6
108	Durana (MB 211)	7.0	4.3	6.3	4.3	4.7	4.3	2.7	3.0	2.3	3.6
109	JSC-1	6.3	5.7	6.0	4.0	5.0	4.0	3.0	3.0	2.7	3.6
110	MB 213	6.7	5.7	7.0	4.7	5.3	3.7	2.7	3.0	2.3	3.6
111	MB 28	6.3	5.3	6.3	4.3	5.3	3.7	2.7	3.3	2.3	3.6
112	Pick FA 20-92	7.7	5.0	5.7	4.0	5.0	3.7	3.0	3.3	2.3	3.6
113	R5AU	6.3	4.7	6.3	4.3	4.7	4.0	3.0	3.3	2.0	3.6
114	Good-en (KOOS 96-14)	6.0	5.3	5.3	4.3	4.3	3.7	3.0	3.0	2.7	3.5
115	MB 214	7.0	4.7	6.0	4.7	5.0	4.0	2.7	2.7	2.0	3.5
116	OFI-931	6.7	5.3	6.0	4.0	4.3	4.0	3.0	3.0	2.7	3.5
117	BAR FA 6D	5.3	4.7	6.3	4.0	4.0	3.7	3.3	3.0	2.7	3.4
118	Comstock (SSDE31)	6.7	6.3	6.0	4.0	5.3	3.7	2.7	3.0	2.0	3.4
119	Southern Choice	6.3	5.3	5.7	4.0	4.7	3.3	3.0	3.3	2.3	3.4
120	Arizona (Pick FA6-91)	6.7	5.3	6.7	4.3	5.0	3.0	2.7	3.0	2.0	3.3
121	BAR FA 6LV	6.3	4.7	6.3	4.3	4.3	3.3	2.7	3.0	2.0	3.3
122	BAR FA6 US2U	7.0	4.7	6.3	4.3	4.3	3.7	2.3	2.7	2.3	3.3
123	MB 26	5.7	4.7	6.3	3.7	5.0	3.0	3.0	3.0	2.3	3.3
124	Pick FA N-93	7.0	4.7	6.3	3.7	4.0	3.7	3.0	3.3	2.3	3.3
125	Velocity (AA-983)	6.0	5.3	6.3	3.7	4.0	3.7	2.7	3.3	2.7	3.3
126	Shortstop II	6.0	5.3	6.3	4.0	4.3	3.7	2.7	2.7	2.0	3.2
127	Tomahawk-E	6.0	4.7	6.0	3.7	4.3	3.3	3.0	2.7	2.3	3.2
128	Tracer (BAR FA6 US1)	6.7	4.3	7.0	3.7	4.0	3.3	2.7	2.7	2.0	3.1
129	Pick FA UT-93	6.3	4.7	6.0	3.7	4.7	2.7	2.3	2.7	2.0	3.0
	$LSD_{0.05}$	1.8	1.5	1.5	2.1	3.2	2.1	2.5	1.8	1.4	1.2

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.

[2]Genetic color (Gcol) was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Spring greenup (Grn) was determined using a 9 to 1 scale with 9 = green and 1 = dormant. Leaf texture (Leaf) was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture.

Regional Fine Fescue Cultivar Trial - Established 1998

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

This was the third 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. Three replications of the 3 x 5 ft (15 ft^2) plots were established for each cultivar 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. Preemergence herbicide was applied once in the spring.

Visual quality was evaluated monthly in 2000 from May through October (Table 1). Quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. The values listed under each month in Table 1 are the averages of visual quality ratings made on three replicated plots for the three studies. Yearly means of monthly data were taken and are listed in the last column. The first cultivar received the highest average rating for the entire 2000 season. The cultivars are listed in descending order of average quality.

Data for genetic color (Gcol), spring greenup (Grn), and leaf texture (Leaf) also are included for the high-maintenance, irrigated and for the low-maintenance trials. Genetic color was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Spring greenup was estimated using a 9 to 1 scale with 9 = green and 1 = dormant turf. Leaf texture was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture.

Table 1. The 2000 visual quality[1] and other turf attribute ratings[2] for cultivars in the 1998 Fineleaf Fescue Cultivar Trial.

	Cultivar	Species[3]	Gcol	Grn	Leaf	May	June	July	Aug	Sept	Oct	Mean
1	SRX 3961	HF	7.7	6.7	7.7	6.0	6.7	7.3	6.7	7.3	6.7	6.8
2	ABT-HF1	HF	7.7	6.0	7.7	5.7	6.7	6.0	6.7	7.3	6.7	6.5
3	PST-4HM	CF	8.0	6.7	6.7	5.7	6.3	7.0	6.0	7.0	7.0	6.5
4	4001	HF	7.0	6.3	6.7	4.7	6.3	7.0	6.3	7.3	6.7	6.4
5	ABT-HF-2	HF	6.3	5.3	7.0	5.0	6.0	6.0	7.0	7.0	7.0	6.3
6	Oxford	HF	7.3	6.0	6.7	6.0	6.7	6.7	6.0	6.3	6.0	6.3
7	Scaldis II (AHF 008)	HF	7.7	5.3	7.3	5.0	6.3	6.7	5.7	7.3	7.0	6.3
8	BAR HF 8 FUS	HF	7.3	6.0	7.0	6.7	7.0	6.0	5.7	6.0	6.0	6.2
9	ISI FL 12	HF	7.7	6.3	7.3	5.7	5.7	6.3	6.7	6.7	6.3	6.2
10	Salsa	STF	6.0	7.0	6.7	5.7	6.0	6.3	5.0	6.7	7.3	6.2
11	Scaldis	HF	7.0	6.7	6.7	5.0	6.0	7.0	6.0	6.3	7.0	6.2
12	ISI FL 11	HF	6.7	5.3	7.3	4.7	6.3	6.7	6.0	6.7	6.0	6.1
13	Defiant	HF	7.3	7.0	6.7	5.3	6.7	6.3	5.0	6.3	6.3	6.0
14	Nordic (E)	HF	8.3	6.3	7.3	4.3	7.3	7.0	5.3	6.3	5.7	6.0
15	Pick FF A-97	HF	7.3	5.3	7.0	4.7	6.3	6.0	6.0	6.3	6.7	6.0
16	ABT-HF-4	HF	6.0	5.0	7.3	5.7	6.7	6.3	5.7	6.0	5.3	5.9
17	ASR 049	SCF	6.0	5.3	7.0	5.3	6.0	5.7	6.3	5.7	6.3	5.9
18	PST-4FR	STF	6.7	6.3	6.3	6.3	5.7	5.7	5.3	5.3	7.0	5.9
19	Stonehenge (AHF 009)	HF	7.0	6.3	7.0	5.3	7.0	7.0	5.0	6.0	5.0	5.9
20	MB-82	HF	6.3	5.3	7.3	4.7	6.0	6.0	6.7	6.0	5.3	5.8
21	PST-4MB	BHF	6.0	5.0	6.0	5.7	6.3	6.0	4.7	6.0	6.3	5.8
22	Discovery	HF	6.7	5.0	7.0	5.3	5.7	5.7	6.0	6.0	5.3	5.7
23	Heron	CF	6.3	6.0	7.0	5.3	6.0	6.3	4.7	5.7	6.3	5.7
24	Reliant II	HF	6.3	6.0	7.0	4.3	6.3	6.3	5.3	5.7	6.0	5.7
25	SR 3200	BF	5.7	5.0	5.7	6.0	6.3	6.0	4.3	5.7	5.0	5.6
26	ABT-HF-3	HF	6.3	5.0	6.3	4.7	6.3	6.0	4.0	6.3	5.7	5.5
27	Attila E	HF	6.0	5.3	6.7	5.3	5.7	5.0	5.7	5.7	5.3	5.4
28	ISI FRR 5	STF	5.7	5.7	6.7	5.3	6.3	4.7	5.0	5.3	6.0	5.4
29	Longfellow II	CF	6.3	5.7	7.0	5.3	7.3	5.0	3.7	5.3	6.0	5.4
30	Minotaur	HF X BF	5.3	5.0	6.3	5.7	6.0	5.7	4.3	5.7	5.0	5.4
31	Quatro	SF	7.0	6.0	7.0	5.0	6.0	6.0	5.7	5.0	5.0	5.4
32	Rescue 911	HF	6.3	4.7	6.0	4.7	5.7	5.3	5.7	5.7	5.3	5.4
33	SRX 52961	STF	5.3	6.0	6.0	6.3	6.0	5.0	4.3	5.0	5.7	5.4

	Cultivar	Species[3]	Gcol	Grn	Leaf	May	June	July	Aug	Sept	Oct	Mean
34	BAR SCF 8 FUS3	SCF	5.7	5.0	6.7	4.7	5.7	5.0	5.3	5.7	5.7	5.3
35	Bighorn	HF	6.0	5.0	6.3	5.7	6.0	5.7	4.0	5.3	5.3	5.3
36	ABT-CHW-3	CF	6.3	5.7	7.0	5.3	6.3	4.7	3.7	5.3	6.0	5.2
37	ACF 092	CF	6.0	6.3	7.0	6.0	7.0	4.7	3.3	4.3	6.0	5.2
38	BAR CF 8 FUS1	STF	5.3	6.3	6.0	5.3	5.7	4.7	4.0	5.3	6.0	5.2
39	Osprey	HF	6.3	4.7	6.7	5.0	4.3	5.3	5.7	5.7	5.0	5.2
40	ABT-CR-3	STF	6.0	6.0	6.3	4.3	5.7	5.0	4.7	5.0	5.7	5.1
41	ISI FRR 7	STF	5.7	5.7	6.7	5.7	5.7	5.3	3.0	4.7	6.0	5.1
42	Jasper II	STF	5.7	6.0	6.7	5.0	5.0	4.7	4.7	5.3	5.7	5.1
43	ASC 087	STF	5.3	6.0	6.3	5.0	4.7	4.7	4.0	5.3	6.3	5.0
44	Dawson E+	SCF	6.7	5.3	7.3	4.7	5.7	5.0	4.0	5.7	5.0	5.0
45	PST-EFL	STF	5.3	6.3	6.3	4.0	5.3	5.0	4.7	5.0	6.0	5.0
46	ABT-CHW-2	CF	6.0	5.0	7.0	5.3	6.7	4.7	3.3	4.3	5.0	4.9
47	ABT-CR-2	STF	5.7	5.3	6.7	6.0	6.0	4.3	4.3	3.7	5.0	4.9
48	ACF 083	CF	6.3	7.0	7.3	5.0	5.7	5.0	3.7	5.3	4.7	4.9
49	Bridgeport	CF	6.0	5.7	7.0	5.3	5.3	4.0	4.3	4.7	5.7	4.9
50	DGSC 94	STF	5.0	6.3	6.3	5.3	5.3	4.7	4.0	4.7	5.7	4.9
51	MB-63	CF	5.3	6.7	6.0	6.0	5.3	4.0	4.0	4.3	5.7	4.9
52	PST-47TCR	STF	5.3	5.3	6.3	5.0	5.3	5.3	4.3	4.7	4.7	4.9
53	Seabreeze	SCF	6.0	6.7	7.0	5.0	5.7	4.3	4.3	5.3	5.0	4.9
54	BAR CHF 8 FUS2	CF	6.3	6.0	6.0	5.0	5.7	4.7	4.3	4.3	4.7	4.8
55	Pathfinder	STF	5.7	6.3	6.3	5.0	6.0	4.0	4.3	4.3	5.3	4.8
56	Shademark	STF	5.3	6.7	5.7	4.7	4.7	4.7	3.7	5.0	6.0	4.8
57	Shademaster II	STF	5.7	7.0	6.0	4.7	5.7	4.7	4.0	4.7	5.0	4.8
58	Shadow II	CF	6.0	6.3	7.3	5.7	6.3	4.3	3.0	4.0	5.3	4.8
59	ABT-CHW-1	CF	5.3	5.7	6.7	3.7	6.3	3.7	4.0	4.3	6.0	4.7
60	ASC 082	STF	5.3	5.7	6.7	5.3	4.7	4.0	4.0	4.7	5.3	4.7
61	Culombra	CF	5.3	6.0	6.0	5.3	5.7	4.3	3.7	4.3	5.0	4.7
62	Florentine	STF	5.3	5.3	6.3	5.0	5.0	4.7	4.7	4.3	4.7	4.7
63	Intrigue	CF	6.3	5.0	7.0	4.7	6.0	4.7	3.0	4.3	5.3	4.7
64	SRX 52LAV	STF	5.0	5.3	6.3	4.7	5.0	4.7	4.0	5.0	5.0	4.7
65	Tiffany	CF	7.0	6.3	7.0	5.7	5.3	3.7	3.7	4.3	5.7	4.7
66	Ambassador	CF	6.0	6.0	7.0	4.7	6.3	3.7	4.0	3.7	5.0	4.6
67	Boreal	STF	5.7	4.7	6.7	3.7	4.7	4.7	3.0	5.3	6.3	4.6
68	Sandpiper	CF	6.0	6.0	7.0	5.0	5.3	4.3	3.3	4.0	5.3	4.6
69	Treazure (E)	CF	6.3	6.7	6.7	5.0	5.7	4.0	4.0	4.0	4.7	4.6
70	Magic	CF	6.0	5.3	6.3	4.7	5.7	4.3	3.0	4.3	5.0	4.5
71	SR 5100	CF	6.3	6.0	7.0	4.7	5.3	3.7	3.7	4.3	5.3	4.5
72	Brittany	CF	6.3	5.3	7.0	5.3	5.3	4.0	3.3	3.7	4.7	4.4
73	Pick FRC A-93	CF	5.7	5.3	6.7	4.3	5.0	4.0	3.3	4.3	5.7	4.4
74	Banner III	CF	5.7	6.3	6.3	5.7	5.7	3.3	4.0	3.3	3.7	4.3
75	Common creeping red	STF	5.7	5.0	6.7	4.0	5.7	4.3	3.0	4.0	5.0	4.3
76	Pick FRC 4-92	CF	5.7	5.7	6.0	5.0	6.3	3.3	3.7	3.7	3.3	4.2
77	ASC 172	STF	4.3	5.0	6.3	5.0	4.3	3.0	3.7	4.0	4.7	4.1
78	Jamestown II	CF	5.7	6.3	6.7	4.3	5.0	3.3	3.3	4.0	4.3	4.1
79	SR 6000	TH	5.0	3.0	4.0	3.3	4.0	3.7	2.7	3.0	3.3	3.3
	$LSD_{0.05}$		1.3	1.9	1.3	1.8	2.0	1.4	1.4	1.6	1.9	0.9

[1]Visual quality was assessed using a scale of 9 to 1 with 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality.
[2]Genetic color (Gcol) was rated using a 9 to 1 scale with 9 = dark and 1 = light green. Spring greenup (Grn) was determined using a 9 to 1 scale = with 9 = green and 1 = dormant. Leaf texture (Leaf) was assessed with a 9 to 1 scale with 9 = fine and 1 = coarse texture.
[3]BF blue fescue, BHF = blue hard fescue, CF = creeping fescue, HF = hard fescue, SF = sheep fescue, SCF = slender creeping fescue, STF = strong creeping fescue, TH = tufted hairgrass.

Fairway Height Bentgrass Cultivar Trials - Established 1998

Nick E. Christians and Rodney A. St. John

This is the third 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.

Visual quality ratings were taken from May through October, 2000 (Table 1). Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. Spring greenup (Green) was evaluated in April, 2000 using a 9 to 1 scale with 9 = best and 1 = worst greenup. Genetic color (Color) and spring density (dens) were evaluated in June, 2000. Genetic color was based on a 9 to 1 scale with 9 = dark green and 1 = light green. Density values are a visual rating of the density of the various cultivars collected in June with 9 = greatest density and 1 = lowest density.

Table 1. Visual turf quality and other physical ratings for cultivars in the 1998 Fairway Height Bentgrass Trial.

					Quality						
	Cultivar	Color	Green	Dens	May	June	July	Aug	Sept	Oct	Mean
1	Grand Prix	7.7	6.7	7.3	7.3	7.0	6.7	7.3	7.7	6.3	7.1
2	Backspin	7.3	7.7	7.7	6.3	6.7	6.7	6.7	8.0	7.0	6.9
3	Imperial	7.7	7.7	7.0	6.7	6.7	6.7	7.3	7.7	6.7	6.9
4	Seaside II	7.3	6.3	6.3	7.7	6.3	7.0	6.3	7.3	7.0	6.9
5	Century	7.3	7.7	7.0	7.3	6.7	6.7	6.7	7.0	6.3	6.8
6	Providence	6.3	6.7	6.3	6.3	6.0	6.3	7.0	8.0	6.7	6.7
7	L-93	6.7	6.3	6.7	6.0	6.3	6.0	6.7	7.7	6.7	6.6
8	SR 1119	6.7	7.0	5.7	6.0	6.0	6.7	6.7	6.7	6.3	6.4
9	SRX 1120	7.3	6.7	7.0	5.7	6.0	6.7	7.0	7.0	6.0	6.4
10	PST-OVN	7.0	6.7	6.3	6.3	6.3	6.0	6.3	7.0	6.0	6.3
11	Penn G-6	6.7	7.3	6.3	6.0	7.0	6.0	6.0	6.7	5.7	6.2
12	Trueline	7.0	6.3	5.3	5.3	6.0	6.0	6.0	7.3	6.7	6.2
13	SRX 1BPAA	7.0	6.3	5.3	5.3	5.7	5.7	6.0	6.3	5.7	5.8
14	Penneagle	6.0	6.7	6.3	5.7	6.0	5.3	6.0	5.7	5.7	5.7
15	Penncross	6.7	6.7	5.7	5.3	6.7	5.3	5.3	4.7	5.0	5.4
16	Princeville	6.7	6.3	5.3	5.0	6.0	4.7	5.7	5.3	5.7	5.4
17	Radiance* (PST-9HG)	7.3	6.3	4.7	4.3	5.3	4.3	5.0	4.7	4.3	4.7
18	Tiger	7.0	5.0	5.0	4.7	4.7	4.0	4.0	4.3	5.7	4.6
19	ISI AT-5*	7.0	5.3	5.3	4.3	5.0	4.0	4.3	4.7	4.3	4.4
20	SR 7100*	6.7	5.0	6.0	4.3	5.0	4.0	4.0	4.3	5.0	4.4
21	PST-9PM*	6.7	5.3	4.0	4.3	4.7	3.7	4.3	4.3	4.7	4.3
22	SRX 7MOBB*	7.0	5.7	4.3	4.3	4.7	3.7	4.7	4.0	4.3	4.3
23	ABT-COL-2*	6.0	4.7	4.3	4.3	4.3	3.7	4.7	4.0	4.3	4.2
24	Golfstar**	5.7	4.7	3.7	3.7	4.3	3.7	4.3	4.0	5.0	4.2
25	Seaside	5.3	5.7	4.0	3.7	4.3	4.0	4.3	3.7	4.7	4.1
26	SRX 7MODD*	7.0	5.0	4.0	4.3	4.0	3.3	3.7	4.7	4.7	4.1
	$LSD_{(0.05)}$	1.8	0.9	1.2	0.8	1.1	1.0	0.9	1.2	1.9	0.6

*Colonial bentgrass
**Idaho bentgrass
Color (Genetic color): 9 = dark green and 1 = light green. Green (Spring Greenup): 9 = best and 1 = worst greenup. Density (dens) values are a visual rating of the density of the various cultivars collected in June with 9 = greatest density and 1 = lowest density.
Visual quality was assessed with a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.
NS = means are not significantly different at the 0.05 level.

Green Height Bentgrass Cultivar Trials - Established 1998

Nick E. Christians and Rodney A. St. John

This is the third year of data from the Green Height Bentgrass Cultivar 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.

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 preventive program. Herbicides and insecticides are applied as needed.

Visual quality ratings were taken from May through October, 2000 (Table 1). Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. Spring greenup (Green) was evaluated in April 2000 using a 9 to 1 scale with 9 = best and 1 = worst greenup. Genetic color (Color) and spring density (Dens) were evaluated in June 2000. Genetic color was based on a 9 to 1 scale with 9 = dark green and 1 = light green. Density values are a visual rating of the density of the various cultivars collected in June with 9 = greatest density and 1 = lowest density.

Table 1. Visual turf quality and other physical ratings for cultivars in the 1998 Green Height Bentgrass Trial.

					Quality						
	Cultivar	Color	Green	Dens	May	June	July	Aug	Sept	Oct	Mean
1	SYN 96-2	7.3	8.0	8.3	7.3	8.3	8.0	8.3	6.7	7.0	7.6
2	SYN 96-3	7.3	7.7	7.7	6.7	7.7	7.7	8.3	7.3	6.7	7.4
3	Century	6.7	6.7	7.3	6.3	7.3	7.7	7.3	7.0	6.3	7.0
4	Crenshaw	6.7	7.0	7.3	6.0	6.3	7.3	7.0	8.0	7.3	7.0
5	BAR AS 8FUS2	6.7	7.3	7.3	6.3	7.3	6.7	7.3	7.0	6.7	6.9
6	PENN A-4	6.3	6.3	7.0	6.3	6.7	7.0	6.7	7.7	7.0	6.9
7	SYN 96-1	7.0	7.3	8.0	6.3	7.3	6.7	7.7	7.0	6.7	6.9
8	ABT-CRB-1	7.3	7.0	7.3	5.7	7.3	7.3	6.3	7.7	6.7	6.8
9	Imperial	6.7	6.3	6.7	6.3	6.7	6.7	6.7	7.0	6.7	6.7
10	PENN A-2	5.7	7.0	6.7	6.0	6.3	7.0	6.7	7.7	6.7	6.7
11	PENN A-1	7.0	7.3	7.0	5.7	7.7	6.3	7.0	7.0	6.0	6.6
12	PST-A2E	6.3	7.0	7.3	6.0	6.7	6.3	6.3	7.0	6.7	6.5
13	Backspin	5.7	6.7	6.7	5.7	6.7	6.3	7.0	6.7	6.0	6.4
14	ISI AP-5	6.0	6.7	6.3	6.3	6.0	6.0	6.7	6.3	7.0	6.4
15	L-93	5.7	6.0	6.0	6.3	6.0	6.0	6.7	6.7	6.7	6.4
16	BAR CB 8US3	6.0	6.3	6.0	6.0	6.0	6.0	6.0	6.7	7.0	6.3
17	PENN G-6	5.7	6.7	6.0	6.3	6.0	6.3	6.3	6.7	6.3	6.3
18	Providence	5.7	6.3	5.0	6.7	5.7	5.7	6.3	6.0	7.3	6.3
19	PENN G-1	6.3	6.0	6.3	6.0	7.0	6.3	5.7	6.3	6.0	6.2
20	SRX 1NJH	5.3	6.0	6.3	5.7	5.7	5.3	6.7	6.0	6.0	5.9
21	SR 1119	5.7	6.0	5.7	6.0	5.0	5.7	6.7	5.7	5.7	5.8
22	PICK CB 13-94	6.0	6.3	6.0	6.0	5.3	5.7	6.3	4.7	6.0	5.7
23	SRX 1120	5.7	5.7	5.7	5.7	6.0	5.3	5.3	6.0	5.3	5.6
24	Pennlinks	5.0	5.7	5.0	5.3	4.7	5.0	5.7	5.3	6.0	5.3
25	SRX 1BPAA	5.7	6.0	5.3	5.0	5.0	5.7	5.7	5.0	5.7	5.3
26	Penncross	4.7	5.7	5.0	5.3	5.0	5.0	5.3	5.0	5.0	5.1
27	Pick MVB*	6.3	5.0	7.0	4.0	4.7	5.0	4.0	4.7	4.7	4.5
28	SR 7200	5.0	5.0	6.7	4.0	4.7	4.3	4.7	4.7	4.3	4.4
29	Bavaria*	4.3	5.0	5.0	5.3	3.7	4.0	4.0	4.0	4.3	4.2
	$LSD_{(0.05)}$	0.9	0.9	1.1	1.4	1.0	1.2	1.5	1.4	1.3	0.7

*Velvet bentgrass

Color (Genetic color): 9 = dark green and 1 = light green. Green (Greenup): 9 = best and 1 = worst greenup. Density (dens) values are a visual rating of the density of the various cultivars collected in June with 9 = greatest density and 1 = lowest density.

Visual quality was assessed with a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.

Shade Adaptation Study - 2000

Nick E. Christians, Barbara R. Bingaman, and Gary M. Peterson

The first 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*).

A new shade trial was added in the fall of 1994 to evaluate the performance of cultivars of chewings fescue (C.F.), creeping red fescue (C.R.F.), hard fescue (H.F.), tall fescue (T.F.), Kentucky bluegrass (KBG), rough bluegrass (*Poa trivialis*), and *Poa supina*.

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 and 2). Visual quality is based on a scale of 9 to 1: 9 = best quality, 6 = lowest acceptable quality, and 1 = worst quality.

Table 1. 2000 Visual quality[1] data for culitvars in the 1987 Shade Trial in descending order for mean quality.

	Cultivar	April	May	June	July	Aug	Sept	Oct	Mean
1	Victor (C.F.)	7.0	7.0	7.0	6.7	6.7	6.0	6.7	6.7
2	BAR Fo 81- 225 (H.F.)	5.3	5.7	7.0	7.0	7.3	6.7	7.0	6.6
3	Waldina (H.F.)	5.7	6.3	6.7	7.0	7.0	6.7	6.3	6.5
4	Shadow (C.F.)	6.3	6.7	6.0	6.0	6.3	6.0	6.7	6.3
5	ST-2 (SR 3000) (H.F.)	5.0	6.0	6.3	6.3	6.7	6.0	6.3	6.1
6	Banner (C.F.)	6.7	6.3	7.0	5.7	5.7	4.7	5.7	6.0
7	Agram (C.F.)	6.3	6.0	6.7	5.7	5.7	5.3	6.0	6.0
8	Jamestown (C.F.)	6.7	5.7	6.3	5.7	6.0	5.0	5.7	5.9
9	Waldorf (C.F.)	6.0	6.0	6.0	5.7	5.7	5.7	5.7	5.8
10	Mary (C.F.)	6.0	5.7	6.3	5.3	5.7	5.0	6.0	5.7
11	Atlanta (C.F.)	5.3	5.0	6.0	5.7	6.0	5.3	6.0	5.6
12	Pennlawn (C.R.F.)	6.0	6.3	5.3	5.3	5.7	5.0	4.0	5.4
13	Estica (C.R.F.)	4.7	5.0	4.7	5.7	6.3	5.7	5.7	5.4
14	Biljart (H.F.)	5.0	5.3	4.7	5.7	6.0	5.7	5.0	5.3
15	Ensylva (C.R.F.)	6.0	5.7	5.0	5.3	5.3	4.7	5.3	5.3
16	Rebel II (T.F.)	5.7	6.3	5.3	5.3	4.7	4.7	5.3	5.3
17	Reliant (H.F.)	5.0	5.3	5.3	5.0	5.7	5.3	5.0	5.2
18	Rebel (T.F.)	5.7	5.3	5.0	4.7	4.3	5.3	5.0	5.0
19	Spartan (H.F.)	4.0	5.0	5.3	5.3	5.3	5.0	5.3	5.0
20	Koket (C.F.)	4.7	4.7	4.7	5.0	4.7	4.3	5.7	4.8
21	Scaldis (H.F.)	4.3	4.0	4.0	4.7	5.0	4.7	6.3	4.7
22	Wintergreen (C.F.)	4.7	4.7	5.3	5.3	4.7	4.0	4.3	4.7
23	Highlight (C.F.)	4.7	4.3	4.7	4.0	4.7	3.3	4.3	4.3
24	Bonanza (T.F.)	5.3	4.3	3.7	4.0	4.0	3.7	4.3	4.2
25	Arid(T.F.)	4.7	4.3	3.7	4.0	3.3	3.7	4.7	4.0
26	Apache (T.F.)	4.7	4.0	3.0	3.3	4.0	3.0	3.3	3.6
27	Falcon(T.F.)	4.0	3.7	3.7	3.3	3.7	3.3	3.7	3.6
28	Midnight (KBG)	3.0	2.7	3.7	3.7	3.7	2.3	2.7	3.1
29	Sabre (*P. trivialis*)	2.3	3.0	4.0	3.3	3.3	1.3	2.0	2.8
30	Ram I (KBG)	2.7	2.3	2.3	2.7	2.7	2.0	2.3	2.4
31	Nassau (KBG)	2.3	2.0	2.3	2.3	2.3	2.7	2.0	2.3
32	Bristol (KBG)	2.0	1.7	2.0	2.3	2.0	1.7	3.3	2.1
33	Coventry (KBG)	2.3	2.0	2.3	2.3	1.7	1.7	2.0	2.0
34	Glade (KBG)	1.7	1.3	2.0	1.7	1.3	1.7	2.7	1.8
35	Chateau (KBG)	2.0	1.7	1.3	1.7	1.3	1.3	2.0	1.6
	$LSD_{0.05}$	1.6	1.6	1.7	1.8	1.7	1.7	1.6	1.4

[1]Visual quality was assessed using a scale of 9 to 1 with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.

Table 2. 2000 visual quality[1] data for cultivars in the 1994 Shade Trial in descending order for mean quality.

	Cultivar	April	May	June	July	August	Sept	Oct	Mean
1	Southport (C.F.)	5.3	4.7	5.0	5.7	5.7	5.3	5.0	5.2
2	Waldina (H.F.)	4.0	4.0	5.0	5.3	5.0	5.7	5.0	4.9
3	Victory (C.F.)	5.3	4.7	5.0	4.7	5.0	5.0	4.7	4.9
4	Banner (C.F.)	5.3	4.7	4.7	5.0	4.7	4.0	5.7	4.9
5	Banner II (C.F.)	5.0	4.0	4.7	5.3	4.3	5.0	5.7	4.9
6	Shenandoah (T.F.)	5.0	5.0	4.3	5.3	5.0	5.0	4.3	4.9
7	SR 5100 (C.F.)	4.3	4.7	5.3	6.3	5.3	4.3	3.0	4.8
8	Silvana (H.F.)	4.0	4.0	4.7	5.0	5.0	4.7	4.7	4.6
9	Bridgeport (C.F.)	4.3	4.3	4.7	4.7	4.7	4.7	4.7	4.6
10	Molinda (C.F.)	4.0	4.0	4.7	5.0	4.3	5.0	3.7	4.4
11	Shadow (C.F.)	4.0	3.7	4.3	5.0	4.3	4.7	3.7	4.2
12	Midnight (KBG)	3.3	4.0	4.7	4.3	4.3	3.7	4.0	4.0
13	Nordic (H.F.)	3.0	3.0	3.3	5.0	5.0	4.3	4.3	4.0
14	Polder *(P. trivialis)*	5.7	5.0	3.7	4.0	3.0	2.3	3.7	3.9
15	Arid (T.F.)	4.3	3.3	3.7	4.3	4.0	4.0	3.7	3.9
16	Flyer (C.R.F.)	3.3	3.3	3.0	4.0	3.7	2.3	3.7	3.3
17	Saber *(P. trivialis)*	3.0	2.7	3.7	4.0	3.3	2.0	3.7	3.2
18	Rebel II (T.F.)	3.3	3.0	3.3	3.3	2.7	3.7	3.3	3.2
19	Adobe (T.F.)	3.3	2.7	2.7	3.0	2.7	4.0	4.0	3.2
20	Bonanza (T.F.)	2.7	2.7	3.0	3.7	3.0	3.0	3.7	3.1
21	Bonanza II (T.F.)	3.0	3.0	3.0	2.7	3.3	2.3	3.3	3.0
22	Mirage (T.F.)	2.7	2.7	3.0	3.0	3.0	2.7	3.3	2.9
23	Cypress *(P. trivialis)*	2.7	2.7	3.3	2.7	2.7	2.0	2.7	2.7
24	Coventry (KBG)	3.0	2.3	2.7	2.7	2.0	2.3	3.0	2.6
25	Spartan (H.F.)	2.3	2.0	2.0	3.0	3.7	2.7	2.7	2.6
26	Aztec (T.F.)	2.0	2.3	2.3	2.3	2.3	2.0	4.3	2.5
27	Glade (KBG)	2.7	2.0	2.0	2.7	2.3	2.3	2.3	2.3
28	Rebel (T.F.)	2.3	2.7	1.7	2.7	2.3	2.0	2.3	2.3
29	Falcon II (T.F.)	2.0	1.3	2.0	2.3	2.7	2.0	3.0	2.2
30	Buckingham (KBG)	1.7	1.7	1.7	2.0	1.7	1.7	3.3	2.0
31	Ascot (KBG)	1.7	1.3	2.0	2.3	2.0	1.7	2.7	2.0
32	Bonsai (T.F.)	1.7	1.7	2.0	2.0	2.0	1.7	2.7	2.0
33	Bristol (KBG)	1.7	1.0	1.3	2.3	1.3	1.7	2.0	1.6
34	Supranova *(P. supina)*	1.3	1.0	1.3	1.7	1.3	1.3	2.3	1.5
35	Brigade H. F.	1.3	1.0	1.0	2.0	1.3	1.3	2.3	1.5
	$LSD_{0.05}$	1.6	1.7	1.8	1.7	1.8	1.9	NS	1.4

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

Table 3. The average quality ratings for grasses in the 1987 Shade Trial: 1993 - 2000.

	Cultivar	1993	1994	1995	1996	1997	1998	1999	2000	Ave.*
1	Victor (C.F.)	7.2	7.1	6.6	6.6	7.1	7.0	6.8	6.7	6.54
2	BAR FO 81-225 (H.F.)	5.5	6.1	6.5	5.7	5.9	5.8	6.6	6.6	6.14
3	Waldorf (C.F.)	5.9	6.2	5.8	6.1	6.6	6.1	6.0	5.8	6.14
4	ST-2 (SR 3000) (H.F.)	5.7	6.1	6.1	5.5	5.8	5.1	5.7	6.1	6.11
5	Mary (C.F.)	6.7	6.6	6.7	6.3	6.2	5.8	5.9	5.7	6.08
6	Shadow (C.F.)	6.6	6.6	5.9	5.9	6.6	6.3	6.0	6.3	6.04
7	Jamestown (C.F.)	6.5	6.6	6.2	5.9	6.1	6.1	6.1	5.9	6.02
8	Waldina (H.F.)	5.5	5.8	5.8	5.1	5.9	6.4	6.6	6.5	5.99
9	Atlanta (C.F.)	5.8	5.7	5.5	6.7	6.6	5.9	6.1	5.6	5.92
10	Banner (C.F.)	6.0	5.6	5.3	6.2	6.3	5.7	5.8	6.0	5.76
11	Pennlawn (C.R.F.)	6.3	5.5	5.5	5.9	6.2	5.8	5.3	5.4	5.76
12	Estica (C.R.F.)	6.6	6.1	5.6	4.3	4.3	5.2	4.9	5.4	5.68
13	Rebel (T.F.)	6.9	5.9	5.7	4.6	4.5	5.3	4.8	5.0	5.68
14	Agram (C.F.)	5.4	5.3	5.1	5.5	5.6	6.0	6.0	6.0	5.56
15	Biljart (H.F.)	5.0	5.1	5.1	4.8	5.1	4.4	4.8	5.3	5.54
16	Rebel II (T.F.)	6.1	6.2	5.1	4.3	4.1	5.4	5.1	5.3	5.53
17	Sabre (P.T.)	7.4	6.2	4.8	4.9	5.0	5.4	4.9	2.8	5.50
18	Bonanza (T.F.)	6.3	6.2	5.2	4.2	4.1	4.2	3.8	4.2	5.39
19	Wintergreen (C.F.)	5.0	5.0	5.0	6.0	5.9	5.3	5.3	4.7	5.38
20	Ensylva (C.R.F.)	5.9	5.4	4.4	5.3	4.9	5.2	5.3	5.3	5.27
21	Falcon (T.F.)	6.5	6.3	5.2	4.2	4.2	4.2	3.7	3.6	5.27
22	Spartan (H.F.)	4.7	5.1	4.9	5.0	4.8	4.6	4.2	5.0	5.21
23	Apache (T.F.)	6.3	5.4	5.3	3.7	3.2	4.2	3.8	3.6	5.20
24	Koket (C.F.)	5.2	5.7	4.6	4.6	5.4	5.6	4.9	4.8	5.14
25	Arid (T.F.)	6.7	5.6	4.7	2.9	2.7	4.0	4.3	4.0	5.11
26	Scaldis (H.F.)	4.6	4.4	4.8	4.1	4.6	3.7	3.8	4.7	4.80
27	Highlight (C.F.)	5.0	4.8	4.7	4.9	5.1	5.2	4.4	4.3	4.72
28	Reliant (H.F.)	4.2	4.9	4.8	4.9	5.0	5.4	5.3	5.2	4.55
29	Midnight (K.B.)	6.4	4.6	4.4	4.0	3.9	4.6	3.9	3.1	4.40
30	Coventry (K.B.)	6.0	4.7	3.8	3.9	3.5	3.4	2.9	2.0	4.37
31	RAM I (K.B.)	5.9	4.3	3.3	2.8	2.7	3.2	2.9	2.4	4.23
32	Chateau (K.B.)	5.2	4.1	3.0	2.2	1.9	2.1	2.2	1.6	3.90
33	Glade (K.B.)	5.3	3.3	2.8	2.8	2.3	2.7	1.8	1.8	3.76
34	Bristol (K.B.)	5.0	4.1	3.6	2.8	2.4	3.1	2.2	2.1	3.61
35	Nassau (K.B.)	4.3	3.3	2.4	2.1	2.0	2.4	2.2	2.3	3.10

Quality Based on a 9 to 1 scale: 9 = best quality, 6 = lowest acceptable quality, and 1 = poorest quality.
*Average includes 1988, 1989, 1990, 1991, and 1992 data (not listed).
C.F. = chewings fescue, C.R.F. = creeping red fescue, H.F. = hard fescue, K.B. = Kentucky bluegrass, P.T. = *Poa trivialis* ,
T.F. = tall fescue. P.S. = *Poa supina*.

Ornamental Grasses Project 2000-2001

Mark Helgeson, Heather McDorman, and Nick Christians

Purpose:

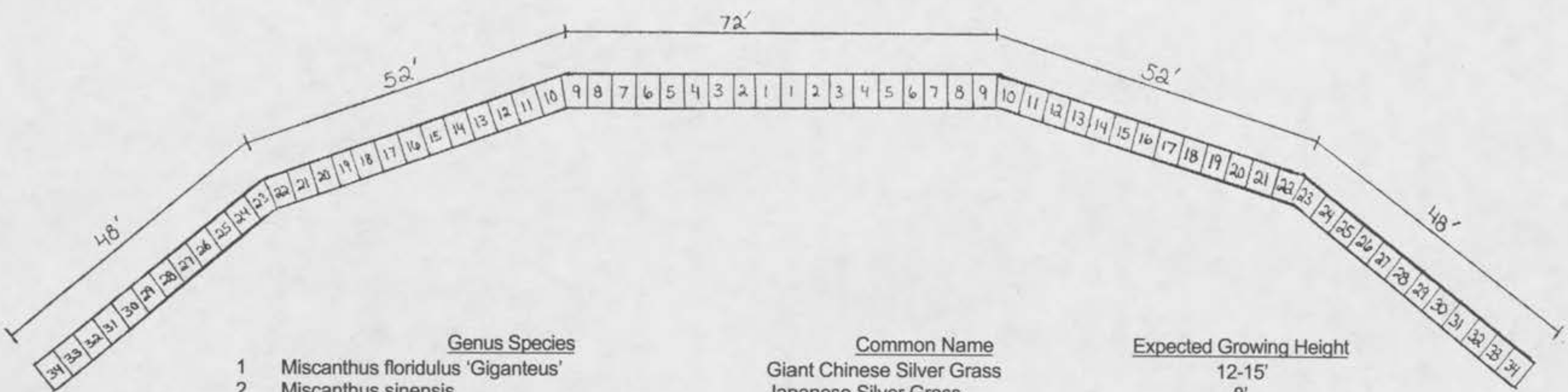
The purpose of the ornamental grass project is to evaluate 34 ornamental grasses for their adaptation to Iowa conditions. The study is located south of the turfgrass research building. Grasses 1 and 2 were established in 1989. Grasses 3-5, 11-15, 17-18, 20-21, and 33 were established in 2000. The remaining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

Each plot on this site has a four by five foot 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"

2000 Preemergent Annual Grass Control Study

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

The annual weed control study was designed to compare the efficacy of experimental formulations and commercial herbicides in controlling crabgrass in turf and to examine turf tolerance. Some of the products were screened at various rates and tested in formulations with fertilizer.

This study was located in an area of common Kentucky bluegrass at the Iowa State University Horticulture Research Station north of Ames, IA. The design was a randomized complete block. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 3.1% organic matter, 86 ppm K, 7 ppm P, and a pH of 6.5. Three replications were conducted and individual plot size was 5 x 5 ft. Experimental formulations and commercial products were screened with an untreated control and Pendimethalin 60WDG included for comparisons for a total of 22 treatments (Table 1).

Granular materials were applied using 'shaker dispensers' to ensure uniform application. Sprayables were applied using a carbon dioxide backpack sprayer equipped with TeeJet #8006 nozzles at a spray pressure of 30-40 psi. For those treatments that included both a sprayable and granular product, the granular material was applied first and the sprayable was applied over it. Preemergent materials were applied to dry foliage on April 21 before crabgrass germination and were 'watered in'. The early postemergent material (treatment 21) was applied on June 19 when the crabgrass was in the 1- to 4-leaf stage. On July 27, when the crabgrass had 1 to 4 tillers, the late postemergent material (treatment 22) was applied.

Crabgrass infestation data were taken beginning July 7 and ending on August 29 (Table 1). Crabgrass populations were estimated as the percentage area per plot covered by crabgrass. Crabgrass control was calculated as the reduction in cover per plot compared with the untreated control (Table 2). Visual quality data were taken weekly from May 2 through August 29 (Table 3). Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.

Data were analyzed using the Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Treatment effects on weed populations and visual quality were tested using Fisher's Least Significant Difference (LSD) test.

The growing season was unusual with temperatures above normal and precipitation much below normal. It was a good year for aggressive annual weeds such as crabgrass. Percentage crabgrass cover was 30% on July 7 and reached 75% by August 29 in the untreated controls (Table 1). Throughout the duration of the study, all herbicide materials except an experimental treatment (Sample A, at 0.5 lb a.i./A applied preemergently and at 1.0 lb a.i./A applied late postemergently) significantly reduced crabgrass populations as compared with the untreated control (Table 2). An experimental Dithiopyr PE2 formulation applied at 0.250 lb a.i./A (treatment 9) provided greater than 93% control for the entire test period. This level of control, however, was not statistically different from that provided by many herbicides including commonly used Dimension 1EC at 0.250 lb a.i./A and Pendimethalin 60WDG at 1.5 lb a.i./A. Mean crabgrass control data show that all materials except Sample A provided similar levels of control as compared with the untreated crabgrass. Twelve of the treatments reduced crabgrass populations by > 80% and 17 by > 70%.

There were significant differences in visual quality from May 5 through June 8 and from June 23 through June 30 (Table 3). After July 7, there were no differences in quality. Because of the high temperatures and lack of moisture, turf quality deteriorated in the entire area. Mean data show that turf treated with herbicides (except Sample A at all rates, or Dithiopyr PE1 at 0.250 lb a.i./A or Pendimethalin 60WDG at 1.5 lb a.i./A) had better quality than the untreated control.

Table 1. Percentage crabgrass cover[1] in turf treated for the 2000 Preemergent Annual Grass Study.

	Material	Rate lb a.i./A	July 7	July 14	July 20	July 25	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Mean
1	Untreated control	N/A	30.0	55.0	51.7	50.0	58.3	61.7	63.3	68.3	75.0	57.0
2	Dimension 1EC[2]	0.180	8.7	8.3	8.3	8.3	8.3	11.7	15.0	20.0	25.0	12.6
3	Dimension 1EC[2]	0.250	5.3	5.3	7.0	2.3	5.0	5.0	6.7	11.7	15.0	7.0
4	Dimension 0.072FG AD445[2]	0.180	11.7	15.0	11.7	10.0	10.0	16.7	18.3	21.7	23.3	15.4
5	Dimension 0.164FG AD445[2]	0.250	5.3	10.3	8.3	6.7	10.0	10.0	6.7	18.3	18.3	10.4
6	Dithiopyr PE1 (2.43 XF-00045)[2]	0.180	3.3	10.0	10.3	8.3	5.0	10.0	15.0	21.7	21.7	11.7
7	Dithiopyr PE1 (2.43 XF-00045)[2]	0.250	5.3	8.3	13.3	10.0	6.7	11.7	10.0	15.0	18.3	11.0
8	Dithiopyr PE2 (2.65 XF-00020)[2]	0.180	6.7	6.7	7.0	6.7	5.0	8.3	8.3	15.0	16.7	8.9
9	Dithiopyr PE2 (2.65 XF-00020)[2]	0.250	2.0	1.0	2.3	1.7	0.3	3.3	3.7	3.3	3.3	2.3
10	Dimension 40WP[2]	0.180	2.0	8.3	8.3	8.3	4.0	11.7	13.3	15.0	20.0	10.1
11	Dimension 40WP[2]	0.250	3.7	7.0	10.3	7.0	5.3	10.0	11.7	11.7	20.0	9.6
12	Fertilized control[2]	N/A	13.3	20.0	18.3	15.0	16.7	33.3	25.0	30.0	35.0	23.0
13	Turf builder + Halts [3]	1.500	5.0	11.7	8.3	6.7	6.7	8.3	8.3	15.0	11.7	9.1
14	Sta-Green Premium Crab-Ex [3]	0.237	8.3	10.0	6.7	11.7	10.3	10.0	10.0	15.0	18.3	11.1
15	Vigoro Crabgrass Preventer [3]	0.237	3.7	12.0	6.7	8.3	8.3	13.3	11.7	15.0	20.0	11.0
16	Best Turf Supreme Crabgrass [3]	0.220	2.3	10.0	5.0	6.7	5.0	10.0	6.7	13.3	16.7	8.4
17	Pendimethalin 60WDG	1.500	6.7	11.7	8.7	7.3	8.3	10.0	10.3	13.3	13.3	10.0
18	Sample A[4]	0.500[5]	30.0	33.3	36.7	35.0	36.7	48.3	55.0	65.0	66.7	45.2
19	Sample A[4]	1.000[5]	18.3	21.7	25.0	21.7	23.3	26.7	25.0	26.7	45.0	25.9
20	Sample A[4]	1.500[5]	15.0	18.3	18.3	18.7	21.7	26.7	30.0	31.7	40.0	24.5
21	Sample A[4]	1.000[5]	13.3	18.3	21.7	6.7	16.7	33.3	25.0	35.0	35.0	22.8
22	Sample A[4]	1.000[5]	--	--	--	--	53.3	61.7	63.3	68.3	71.7	63.7
	$LSD_{0.05}$		10.3	14.2	14.6	14.0	15.6	16.9	17.6	18.8	20.9	13.3

[1]These figures represent the area per plot covered by crabgrass.
[2]These materials are being screened for the Rohm and Haas Company.
[3]These materials are being screened for the Scotts Company.
[4]This material is being screened for Aventis Environmental Science. A non-ionic surfactant was added to these treatments at 0.25% V/V.
[5]The rates of these materials are expressed in oz/1000 ft^2.

Preemergent materials were applied on April 21,2000 before crabgrass germination. Early postemergent materials (treatment 21) were applied on June 19 when the crabgrass was in the 1 – 4 leaf stage. Late postemergent materials (treatment 22) were applied on July 27 when the crabgrass had 1 – 4 tillers.

Table 2. Percentage crabgrass control[1] in turf treated for the 2000 Preemergent Annual Grass Study.

	Material	Rate lb a.i./A	July 7	July 14	July 20	July 25	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Mean
1	Untreated control	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Dimension 1EC[2]	0.180	71.1	84.8	83.9	83.3	85.7	81.1	76.3	70.7	66.7	77.8
3	Dimension 1EC[2]	0.250	82.2	90.3	86.5	95.3	91.4	91.9	89.5	82.9	80.0	87.7
4	Dimension 0.072FG AD445[2]	0.180	61.1	72.7	77.4	80.0	82.8	73.0	71.0	68.3	68.9	73.0
5	Dimension 0.164FG AD445[2]	0.250	82.2	81.2	83.9	86.7	82.8	83.8	89.5	73.2	75.6	81.7
6	Dithiopyr PE1 (2.43 XF-00045)[2]	0.180	88.9	81.8	80.0	83.3	91.4	83.8	76.3	68.3	71.1	79.5
7	Dithiopyr PE1 (2.43 XF-00045)[2]	0.250	82.2	84.8	74.2	80.0	88.6	81.1	84.2	78.0	75.6	80.8
8	Dithiopyr PE2 (2.65 XF-00020)[2]	0.180	77.8	87.9	86.5	86.7	91.4	86.5	86.8	78.0	77.8	84.3
9	Dithiopyr PE2 (2.65 XF-00020)[2]	0.250	93.3	98.2	95.5	96.7	99.4	94.6	94.2	95.1	95.6	95.9
10	Dimension 40WP[2]	0.180	93.3	84.8	83.9	83.3	93.1	81.1	78.9	78.0	73.3	82.3
11	Dimension 40WP[2]	0.250	87.8	87.3	80.0	86.0	90.9	83.8	81.6	82.9	73.3	83.1
12	Fertilized control[2]	N/A	55.6	63.6	64.5	70.0	71.4	46.0	60.5	56.1	53.3	59.7
13	Turf builder + Halts[3]	1.500	83.3	78.8	83.9	86.7	88.6	86.5	86.8	78.0	84.4	84.1
14	Sta-Green Premium Crab-Ex[3]	0.237	72.2	81.8	87.1	76.7	82.3	83.8	84.2	78.0	75.6	80.4
15	Vigoro Crabgrass Preventer[3]	0.237	87.8	78.2	87.1	83.3	85.7	78.4	81.6	78.0	73.3	80.7
16	Best Turf Supreme Crabgrass[3]	0.220	92.2	81.8	90.3	86.7	91.4	83.8	89.5	80.5	77.8	85.3
17	Pendimethalin 60WDG	1.500	77.8	78.8	83.2	85.3	85.7	83.8	83.7	80.5	82.2	82.5
18	Sample A[4]	0.500[5]	0.0	39.4	29.1	30.0	37.1	21.7	13.1	4.8	11.1	20.7
19	Sample A[4]	1.000[5]	38.9	60.6	51.6	56.7	60.0	56.8	60.5	61.0	40.0	54.5
20	Sample A[4]	1.500[5]	50.0	66.7	64.5	62.7	62.8	56.8	52.6	53.6	46.7	57.1
21	Sample A[4]	1.000[5]	55.6	66.7	58.1	86.7	71.4	46.0	60.5	48.8	53.3	60.0
22	Sample A[4]	1.000[5]	--	--	--	--	8.5	0.1	0.0	0.0	4.4	2.6
	$LSD_{0.05}$		34.4	25.9	28.3	28.1	26.8	27.4	27.8	27.5	27.8	23.3

[1]These figures represent reductions in crabgrass cover per plot as compared with the untreated controls.
[2]These materials are being screened for the Rohm and Haas Company.
[3]These materials are being screened for the Scotts Company.
[4]This material is being screened for Aventis Environmental Science. A non-ionic surfactant was added to these treatments at 0.25% V/V.
[5]The rates of these materials are expressed in oz/1000 ft^2.
Preemergent materials were applied on April 21,2000 before crabgrass germination. Early postemergent materials (treatment 21) were applied on June 19 when the crabgrass was in the 1 – 4 leaf stage. Late postemergent materials (treatment 22) were applied on July 27 when the crabgrass had 1 – 4 tillers.

Table 3. Visual quality[1] of turf treated for the 2000 Preemergent Annual Grass Study (May 2 through June 30).

	Material	Rate lb a.i./A	May 2	May 5	May 10	May 17	May 23	May 31	June 8	June 15	June 23	June 30
1	Untreated control	N/A	6.3	7.3	6.0	6.0	6.0	5.7	6.3	6.0	6.7	6.7
2	Dimension 1EC[2]	0.180	6.7	7.0	7.3	7.0	7.7	7.7	8.0	6.7	8.0	7.3
3	Dimension 1EC[2]	0.250	7.0	7.3	7.7	7.7	7.7	8.0	8.0	7.3	7.3	8.0
4	Dimension 0.072FG AD445[2]	0.180	6.7	6.7	7.3	8.0	7.7	8.0	7.3	6.0	7.7	7.0
5	Dimension 0.164FG AD445[2]	0.250	7.3	7.0	7.7	8.3	8.0	8.7	8.0	7.0	8.7	7.7
6	Dithiopyr PE1 (2.43 XF-00045)[2]	0.180	7.0	7.7	7.0	7.7	7.7	8.3	8.0	7.7	8.0	7.7
7	Dithiopyr PE1 (2.43 XF-00045)[2]	0.250	6.0	6.0	6.7	7.3	7.3	8.3	7.7	6.7	7.7	7.3
8	Dithiopyr PE2 (2.65 XF-00020)[2]	0.180	7.3	7.3	8.0	7.3	7.7	8.7	7.7	8.0	8.3	8.3
9	Dithiopyr PE2 (2.65 XF-00020)[2]	0.250	7.3	7.7	7.7	7.7	7.3	8.7	7.0	6.7	8.0	7.7
10	Dimension 40WP[2]	0.180	7.0	7.0	8.0	8.7	7.7	8.0	8.0	7.0	8.3	8.0
11	Dimension 40WP[2]	0.250	7.3	8.0	7.3	7.7	7.7	8.0	7.7	7.7	7.7	7.7
12	Fertilized control[2]	N/A	7.0	7.3	7.7	8.0	7.3	7.7	7.3	6.7	8.3	7.3
13	Turf builder + Halts [3]	1.500	7.0	8.0	8.7	8.7	7.7	8.3	7.3	6.0	7.7	6.7
14	Sta-Green Premium Crab-Ex [3]	0.237	7.7	8.0	8.7	8.3	7.3	7.7	7.3	7.0	7.7	7.3
15	Vigoro Crabgrass Preventer [3]	0.237	7.3	8.3	8.7	8.7	8.0	8.3	7.3	7.0	7.3	7.0
16	Best Turf Supreme Crabgrass [3]	0.220	7.3	8.3	8.0	7.7	7.7	7.7	7.0	6.0	7.3	7.0
17	Pendimethalin 60WDG	1.500	6.3	6.7	6.7	6.3	6.7	6.3	6.3	6.0	6.3	6.7
18	Sample A[4]	0.500[5]	6.0	6.3	6.0	6.0	5.7	5.7	6.0	6.0	6.7	6.0
19	Sample A[4]	1.000[5]	6.3	6.0	6.3	6.0	6.0	6.0	6.3	6.0	6.7	6.3
20	Sample A[4]	1.500[5]	6.3	6.3	6.3	6.0	6.0	6.0	6.0	6.0	6.3	6.7
21	Sample A[4]	1.000[5]	6.0	6.7	6.3	6.3	6.3	6.3	6.3	6.0	6.3	6.7
22	Sample A[4]	1.000[5]	--	--	--	--	--	--	--	--	--	6.0
	$LSD_{0.05}$		NS	1.3	1.0	1.2	1.3	0.9	1.0	NS	1.3	1.0

	Material	Rate lb a.i./A	July 7	July 14	July 20	July 25	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Mean
1	Untreated control	N/A	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.5
2	Dimension 1EC[2]	0.180	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.1
3	Dimension 1EC[2]	0.250	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.2
4	Dimension 0.072FG AD445[2]	0.180	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0
5	Dimension 0.164FG AD445[2]	0.250	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.3
6	Dithiopyr PE1 (2.43 XF-00045)[2]	0.180	7.7	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.3
7	Dithiopyr PE1 (2.43 XF-00045)[2]	0.250	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.9
8	Dithiopyr PE2 (2.65 XF-00020)[2]	0.180	7.3	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.4
9	Dithiopyr PE2 (2.65 XF-00020)[2]	0.250	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.2
10	Dimension 40WP[2]	0.180	7.7	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.3
11	Dimension 40WP[2]	0.250	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.2
12	Fertilized control[2]	N/A	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.1
13	Turf builder + Halts [3]	1.500	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.2
14	Sta-Green Premium Crab-Ex [3]	0.237	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.3
15	Vigoro Crabgrass Preventer [3]	0.237	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.3
16	Best Turf Supreme Crabgrass [3]	0.220	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.1
17	Pendimethalin 60WDG	1.500	8.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.6
18	Sample A[4]	0.500[5]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.4
19	Sample A[4]	1.000[5]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.5
20	Sample A[4]	1.500[5]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.5
21	Sample A[4]	1.000[5]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.5
22	Sample A[4]	1.000[5]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0	6.7
	$LSD_{0.05}$		NS	--	--	--	--	--	--	--	--	0.4

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
[2]These materials are being screened for the Rohm and Haas Company.
[3]These materials are being screened for the Scotts Company.
[4]This material is being screened for Aventis Environmental Science. A non-ionic surfactant was added to these treatments at 0.25% V/V.
[5]The rates of these materials are expressed in oz/1000 ft^2.
NS = Means are not significantly different at the 0.05 level.

2000 Postemergence Broadleaf Trial I

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

This study was designed to compare the efficacy of experimental broadleaf weed control formulations with selected commercial standards. The trial was conducted at the Iowa State University research station in an established area of 'common' Kentucky bluegrass. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.5% organic matter, 131 ppm K, 28 ppm P, and a pH of 7.6.

The experimental design was a randomized complete block. Individual plot size was 5 x 10 ft with three replications. Two experimental formulations, NB20332 and NB30196, were screened at 4.0 and 5.0 pts/A. Another formulation, NB30401 was tested at 3.5 and 4.0 pts/A. A fourth material, NB30404, was tested at 4.125 pts/A. Trimec Classic at 3.5 pts/A and Millenium Ultra at 2.5 pts/A were used as commercial standards. An untreated control was included for a total of ten treatments (Table 1).

Sprayables were diluted in water and applied at an equivalent rate of 40 GPA total spray volume using a carbon dioxide backpack sprayer equipped with TeeJet #8006 flat fan nozzles at 30-35 psi. The treatments were applied on June 22 when the broadleaf weeds in the experimental plot were 1-4 inches high. It was 75 degrees and sunny with a 10-15 mph SW wind.

On June 27 and June 30, estimates of dandelion and clover damage were made (Table 1 and 2). These figures represent the percentage of foliage on each plant that was damaged with 100 = all foliage damaged and dying, 50 = 50% damaged foliage, and 0 = no damaged foliage. Beginning July 7, the surviving plants were surveyed to measure broadleaf control. The number of dandelions per plot was counted July 7, July 13, July 20, July 27, August 3, and August 10 (Table 1). The percentage of dandelion cover per plot was estimated on August 3 and August 10 to account for the large numbers of small dandelions in some plots (Table 2). Clover infestation was estimated as the percentage area per plot covered by clover (Table 5).

Turf quality data were taken weekly from June 23 through August 10 (Table 6). On each date, the turf was examined for phytotoxic symptoms and none were detected. Turf quality was rated using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. Crabgrass was appearing in the untreated and treated turf in August. The number of crabgrass plants per plot was counted on August 3 and August 10 (Table 7).

Data were analyzed using Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Treatment effects on weed populations and visual quality were tested using Fisher's Least Significant Difference (LSD) test.

There were differences in dandelion damage levels on June 27 and June 30 both between treated and untreated and among treated plants (Table 1). Two experimental formulations, NB30196 and NB30401, caused the highest levels of damage to dandelions. These same experimentals, NB30196 and NB30401, caused the most damage on clover (Table 2). In general, none of the herbicides were as effective on clover as on dandelion through June 30.

All herbicides controlled dandelion populations significantly as compared with the untreated control (Table 3). Control was > 95% on July 7 but beyond this date some recovery and regrowth of dandelions occurred in treated plots (Table 4). This was particularly evident on August 3 in turf treated with either NB30196 or NB30401. Dandelion counts in turf treated with NB30196 at 5.0 pts/A were similar to those in the untreated turf on August 10. Percentage dandelion cover data also were similar for turf treated with NB30196 at 5.0 pts/A and for the untreated turf (Table 5).

All materials caused significant reductions in clover cover as compared with the untreated control (Tables 6 and 7). Populations were drastically reduced by July 7 and after July 27, there was no clover in any of the treated plots for the remainder of the duration of the study.

None of the herbicides caused phytotoxic symptoms on the turf. Quality was similar for treated and untreated turf for the entire period (Table 8). In August, turf quality uniformly declined because of high temperatures and sparse rainfall. By August 3, crabgrass had moved into the treated turf. Less competition from dandelion and clover allowed larger populations of crabgrass to become established in treated as compared with untreated turf (Table 9).

Table 1. Percentage foliar damage[1] on dandelions treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

Material	Rate product pts/A	June 27	June 30	Mean
1. Untreated control	NA	0.0	0.0	0.0
2. NB20332	4.000	76.7	83.3	80.0
3. NB20332	5.000	83.3	96.7	90.0
4. NB30196	4.000	90.0	91.7	90.8
5. NB30196	5.000	96.7	96.7	96.7
6. NB30401	3.500	100.0	100.0	100.0
7. NB30401	4.000	96.7	100.0	98.3
8. NB30404	4.125	76.7	88.3	82.5
9. Trimec Classic	3.500	76.7	90.0	83.3
10. Millenium Ultra	2.500	63.3	83.3	73.3
$LSD_{0.05}$		15.2	16.5	12.0

[1]These figures represent the percentage foliar damage on dandelions with 100 = all foliage damaged and dying, 50 = 50% damaged foliage, and 0 = no damaged foliage.

Table 2. Percentage foliar damage[1] on clover treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

Material	Rate product pts/A	June 27	June 30	Mean
1. Untreated control	NA	0.0	0.0	0.0
2. NB20332	4.000	70.0	78.3	74.2
3. NB20332	5.000	50.0	58.3	54.2
4. NB30196	4.000	50.0	75.0	62.5
5. NB30196	5.000	70.0	80.0	75.0
6. NB30401	3.500	63.3	76.7	70.0
7. NB30401	4.000	73.3	90.0	81.7
8. NB30404	4.125	53.3	71.7	62.5
9. Trimec Classic	3.500	63.3	66.7	65.0
10. Millenium Ultra	2.500	56.7	58.3	57.5
$LSD_{0.05}$		16.9	18.6	13.9

[1]These figures represent the percentage foliar damage on clover with 100 = all foliage damaged and dying, 50 = 50% damaged foliage, and 0 = no damaged foliage.

Table 3. Dandelion counts[1] in turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

Material	Rate product pts/A	July 7	July 13	July 20	July 27	August 3	August 10	Mean
1. Untreated control	NA	73.0	55.7	53.3	72.3	68.3	76.3	66.5
2. NB20332	4.000	3.0	2.3	2.3	5.3	16.7	21.7	8.6
3. NB20332	5.000	1.3	0.0	0.3	2.0	10.7	15.0	4.9
4. NB30196	4.000	0.0	3.0	7.0	14.3	28.3	42.3	15.8
5. NB30196	5.000	0.0	2.3	3.0	25.7	51.7	61.7	24.1
6. NB30401	3.500	0.0	17.7	22.0	10.3	30.0	34.3	19.1
7. NB30401	4.000	0.0	1.7	2.0	5.7	26.7	46.3	13.7
8. NB30404	4.125	0.7	0.0	0.3	0.7	5.0	7.0	2.3
9. Trimec Classic	3.500	2.7	0.7	0.7	3.0	11.3	16.0	5.7
10. Millenium Ultra	2.500	1.7	0.0	0.0	0.0	2.0	3.3	1.2
				$p>F=0.07$				
$LSD_{0.05}$		13.9	31.8	33.7	13.1	26.2	26.1	18.3

[1]These figures represent the number of dandelions per plot.

Table 4. Dandelion control[1] in turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

	Material	Rate product pts/A	July 7	July 13	July 20	July 27	August 3	August 10	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	NB20332	4.000	95.9	95.8	95.6	92.6	75.6	71.6	87.1
3.	NB20332	5.000	98.2	100.0	99.4	97.2	84.4	80.3	92.6
4.	NB30196	4.000	100.0	94.6	86.9	80.2	58.5	44.5	79.2
5.	NB30196	5.000	100.0	95.8	94.4	64.5	24.4	19.2	63.8
6.	NB30401	3.500	100.0	68.3	58.7	85.7	56.1	55.0	71.3
7.	NB30401	4.000	100.0	97.0	96.2	92.2	61.0	39.3	79.4
8.	NB30404	4.125	99.1	100.0	99.4	99.1	92.7	90.8	96.6
9.	Trimec Classic	3.500	96.3	98.8	98.7	95.9	83.4	79.0	91.4
10.	Millenium Ultra	2.500	97.7	100.0	100.0	100.0	97.1	95.6	98.2
					$p>F=0.07$				
	$LSD_{0.05}$		19.1	57.0	60.6	18.1	38.4	34.3	27.5

[1]These figures represent percentage reductions in dandelion counts per plot as compared with the untreated control.

Table 5. Percentage dandelion cover[1] in turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

	Material	Rate product pts/A	August 3	August 10	Mean
1.	Untreated control	NA	23.3	26.7	25.0
2.	NB20332	4.000	3.7	5.3	4.5
3.	NB20332	5.000	2.3	2.3	2.3
4.	NB30196	4.000	7.3	13.3	10.3
5.	NB30196	5.000	18.3	16.7	17.5
6.	NB30401	3.500	7.0	10.3	8.7
7.	NB30401	4.000	2.3	8.3	5.3
8.	NB30404	4.125	1.0	1.0	1.0
9.	Trimec Classic	3.500	2.3	3.7	3.0
10.	Millenium Ultra	2.500	0.7	1.0	0.8
	$LSD_{0.05}$		8.5	11.5	9.7

[1]These figures represent the percentage area per plot covered by dandelions.

Table 6. Percentage clover cover[1] in turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

	Material	Rate product pts/A	July 7	July 13	July 20	July 27	August 3	August 10	Mean
1.	Untreated control	NA	51.7	26.7	16.7	15.0	16.7	21.7	24.7
2.	NB20332	4.000	3.7	0.0	0.0	0.0	0.0	0.0	0.6
3.	NB20332	5.000	10.0	0.0	0.0	0.0	0.0	0.0	1.7
4.	NB30196	4.000	3.3	0.0	0.0	0.0	0.0	0.0	0.6
5.	NB30196	5.000	3.3	0.0	0.0	0.0	0.0	0.0	0.6
6.	NB30401	3.500	0.0	6.7	5.0	0.0	0.0	0.0	1.9
7.	NB30401	4.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.	NB30404	4.125	8.3	0.0	0.3	0.0	0.0	0.0	1.4
9.	Trimec Classic	3.500	6.7	0.0	0.0	0.0	0.0	0.0	1.1
10.	Millenium Ultra	2.500	5.0	0.0	0.0	0.0	0.0	0.0	0.8
								$p>F=0.06$	
	$LSD_{0.05}$		14.6	14.6	9.6	7.2	NS	13.4	10.0

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

Table 7. Percentage clover control[1] in turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

	Material	Rate product pts/A	July 7	July 13	July 20	July 27	August 3	August 10	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	NB20332	4.000	92.9	100.0	100.0	100.0	100.0	100.0	97.5
3.	NB20332	5.000	80.7	100.0	100.0	100.0	100.0	100.0	93.3
4.	NB30196	4.000	93.6	100.0	100.0	100.0	100.0	100.0	97.8
5.	NB30196	5.000	93.6	100.0	100.0	100.0	100.0	100.0	97.8
6.	NB30401	3.500	100.0	75.0	70.1	100.0	100.0	100.0	92.1
7.	NB30401	4.000	100.0	100.0	100.0	100.0	100.0	100.0	100.0
8.	NB30404	4.125	83.9	100.0	98.0	100.0	100.0	100.0	94.2
9.	Trimec Classic	3.500	87.1	100.0	100.0	100.0	100.0	100.0	95.5
10.	Millenium Ultra	2.500	90.3	100.0	100.0	100.0	100.0	100.0	96.6
								p>F=0.06	
	$LSD_{0.05}$		28.2	54.7	57.4	47.8	NS	61.7	40.4

[1]These figures represent percentage reductions in clover cover per plot as compared with the untreated control.

Table 8. Visual quality[1] of turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

	Material	Rate product pts/A	June 23	June 27	June 30	July 7	July 13	July 20	July 27	Aug 3	Aug 10	Mean
1.	Untreated control	NA	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
2.	NB20332	4.000	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
3.	NB20332	5.000	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
4.	NB30196	4.000	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
5.	NB30196	5.000	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
6.	NB30401	3.500	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
7.	NB30401	4.000	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
8.	NB30404	4.125	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
9.	Trimec Classic	3.500	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
10.	Millenium Ultra	2.500	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	8.6
	$LSD_{0.05}$		--	--	--	--	--	--	--	--	--	--

[1]Quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality

Table 9. Crabgrass counts[1] in turf treated for the 2000 PBI Gordon Postemergence Broadleaf Study.

	Material	Rate product pts/A	August 3	August 10	Mean
1.	Untreated control	NA	5.0	8.3	6.7
2.	NB20332	4.000	15.0	20.0	17.5
3.	NB20332	5.000	12.3	16.7	14.5
4.	NB30196	4.000	8.3	13.3	10.8
5.	NB30196	5.000	11.7	16.7	14.2
6.	NB30401	3.500	8.0	11.7	9.8
7.	NB30401	4.000	8.3	13.7	11.0
8.	NB30404	4.125	10.7	18.3	14.5
9.	Trimec Classic	3.500	10.7	16.7	13.7
10.	Millenium Ultra	2.500	5.3	10.3	7.8
	$LSD_{0.05}$		NS	NS	NS

[1]These figures represent the number of crabgrass plants per plot.

2000 Postemergent Broadleaf Trial II

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

This study was designed to determine the efficacy of research formulations as compared with the commercially produced herbicide Triplet and the degree of tolerance of turf to these products. The trial was conducted at the Iowa State University Research Station in an established area of 'Ram 1' Kentucky bluegrass. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.2% organic matter, 120 ppm K, 6 ppm P, and a pH of 6.85.

The experimental design was a randomized complete block. Individual plot size was 5 x 10 ft with three replications. An experimental Dissolve formulation, RDL 2000, was applied at 1.65 lb product/A and at 1.25 lb product/A in combination with a diflufenzopyr salt (DFFP) at three rates for a total of six treatments (Table 1). Triplet 49.7 at 3.5 pt product/A was included as the treated standard and an untreated control was also added.

Sprayables were diluted in water and applied at an equivalent rate of 3 gal water/1000 ft^2. The materials were applied on June 22 using a carbon dioxide backpack sprayer equipped with TeeJet #8006 flat fan nozzles at 30-35 psi. It was 75 degrees, sunny with a 10-15 mph SW wind. We had the materials on by 11:30 a.m. This date coincided with local lawn care broadleaf weed control applications.

Weed control data were taken weekly until eight weeks after treatment beginning June 27 and ending August 16. On June 27 and 30, herbicide effects were recorded as percentage of plants severely damaged and expected to die (Table 1). Damage was assessed using a percentage scale with 100 = dead plants, 50 = 50% mortality, and 0 = undamaged plants. Beginning on July 7, the number of weeds remaining in each individual plot was counted. Dandelion and white clover were the predominant weed species present. Dandelion plants were counted as the number in each plot (Table 2) and clover infestation was estimated as the percentage area per plot covered by clover (Table 4). Dandelion and clover data were converted to percentage reductions as compared with the untreated controls (Tables 3 and 5).

Black medic was present in most turf prior to treatment. Following treatment black medic was found in untreated turf but only a few individual plants were found in treated areas (Table 6). Oxalis also was present but the distribution was not uniform among the plots (Table 7). Black medic infestations were determined as percentage cover per plot and oxalis plants per plot were counted.

Visual turf quality and turf tolerance ratings were made weekly from June 25 through August 16 (Table 8). Turf quality was rated using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.

Data were analyzed using Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Treatment effects on weed populations and visual quality were tested using Fisher's Least Significant Difference (LSD) test.

All materials caused similar levels of damage to dandelion and clover on June 27 and June 30 (Table 1). By July 7, there were very few dandelions left in treated turf (Table 2). Dandelion numbers increased in August but the numbers were still significantly less than the untreated control. Dandelion control remained > 98% for all products through July 27 and the mean level of control was above 92% for all herbicides (Table 3).

By July 7, percentage clover cover was significantly reduced by all treatments but there were differences in clover cover among the treatments (Table 4). Some of the materials did not kill the clover as quickly as others but by July 27, clover populations were very low in all treated turf. Clover did not re-establish in any of the treated turf through August 16. Clover control was > 93% for all treatments from July 27 through August 16 (Table 5).

Except for a few plants in one treated plot, black medic populations did not survive the herbicide treatments (Table 6). Oxalis was present in some treated plots beginning on July 14 had moved into all treated plots by August 16.

Following treatment visual quality was similar in treated and untreated turf until July 7 (Table 8). On this date all treated turf had worse quality than the untreated control. By July 14, turf quality was similar in all treated and untreated turf.

Table 1. Damage[1] detected on dandelions and white clover treated for the 2000 Riverdale Postemergence Broadleaf Study.

	Material	Rate product/ 1000 ft^2	Dandelion June 27	Dandelion June 30	Dandelion Mean	White clover June 27	White clover June 30	White clover Mean
1.	Untreated control	NA	6.7	0.0	3.3	6.7	0.0	3.3
2.	Triplet 49.7%	1.29 oz	70.0	75.0	72.5	53.3	58.3	55.8
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g						
	DFFP (Salt) 0.75 lbs/A	0.90 g	76.7	85.0	80.8	31.7	66.7	49.2
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g						
	DFFP (Salt) 0.75 lbs/A	0.90 g	63.3	76.7	70.0	46.7	63.3	55.0
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g						
	DFFP (Salt) 0.05 lbs/A	0.60 g	80.0	80.0	80.0	56.7	58.3	57.5
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g						
	DFFP (Salt) 0.05 lbs/A	0.60 g	70.0	63.3	66.7	36.7	60.0	48.3
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g						
	DFFP (Salt) 0.0375 lbs/A	0.45 g	80.0	80.0	80.0	46.7	61.7	54.2
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g						
	DFFP (Salt) 0.0375 lbs/A	0.45 g	73.3	81.7	77.5	56.7	60.0	58.3
	$LSD_{0.05}$		27.2	15.2	19.9	NS	27.7	27.1

[1]Dandelion and clover damage was assessed as the percentage severely damaged with 100 = dead plants, 50 = 50% mortality, and 0 = undamaged plants.
NS = means are not significantly different at the 0.05 level.

Table 2. Dandelion counts[1] in turf treated for the 2000 Riverdale Postemergence Broadleaf Study.

	Material	Rate product/ 1000 ft^2	July 7	July 14	July 20	July 27	Aug 8	Aug 16	Mean
1.	Untreated control	NA	79.3	99.7	101.7	101.7	101.7	69.7	92.3
2.	Triplet 49.7%	1.29 oz	5.0	0.0	0.3	2.0	3.7	11.7	3.8
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.75 lbs/A	0.90 g	0.0	0.0	1.0	3.7	9.7	13.7	4.7
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.75 lbs/A	0.90 g	9.3	0.3	0.7	4.0	5.3	12.0	5.3
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.05 lbs/A	0.60 g	2.7	0.0	0.7	4.3	6.3	11.3	4.2
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.05 lbs/A	0.60 g	4.7	0.3	1.3	5.7	11.7	20.0	7.3
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.0375 lbs/A	0.45 g	3.3	0.3	0.4	5.3	8.7	16.0	5.7
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.0375 lbs/A	0.45 g	3.7	1.7	0.0	7.0	11.3	15.0	6.4
	$LSD_{0.05}$		22.3	54.2	53.7	53.1	53.9	33.5	43.4

[1]These data represent the number of dandelions per individual plot.

Table 3. Dandelion control[1] in turf treated for the 2000 Riverdale Postemergence Broadleaf Study.

	Material	Rate product/ 1000 ft^2	July 7	July 14	July 20	July 27	Aug 8	Aug 16	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Triplet 49.7%	1.29 oz	93.7	100.0	99.7	98.0	96.4	83.3	95.9
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g	100.0	100.0	99.0	96.4	90.5	80.4	94.9
	DFFP (Salt) 0.75 lbs/A	0.90 g							
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g	88.2	99.7	99.3	96.1	94.8	82.8	94.3
	DFFP (Salt) 0.75 lbs/A	0.90 g							
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g	96.6	100.0	99.3	95.7	93.8	83.7	95.4
	DFFP (Salt) 0.05 lbs/A	0.60 g							
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g	94.1	99.7	98.7	94.4	88.5	71.3	92.1
	DFFP (Salt) 0.05 lbs/A	0.60 g							
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g	95.8	99.7	99.3	94.8	91.5	77.0	93.8
	DFFP (Salt) 0.0375 lbs/A	0.45 g							
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g	95.4	98.3	100.0	93.1	88.9	78.5	93.0
	DFFP (Salt) 0.0375 lbs/A	0.45 g							
	$LSD_{0.05}$		28.1	54.4	52.8	52.2	53.0	48.1	47.1

[1]These data represent the reduction in dandelion counts as compared with the untreated control.

Table 4. Percentage clover cover[1] in turf treated for the 2000 Riverdale Postemergence Broadleaf Study.

	Material	Rate product/ 1000 ft²	July 7	July 14	July 20	July 20	Aug 8	Aug 16	Mean
1.	Untreated control	NA	50.0	30.0	30.0	30.0	33.3	40.0	35.6
2.	Triplet 49.7%	1.29 oz	13.3	5.0	0.0	0.0	0.0	0.0	3.1
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.75 lbs/A	0.90 g	13.3	8.7	1.7	1.7	1.7	0.0	4.5
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.75 lbs/A	0.90 g	11.7	5.3	2.0	2.0	2.0	0.3	3.9
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.05 lbs/A	0.60 g	6.7	3.7	1.0	0.7	2.0	1.0	2.5
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.05 lbs/A	0.60 g	16.7	7.0	1.0	0.3	0.3	2.0	4.6
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.0375 lbs/A	0.45 g	8.3	10.0	2.3	2.0	2.0	0.0	4.1
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.0375 lbs/A	0.45 g	2.0	15.3	3.7	2.0	2.0	0.3	7.2
	$LSD_{0.05}$		11.1	9.9	2.6	2.4	4.9	6.2	4.4

[1]These data represent the percentage area per individual plot covered by clover.

Table 5. Percentage clover control[1] in turf treated for the 2000 Riverdale Postemergence Broadleaf Study

	Material	Rate product/ 1000 ft²	July 7	July 14	July 20	July 27	Aug 8	Aug 16	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Triplet 49.7%	1.29 oz	73.3	83.3	100.0	100.0	100.0	100.0	91.4
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g	73.3	71.1	94.4	94.4	95.0	100.0	87.4
	DFFP (Salt) 0.75 lbs/A	0.90 g							
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g	76.7	82.2	93.3	93.3	94.0	99.2	89.1
	DFFP (Salt) 0.75 lbs/A	0.90 g							
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g	86.7	87.8	96.7	97.8	93.0	97.5	93.0
	DFFP (Salt) 0.05 lbs/A	0.60 g							
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g	66.7	76.7	96.7	98.9	99.0	95.0	87.2
	DFFP (Salt) 0.05 lbs/A	0.60 g							
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g	83.3	66.7	92.2	93.3	94.0	100.0	88.5
	DFFP (Salt) 0.0375 lbs/A	0.45 g							
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g	60.0	48.9	87.8	93.3	94.0	99.2	79.7
	DFFP (Salt) 0.0375 lbs/A	0.45 g							
	$LSD_{0.05}$		22.8	33.2	8.7	8.0	14.7	15.5	12.4

[1]These figures represent the percentage reduction in clover cover as compared with the untreated controls.

Table 6. Percentage black medic cover[1] in turf treated for the 2000 Riverdale Postemergence Broadleaf Study

	Material	Rate product/ 1000 ft²	July 7	July 14	July 20	July 27	Aug 8	Aug 16	Mean
1.	Untreated control	NA	18.3	11.7	10.0	13.3	16.7	3.3	12.2
2.	Triplet 49.7%	1.29 oz	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.75 lbs/A	0.90 g	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.75 lbs/A	0.90 g	0.0	0.0	0.3	0.0	0.0	0.0	0.1
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.05 lbs/A	0.60 g	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.05 lbs/A	0.60 g	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g							
	DFFP (Salt) 0.0375 lbs/A	0.45 g	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g							
	DFFP (Salt) 0.0375 lbs/A	0.45 g	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1]These data represent the percentage area per individual plot covered by black medic.

Table 7. Oxalis counts[1] in turf treated for the 2000 Riverdale Postemergence Broadleaf Study

	Material	Rate product/ 1000 ft²	July 14	July 20	July 27	Aug 8	Aug 16	Mean
1.	Untreated control	NA	1.3	0.7	0.0	0.0	4.3	1.3
2.	Triplet 49.7%	1.29 oz	0.0	0.0	0.0	0.0	0.0	0.1
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g						
	DFFP (Salt) 0.75 lbs/A	0.90 g	0.0	0.0	0.0	0.0	1.0	0.2
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g						
	DFFP (Salt) 0.75 lbs/A	0.90 g	1.0	1.7	1.7	1.7	1.7	1.5
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g						
	DFFP (Salt) 0.05 lbs/A	0.60 g	1.0	0.3	0.3	0.3	0.7	0.5
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g						
	DFFP (Salt) 0.05 lbs/A	0.60 g	0.3	0.0	0.7	0.7	0.7	0.5
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g						
	DFFP (Salt) 0.0375 lbs/A	0.45 g	0.3	0.3	0.7	0.7	0.3	0.5
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g						
	DFFP (Salt) 0.0375 lbs/A	0.45 g	0.0	0.0	1.3	2.0	1.7	1.0
	$LSD_{0.05}$		NS	NS	NS	NS	2.0	NS

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

Table 8. Visual quality[1] of Kentucky bluegrass treated for the 2000 Riverdale Postemergence Broadleaf Study.

	Material	Rate product/ 1000 ft²	June 26	June 27	June 30	July 7	July 14	July 20	July 20	Aug 8	Aug 16	Mean
1.	Untreated control	NA	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2.	Triplet 49.7%	1.29 oz	9.0	9.0	9.0	5.3	9.0	9.0	9.0	9.0	9.0	8.6
3.	RDL 2000-10 Dissolve (.66 lbs 2,4-D/A)	17.20 g										
	DFFP (Salt) 0.75 lbs/A	0.90 g	9.0	9.0	9.0	5.0	9.0	9.0	9.0	9.0	9.0	8.6
4.	RDL 2000-11 Dissolve (.50 lbs 2,4-D/A)	13.03 g										
	DFFP (Salt) 0.75 lbs/A	0.90 g	9.0	9.0	9.0	5.7	9.0	9.0	9.0	9.0	9.0	8.6
5.	RDL 2000-13 Dissolve (.66 lbs 2,4-D/A)	17.20 g										
	DFFP (Salt) 0.05 lbs/A	0.60 g	9.0	9.0	9.0	5.0	9.0	9.0	9.0	9.0	9.0	8.6
6.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g										
	DFFP (Salt) 0.05 lbs/A	0.60 g	9.0	9.0	9.0	4.0	9.0	9.0	9.0	9.0	9.0	8.4
7.	RDL 2000-16 Dissolve (.66 lbs 2,4-D/A)	17.20 g										
	DFFP (Salt) 0.0375 lbs/A	0.45 g	9.0	9.0	9.0	6.3	9.0	9.0	9.0	9.0	9.0	8.7
8.	RDL 2000-14 Dissolve (.50 lbs 2,4-D/A)	13.03 g										
	DFFP (Salt) 0.0375 lbs/A	0.45 g	--	9.0	9.0	4.7	9.0	9.0	9.0	9.0	9.0	8.5
	$LSD_{0.05}$			--	--	1.6	--	--	--	--	--	0.2

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.

2000 Postemergence Broadleaf Trial III

Barbara R. Bingaman and Nick E. Christians

The purpose of this study was to compare the efficacy of Scotts Turf Builder with Plus 2 weed control to that of competitive broadleaf herbicide products. The trial was conducted at the Iowa State University research station in an established area of 'common' Kentucky bluegrass. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.5% organic matter, 131 ppm K, 28 ppm P, and a pH of 7.6.

The experimental design was a randomized complete block. Individual plot size was 5 x 10 ft with three replications. Scotts Turf Builder with Plus 2 Weed Control, Sta-Green 200+ Weed & feed, Vigoro Weed & Feed, Ultra Vigoro Weed & Feed, Best Turf Supreme Weed & Feed, Bandini Superblade Weed & Feed, and Schultz Expert Gardener Premium Weed & Feed were furnished by Scotts for comparisons. All materials from other sources than Scotts were applied at label rate for bluegrass (Table 1). Trimec Classic 3.4 SL was included as a standard and applied at label rate. An untreated control also was added for a total of nine treatments. All materials were applied postemergently when dandelions were flowering but not in the puff-ball stage. Applications were made on June 22. All treatments except Trimec Classic 3.4 SL were made to wet foliage as per instructions. No irrigation was used for 24 hours following applications and there was no rain during this period. The plot was not mowed within 1 day before and after application.

On June 27, June 30, and July 7, dandelion and clover mortality data were recorded (Tables 1 and 2). Damage was assessed using a 0 to 100 scale with 100 = dead plants, 50 = 50% dead, 0 = no damaged plants. Dandelion and clover surviving populations were estimated from July 13 through August 17. The number of dandelions per plot was counted (Table 3) and the percentage area per plot covered by clover was estimated (Table 5). To account for the large number of small dandelions in some of the treated turf, percentage dandelion cover data were taken on August 17 (Table 3). Turf quality data were taken on each data collection date (Table 7). Quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable and 1 = worst quality.

Data were analyzed using the Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Treatment effects on weed populations and visual quality were tested using Fisher's Least Significant Difference (LSD) test.

On June 27, dandelions treated with either Trimec Classic 3.4 SL or Scotts Turf Builder exhibited substantial damage (Table 1). Dandelions treated with the other herbicide materials and those untreated had significantly less damage. By July 7, dandelions treated with the other materials had higher levels of damage than noted on previous days but the damage was still significantly less than on dandelions treated with either Trimec Classic 3.4 SL or Scotts Turf Builder.

Clover damage followed the same trend as dandelion damage. Trimec Classic 3.4 SL and Scotts Turf Builder caused significantly more damage than the other herbicides (Table 2). Damage caused by Scotts Turf Builder was statistically less than that caused by Trimec Classic 3.4 SL on June 27 and July 7 and mean damage also was less for Scotts Turf Builder.

Beginning with the data for July 13, all remaining dandelions were counted as survivors (Table 3). Trimec Classic 3.4 SL provided better dandelion control than all of the other herbicides except Scotts Turf Builder. Sta-Green 200+ and Vigoro Weed & Feed did not cause significant reductions in dandelion counts as compared with the untreated control for the entire duration. Overall mean values show that dandelion control was similar for Trimec Classic 3.4 SL and Scotts Turf Builder and better than provided by the other herbicides.

Percentage dandelion cover data from August 17 suggest that dandelion cover was significantly reduced by Trimec Classic 3.4 SL and Scotts Turf Builder (Tables 3 and 4). The levels for Trimec Classic 3.4 SL and Scotts Turf Builder were similar to those for Best Turf Supreme and Bandini Superblade.

Trimec Classic 3.4 SL killed all clover by July 13 (Table 5). Clover cover was significantly less in turf treated with Trimec Classic 3.4 SL or Scotts Turf Builder than in untreated turf on July 27. On this date there was more clover in turf treated with Sta-Green 200+, or Bandini Superblade or Schultz Expert Gardener than in untreated turf. By August 3, clover was declining in treated and untreated turf because of the hot and dry conditions and there were no statistical differences in clover cover for August but there were numerical differences. Clover control provided by Trimec Classic

3.4 SL, Scotts Turf Builder, Ultra Vigoro Weed & Feed, and Bandini Superblade Weed & Feed was ≥ 96% on August 17.

There were some statistical differences in turf quality between both treated and untreated turf and among herbicide treatments (Table 7). On June 30 all treated turf had better quality than the untreated controls. On July 7 and July 13, quality of treated turf was better for all treated turf than the untreated controls. Because of the hot and dry conditions, the quality of all turf was declining by July 20 and no additional differences in quality were detected for the duration of the study.

Table 1. Damage[1] observed on dandelions treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	Rate product /1000 ft^2	Percent damage (%) June 27	June 30	July 7	Mean
1.	Untreated control	NA	NA	6.7	1.7	13.3	7.2
2.	Trimec Classic 3.4 SL		1.50 oz	63.3	86.7	90.0	80.0
3.	Scotts Turf Builder w/Plus 2	3.00	2.86 lb	50.0	58.3	70.0	59.4
4.	Sta-Green 200+ Weed & Feed	1.37	3.20 lb	0.0	6.7	30.0	12.2
5.	Vigoro Weed & Feed	1.18	3.20 lb	13.3	5.0	15.0	11.1
6.	Ultra Vigoro Weed & Feed	1.37	3.20 lb	6.7	8.3	31.7	15.6
7.	Best Turf Supreme Weed & Feed	1.33	3.60 lb	10.0	8.3	26.7	15.0
8.	Bandini Superblade Weed & Feed	1.33	3.60 lb	23.3	6.7	28.3	19.4
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	3.60 lb	3.3	3.3	23.3	10.0
	$LSD_{0.05}$			16.4	13.1	25.4	13.0

[1]Damage was assessed using a 0 - 100% scale with 100% = dead plants, 50 = 50% dead, and 0 = no damage.
Materials were applied on June 22, 2000.

Table 2. Damage[1] observed on clover treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	Rate product /1000 ft^2	Percent damage (%) June 27	June 30	July 7	Mean
1.	Untreated control	NA	NA	0.0	0.0	5.0	1.7
2.	Trimec Classic 3.4 SL	--	1.50 oz	73.3	80.0	76.7	76.7
3.	Scotts Turf Builder w/Plus 2	3.00	2.86 lb	56.7	58.3	50.0	55.0
4.	Sta-Green 200+ Weed & Feed	1.37	3.20 lb	3.3	11.7	23.3	12.8
5.	Vigoro Weed & Feed	1.18	3.20 lb	3.3	8.3	30.0	13.9
6.	Ultra Vigoro Weed & Feed	1.37	3.20 lb	10.0	23.3	25.0	19.4
7.	Best Turf Supreme Weed & Feed	1.33	3.60 lb	15.0	5.0	13.3	11.1
8.	Bandini Superblade Weed & Feed	1.33	3.60 lb	10.0	8.3	25.0	14.4
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	3.60 lb	10.0	3.3	13.3	8.9
	$LSD_{0.05}$			14.8	22.1	15.5	10.9

[1]Damage was assessed using a 0 - 100% scale with 100% = dead plants, 50 = 50% dead, and 0 = no damage.

Table 3. Dandelion counts[1] in turf treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	July 13	July 20	July 27	Aug 3	Aug 10	Aug 17	Mean	Percent[2] cover Aug 17
1.	Untreated control	NA	78.3	93.0	148.3	151.7	160.0	175.0	134.4	38.3
2.	Trimec Classic 3.4 SL	--	0.0	0.0	2.0	18.7	27.7	39.0	14.6	5.0
3.	Scotts Turf Builder w/Plus 2	3.00	7.3	14.3	17.7	35.0	46.7	50.0	28.5	10.0
4.	Sta-Green 200+ Weed & Feed	1.37	53.0	63.3	107.3	124.7	171.7	173.3	115.6	36.7
5.	Vigoro Weed & Feed	1.18	63.3	87.3	118.3	133.3	166.7	175.0	124.0	41.7
6.	Ultra Vigoro Weed & Feed	1.37	27.0	63.3	85.0	105.0	145.0	166.7	98.7	36.7
7.	Best Turf Supreme Weed & Feed	1.33	58.7	67.3	58.7	79.0	112.0	120.0	82.6	26.7
8.	Bandini Superblade Weed & Feed	1.33	42.3	51.7	68.3	81.7	88.3	108.3	73.4	23.3
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	36.7	43.3	74.0	93.3	116.7	136.0	83.3	28.3
	$LSD_{0.05}$		35.0	45.3	41.3	51.5	62.2	62.6	43.6	22.5

[1]These values represent the number of dandelions per plot.
[2]These data are the percentage area per plot covered by dandelions on August 17.

Table 4. Dandelion count reductions[1] in turf treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	July 13	July 20	July 27	Aug 3	Aug 10	Aug 17	Mean	Percent[2] cover Aug 17
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Trimec Classic 3.4 SL	--	100.0	100.0	98.7	87.7	82.7	77.7	89.2	86.9
3.	Scotts Turf Builder w/Plus 2	3.00	90.6	84.6	88.1	76.9	70.8	71.4	78.8	73.9
4.	Sta-Green 200+ Weed & Feed	1.37	32.3	31.9	27.6	17.8	0.0	1.0	14.0	4.3
5.	Vigoro Weed & Feed	1.18	19.1	6.1	20.2	12.1	0.0	0.0	7.7	0.0
6.	Ultra Vigoro Weed & Feed	1.37	65.5	31.9	42.7	30.8	9.4	4.8	26.6	4.3
7.	Best Turf Supreme Weed & Feed	1.33	25.1	27.6	60.4	47.9	30.0	31.4	38.5	30.4
8.	Bandini Superblade Weed & Feed	1.33	45.9	44.4	53.9	46.2	44.8	38.1	45.4	39.1
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	53.2	53.4	50.1	38.5	27.1	22.3	38.0	26.0
	$LSD_{0.05}$		44.6	48.7	27.9	34.0	38.9	35.8	32.4	58.9

[1]These values represent reductions in the number of dandelions per plot as compared with the untreated control.
[2]These data represent reductions in the area covered by dandelions per plot as compared with the untreated control.

Table 5. Percentage clover cover[1] in turf treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	July 13	July 20	July 27	August 3	August 10	August 17	Mean
1.	Untreated control	NA	23.3	26.7	18.3	13.3	8.3	8.3	16.4
2.	Trimec Classic 3.4 SL	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.	Scotts Turf Builder w/Plus 2	3.00	16.7	18.3	3.7	5.0	0.0	0.0	7.8
4.	Sta-Green 200+ Weed & Feed	1.37	23.3	26.7	23.3	15.0	10.0	10.0	18.1
5.	Vigoro Weed & Feed	1.18	28.3	28.3	16.7	8.3	1.7	1.7	14.2
6.	Ultra Vigoro Weed & Feed	1.37	18.3	16.7	11.7	6.7	0.3	0.0	8.9
7.	Best Turf Supreme Weed & Feed	1.33	16.7	20.0	11.7	13.3	6.7	6.7	12.5
8.	Bandini Superblade Weed & Feed	1.33	25.0	26.7	18.3	11.7	1.7	0.3	13.9
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	25.0	30.0	25.0	15.0	3.7	3.3	17.0
	$LSD_{0.05}$		12.2	15.9	14.4	NS	NS	NS	10.1

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

Table 6. Percentage clover cover reductions[1] in turf treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	July 13	July 20	July 27	August 3	August 10	August 17	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Trimec Classic 3.4 SL		100.0	100.0	100.0	100.0	100.0	100.0	100.0
3.	Scotts Turf Builder w/Plus 2	3.00	28.5	31.3	63.6	62.4	100.0	100.0	52.6
4.	Sta-Green 200+ Weed & Feed	1.37	0.0	0.1	0.0	0.0	0.0	0.0	0.0
5.	Vigoro Weed & Feed	1.18	0.0	0.0	8.9	37.3	79.9	79.9	13.6
6.	Ultra Vigoro Weed & Feed	1.37	21.3	37.6	36.2	19.9	96.0	100.0	45.5
7.	Best Turf Supreme Weed & Feed	1.33	28.5	25.1	36.2	0.0	19.7	19.7	23.8
8.	Bandini Superblade Weed & Feed	1.33	0.0	0.0	0.0	12.3	79.9	96.0	15.0
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	0.0	0.0	0.0	0.0	55.8	59.8	0.0
	$LSD_{0.05}$		52.5	59.4	78.6	NS	NS	NS	61.6

[1]These values represent reductions in clover cover per plot as compared with the untreated control.
NS = Means are not significantly different at the 0.05 level.

Table 7. Visual turf quality[1] in turf treated for the 2000 Scotts Postemergent Broadleaf Study.

	Material	Rate lb a.i./A	June 26	June 30	July 7	July 13	July 20	July 27	Aug 3	Aug 10	Aug 17	Mean
1.	Untreated control	NA	9.0	7.0	6.3	7.0	8.0	7.0	7.0	7.0	7.0	7.4
2.	Trimec Classic 3.4 SL	--	9.0	9.0	8.0	8.0	8.0	7.0	7.0	7.0	7.0	7.9
3.	Scotts Turf Builder w/Plus 2	3.00	9.0	9.0	8.7	8.7	8.0	7.0	7.0	7.0	7.0	8.0
4.	Sta-Green 200+ Weed & Feed	1.37	9.0	9.0	8.0	8.0	8.0	7.0	7.0	7.0	7.0	7.9
5.	Vigoro Weed & Feed	1.18	9.0	8.7	8.3	8.3	8.0	7.0	7.0	7.0	7.0	7.9
6.	Ultra Vigoro Weed & Feed	1.37	9.0	9.0	8.7	8.7	8.0	7.0	7.0	7.0	7.0	8.0
7.	Best Turf Supreme Weed & Feed	1.33	9.0	9.0	8.7	8.7	8.0	7.0	7.0	7.0	7.0	8.0
8.	Bandini Superblade Weed & Feed	1.33	9.0	9.0	8.7	8.7	8.0	7.0	7.0	7.0	7.0	8.0
9.	Schultz Expert Gardener Premium Weed & Feed	1.79	9.0	9.0	9.0	9.0	8.0	7.0	7.0	7.0	7.0	8.1
	$LSD_{0.05}$		--	0.3	0.8	0.7	--	--	--	--	--	0.2

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable and 1 = worst quality.

The Use of Bensulide to Reduce *Poa annua* Infestations in Golf Course Fairways

Nick E. Christians and Barbara R. Bingaman

These studies were conducted in the 2000 season at the Ames Golf and Country Club. The objective was to determine if Bensulide, a preemergence herbicide, can be used to prevent the reestablishment of *Poa annua* back into areas that had been treated with Prograss (ethofumasate).

STUDY 1

The study was conducted on the same area used for the 1999 Prograss trial (see pages 35 and 36 the 2000 Iowa Turfgrass Research Report). This replicated field trial was conducted on the 14th fairway. The Kentucky bluegrass fairway was estimated to have a 60% *Poa annua* cover in the area where the trial was conducted at the initiation of treatments. The study was arranged as a randomized complete block with 3 replications. Prograss was applied at 0, 0.75, 1.5, and 3 oz/1000 ft^2 to plots measuring 5 ft x 5 ft on the following dates: May 14, June 7, June 29, August 1, September 16, and October 12. Data were collected on percentage *Poa annua* control on September 16 and October 12. Each application was combined in a tank mix with Sprint 330 at 3.5 oz product/1000 ft^2 and urea at 0.1 lb N/1000 ft^2. Prior to September 16, no reduction in *Poa annua* was observed at any of the application rates. No phytotoxicity was observed on the Kentucky bluegrass at any time during the season.

The cumulative rate of application on the plots by September 16 was 0, 3.75, 7.5, and 15 oz/1000 ft^2. The cumulative rate on October 12 was 0, 4.5, 9, and 18 oz/1000 ft^2, and the total application rate for the season was 0, 5.25, 10.5, and 21 oz/1000 ft^2. On September 16, *Poa annua* was reduced by 0, 0, 43, and 88% in response to cumulative rates of 0, 3.75, 7.5, and 15 oz/1000 ft^2, respectively. By October 12, *Poa annua* reduction was observed to be 0, 25, 52, 93% in response to cumulative rates of 0, 5.25, 10.5, and 21 oz/1000 ft^2 Prograss. A final treatment for the season was made on October 12 which resulted in cumulative rates of 0, 5.25, 10.5, and 21 oz/1000 ft^2 Prograss for the season. On April 17, 2000, *Poa annua* reduction was 39, 72, and 97% in response to the cumulative Prograss applications of 5.25, 10.5, and 21 oz/1000 ft^2, respectively.

These same 5 ft by 5 ft plots were divided in half on April 21, 2000 and Bensulide (Betasan) was applied at 9.2 oz product (12.5 lb ai/acre) to one-half of each plot. The Bensulide treatments were randomly assigned and the study was conducted as a split plot study with Prograss treatments from the previous season as main plots and Bensulide treatments as subplots.

Table 1. The effect of Bensulide on *Poa annua* populations with and without previous application of Prograss in the replicated field trial from 1999.

Prograss Tmt. in 1999 season	Bensulide Tmt. in the spring of 2000	% *Poa annua* cover on 5/22/00	% *Poa annua* cover on 8/3/00	% *Poa annua* cover on 9/21/00
0	0	40	43	38
0	9.2 oz/1000 ft^2	27	35	38
0	0	17	52	47
5.25 oz/1000 ft^2	9.2 oz/1000 ft^2	33	50	47
0	0	25	23	33
10.5 oz/1000 ft^2	9.2 oz/1000 ft^2	22	18	33
0	0	13	8	23
21 oz/1000 ft^2	9.2 oz/1000 ft^2	17	9	23
LSD 0.05		NS	NS	NS

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

The Prograss applications from 1999 numerically reduced *Poa annua* through the season. Bensulide applications had no effect on the *Poa annua* population at any of the data collection dates.

STUDY 2

The second study was conducted on an adjacent area of the fairway. In the 1999 season, superintendent Don Portwine treated the north half of the 14th fairway with Prograss on the following schedule: May 20-3 oz, June 17-1.5 oz, July 13-1.5 oz, August 16-1.5 oz, September 24-1.5 oz, and October 18-1.5 oz/1000 ft^2. The total application rate for the season was 10.5 oz/1000 ft^2. The fairway was estimated to have a 60% cover of *Poa annua* and 40% Kentucky bluegrass at the initiation of treatments. Each application was combined in a tank mix with Sprint 330, an iron source containing 10% Fe by weight, at 3 oz product/1000 ft^2, and urea at 0.1 lb N/1000 ft^2. The treated area had approximately 25 to 30% infestation of *Poa annua* in the spring of 2000.

The second Bensulide study involved the establishment of 5 ft x 5 ft plots on the area treated with Prograss the year before and two 5 ft x 5 ft plots on an adjacent area that had not been treated with Prograss. One plot on each area was an untreated control and the other received Bensulide at 9.2 oz/1000 ft^2. Treatments were randomly assigned and the study was conducted with 3 replications.

Table 2. The effect of Bensulide on *Poa annua* populations with and without previous application of Prograss.

Prograss Tmt. in 1999 season	Bensulide Tmt. in the spring of 2000	% *Poa annua* cover on 5/22/00	% *Poa annua* cover on 8/3/00	% *Poa annua* cover on 9/21/00
0	0	37	58	55
0	9.2 oz/1000 ft^2	42	57	57
10.5 oz/1000 ft^2	0	18	36	52
10.5 oz/1000 ft^2	9.2 oz/1000 ft^2	18	41	52
LSD 0.05		14	10	NS

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

Prograss applications in 1999 continued to reduce *Poa annua* populations through August of 2000, but the effect was no longer apparent in September. Bensulide did not reduce *Poa annua* populations at any of the rating dates.

Bentgrass Overseeding Study

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

This study was designed to determine the optimal intervals between application of a Novartis experimental herbicide, CGA-362, and the overseeding of creeping bentgrass with perennial ryegrass and *Poa trivialis*. This herbicide is a new sulfonyl urea formulation that has potential as a non-selective product for cool season grasses. This study was conducted at the Iowa State University Horticulture Research Station on a native soil green with established 'Penncross' creeping bentgrass. The soil on this green was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.9% organic matter, 4 ppm P, 85 ppm K, and a pH of 7.15.

The study was designed as a split plot with herbicide treatment as the main plot treatment and the seeding interval as the sub plot effect. Overseeding with either 'Charger II' perennial ryegrass or 'Winterplay' *Poa trivialis* took place at 3, 7, 14, and 21 days after treatment applications (DAT).

The size of the individual plots was chosen so they could be divided into four subplots that were the width of the Blue Bird verticut. The blade width on the Blue Bird was 18" and it was 21" between the wheels. Each individual plot was, therefore, 7 x 5 ft. Each individual plot was divided into 4 sections in such a way that on each planting date one continuous strip was verticut for planting per replication. Five-foot barrier rows were left between replications. Seeding was performed by hand using the proper amount of seed per subplot.

Perennial ryegrass and *Poa trivialis* were overseeded into separate plots. Ryegrass was seeded at 350 lbs/A and *Poa trivialis* at 150 lbs/A. Overseeding was performed on June 9, June 13, June 20, and June 27. At each event, one subplot per plot was randomly selected and was verticut, swept of debris, and hand planted. The seed was brushed into the grooves produced by the verticut.

There were six treatments including CGA-362 at 20 and 40g a.i./A, and Roundup Pro at 1 lb a.i./A on overseeded plots. In addition, CGA-362 was applied at 10 g a.i./A and 15 g a.i./A on non-overseeded plots. A non-seeded, untreated control was included. The CGA-362 formulation was mixed with a non-ionic surfactant at 0.25% V/V for all applications. Treatments were applied on June 6, 2000. It was 75° F with a slight wind. The sprayables were applied with a carbon dioxide backpack sprayer equipped with TeeJet #8006 flat fan nozzles used at 30 - 40 psi. There was no drift of materials during application. The plots were checked when still wet and coverage was uniform.

Bentgrass visual quality and percentage cover data were taken for overseeded and non-overseeded plots. Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality. Quality data were taken from June 9 through September 5 (Table 1). Percentage bentgrass cover data were taken from June 27 through September 5 and represent the percentage area per plot covered by bentgrass. These data were converted to reflect percentage bentgrass kill per plot (Table 2).

Perennial ryegrass and *Poa trivialis* overseeded plots were rated for stand density beginning soon after germination. Density was assessed as the percentage germination of the overseeded species in the grooves within each plot. Germination data for both species were taken from June 22 through September 5 (Tables 3 and 4). These data also were compiled by treatment for each date by species (Tables 5 and 6).

Visual quality and percentage bentgrass cover data were analyzed using the Statistical Analysis System and the Analysis of Variance (ANOVA) procedure. The analyses for bentgrass quality and percentage cover were designed to indicate differences between treatment effects on quality and cover. The analyses for perennial ryegrass and *Poa trivialis* germination were constructed to test for main plot (herbicide treatment) effects and subplot (seeding interval after herbicide treatment applications) effects and the General Linear Model (GLM) procedure was used. An interaction between herbicide treatment and seeding date was examined to test for an optimum date after treatment for planting each grass species.

Significant differences in quality were found from June 9 through August 8 (Table 1). By June 13, the quality of all treated bentgrass was significantly worse than the untreated control. Bentgrass treated with Roundup Pro had the worst quality as compared with other treated and untreated bentgrass. The treated bentgrass had begun to recover by June 27 and new plants had emerged. From this date through the end of the test, the quality of the treated and untreated bentgrass was similar. Mean data indicate that Roundup Pro was the most toxic to bentgrass and was significantly different from the other treatments and the untreated control. The experimental formulation, CGA-362 was most harmful at 40 g a.i./A. The other CGA-362 treatment levels produced similar amounts of bentgrass damage.

Differences in percentage bentgrass cover were significant for the entire test period (Table 2). Treatment with Roundup Pro resulted in a 92.5% reduction in bentgrass cover on June 27 and the percentage cover remained below 25% through August 16. By September 5, recovery and regrowth had only filled in 40% of the Roundup Pro treated area and the mean percentage cover was 22.9%. Mean bentgrass cover reductions caused by CGA-362 were below 20% for the 10, 15, and 20 g a.i./A treatments. The mean cover reduction for the 40 g a.i./A treatment of CGA-362 was 38% as compared with 77.1% for Roundup Pro.

The data analyses for *Poa trivialis* and perennial ryegrass did not show significant date by treatment interactions (Tables 3 and 4). These data indicate that there were no differences in *Poa trivialis* and perennial ryegrass percentage cover among the four different overseeding dates. Differences in percentage cover for both species were found among the treatments on some of the data sampling dates (Tables 5 and 6).

Table 1. Visual quality[1] of bentgrass on plots treated with CGA-362 and Roundup Pro (June 9 through July 20).

Material	Rate a.i./A	Timing of seeding	June 9	June 13	June 20	June 22	June 27	July 7	July 20
Untreated control	N/A	N/A	7.5	9.0	9.0	9.0	9.0	9.0	9.0
CGA-362 75WG	20 g	3, 7, 14 & 21	6.5	5.3	3.5	5.3	7.3	8.2	8.0
CGA-362 75WG	40 g	3, 7, 14 & 21	6.0	5.0	3.3	4.3	5.8	7.2	7.2
Roundup Pro .75	1 lb	3, 7, 14 & 21	3.2	2.0	1.0	1.0	5.0	7.3	7.7
CGA-362 75WG	15 g	N/A	6.2	5.0	4.3	5.5	7.0	7.7	7.8
CGA-362 75WG	10 g	N/A	7.0	4.8	3.8	5.2	7.5	7.5	7.8
$LSD_{0.05}$			1.6	0.9	0.5	0.9	1.6	0.8	0.9

Material	Rate a.i./A	Timing of seeding	July 27	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Mean
Untreated control	N/A	N/A	9.0	8.5	8.7	8.7	7.8	8.7	8.2	8.6
CGA-362 75WG	20 g	3, 7, 14 & 21	7.3	7.3	7.3	8.7	7.0	8.8	8.7	7.1
CGA-362 75WG	40 g	3, 7, 14 & 21	7.0	7.3	7.7	8.7	7.3	8.7	8.8	6.7
Roundup Pro .75	1 lb	3, 7, 14 & 21	7.3	7.8	8.2	8.7	8.0	9.0	9.0	6.1
CGA-362 75WG	15 g	N/A	7.3	7.3	7.7	8.3	7.5	8.8	8.5	7.1
CGA-362 75WG	10 g	N/A	7.5	7.3	8.0	8.5	7.7	8.8	8.8	7.2
$LSD_{0.05}$			0.5	0.8	0.8	NS	NS	NS	NS	0.2

[1] Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable and 1 = worst quality.
Herbicide treatments were applied on June 6, 2000.

Table 2. Reductions in percentage bentgrass cover[1] on plots treated with CGA-362 and Roundup Pro.

Material	Rate a.i./A	Timing of seeding	June 27	July 7	July 20	July 27	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Mean
Untreated control	N/A	N/A	0.0	1.7	3.3	4.2	2.5	8.5	7.7	5.2	8.3	12.5	5.4
CGA-362 75WG	20 g	3, 7, 14 & 21	35.8	29.2	26.7	19.2	15.8	15.8	12.5	7.7	12.5	15.0	19.0
CGA-362 75WG	40 g	3, 7, 14 & 21	58.3	39.2	40.8	41.7	39.2	39.2	36.7	30.0	25.8	29.2	38.0
Roundup Pro .75	1 lb	3, 7, 14 & 21	92.5	88.3	84.2	83.3	82.5	77.5	75.0	64.2	63.3	60.0	77.1
CGA-362 75WG	15 g	N/A	33.3	21.7	20.8	27.5	19.2	20.0	14.3	15.0	11.7	15.0	19.9
CGA-362 75WG	10 g	N/A	24.2	26.7	20.0	18.3	12.5	14.2	10.2	6.7	6.7	9.2	14.9
$LSD_{0.05}$			9.7	11.9	14.0	14.5	15.2	17.2	15.8	15.5	14.3	13.1	11.6

[1]These figures represent the percentage reduction in bentgrass cover per plot.
Herbicide treatments were applied on June 6, 2000.

Table 3. Percentage *Poa trivialis* cover[1] in bentgrass on plots treated with CGA-362 and Roundup Pro.

Material	Rate a.i./A	Timing of seeding DAT	June 22	June 27	July 7	July 20	July 27	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Sept 12	Mean
CGA-362 75WG	20 g	3	6.7	18.3	51.7	66.7	65.0	58.3	56.7	73.3	51.7	41.7	33.3	20.0	45.3
CGA-362 75WG	40 g	3	3.3	18.3	35.0	66.7	70.0	81.7	66.7	65.0	60.0	51.7	51.7	50.0	51.7
Roundup Pro .75	1 lb	3	10.0	23.3	43.3	55.0	51.7	51.7	58.3	46.7	55.0	41.7	48.3	40.0	43.8
CGA-362 75WG	20 g	7	0.0	30.0	56.7	70.0	43.3	68.3	58.3	58.3	46.7	31.7	23.3	23.3	42.5
CGA-362 75WG	40 g	7	0.0	30.0	46.7	73.3	75.0	75.0	68.3	70.0	70.0	63.3	56.7	51.7	56.7
Roundup Pro .75	1 lb	7	0.0	23.3	53.3	68.3	75.0	76.7	85.0	80.0	85.0	75.0	75.0	55.0	62.6
CGA-362 75WG	20 g	14	--	12.0	15.0	23.3	35.0	33.3	31.7	33.3	28.3	25.0	23.3	20.0	23.4
CGA-362 75WG	40 g	14	--	8.3	25.0	41.7	56.7	48.3	55.0	56.7	48.3	46.7	48.3	41.7	39.7
Roundup Pro .75	1 lb	14	--	6.7	30.0	46.7	40.0	53.3	58.3	50.0	56.7	40.0	50.0	51.7	40.3
CGA-362 75WG	20 g	21	--	--	11.7	18.3	41.7	33.3	28.3	46.7	30.0	30.0	26.7	25.0	24.3
CGA-362 75WG	40 g	21	--	--	13.3	28.3	50.0	48.3	41.7	45.0	53.3	36.7	40.0	31.7	32.4
Roundup Pro .75	1 lb	21	--	--	20.0	30.0	43.3	55.0	61.7	60.0	66.7	53.3	61.7	40.0	41.0
$LSD_{0.05}$			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1]These data represent the percentage area per subplot covered by P. trivialis.
The seeding rate was 150 lb/A for *Poa trivialis*.
DAT = days after treatment application; 3 DAT overseeding was performed on June 9, 7 DAT on June 13, 14 DAT on June 20, and 21 DAT on June 27, 2000.

Table 4. Percentage perennial ryegrass cover[1] on plots treated with CGA-362 and Roundup Pro.

Material	Rate a.i./A	Timing of seeding DAT	June 22	June 27	July 7	July 20	July 27	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Sept 12	Mean
CGA-362 75WG	20 g	3	43.3	36.7	30.0	30.0	10.0	40.0	26.7	20.0	23.3	16.7	13.3	10.0	25.0
CGA-362 75WG	40 g	3	36.7	43.3	36.7	36.7	13.3	40.0	31.7	16.7	20.0	13.3	33.3	11.7	27.8
Roundup Pro .75	1 lb	3	36.7	68.3	46.7	28.3	16.7	36.7	26.7	15.0	21.7	21.7	26.7	16.7	30.1
CGA-362 75WG	20 g	7	43.3	71.7	56.7	33.3	61.7	70.0	43.3	26.7	23.3	15.0	18.3	10.0	39.4
CGA-362 75WG	40 g	7	36.7	60.0	53.3	50.0	58.3	68.3	53.3	30.0	26.7	15.0	28.3	16.7	41.4
Roundup Pro .75	1 lb	7	36.7	80.0	71.7	50.0	46.7	60.0	45.0	40.0	53.3	48.3	43.3	45.0	51.7
CGA-362 75WG	20 g	14	--	6.7	10.0	21.7	20.0	40.0	33.3	20.0	16.7	13.3	15.0	6.7	16.9
CGA-362 75WG	40 g	14	--	6.7	15.0	28.3	33.3	51.7	40.0	31.7	20.0	15.0	28.3	15.0	23.8
Roundup Pro .75	1 lb	14	--	13.3	26.7	38.3	25.0	50.0	28.3	21.7	33.3	30.0	28.3	23.3	26.5
CGA-362 75WG	20 g	21	--	--	10.0	16.7	13.3	23.3	20.0	13.3	20.0	8.3	10.0	6.7	11.8
CGA-362 75WG	40 g	21	--	--	10.0	21.7	11.7	33.3	28.3	13.3	11.7	10.0	16.7	10.0	13.9
Roundup Pro .75	1 lb	21	--	--	30.0	60.0	41.7	61.7	50.0	35.0	51.7	43.3	40.0	35.0	37.4
$LSD_{0.05}$			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1]These data represent the percentage area per subplot covered by ryegrass.
The seeding rate was 350 lb/A for perennial ryegrass.
DAT = days after treatment application; 3 DAT overseeding was performed on June 9, 7 DAT on June 13, 14 DAT on June 20, and 21 DAT on June 27, 2000.

Table 5. Percentage *Poa trivialis* cover[1] on plots treated with CGA-362 and Roundup Pro showing treatment differences for each date.

Material	Rate a.i./A	June 22	June 27	July 7	July 20	July 27	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Sept 12	Mean
CGA-362 75WG	20 g	3.3	20.1	33.8	44.6	46.3	48.3	43.8	52.9	39.2	32.1	26.7	22.1	43.9
CGA-362 75WG	40 g	1.7	18.9	30.0	52.5	62.9	63.3	57.9	59.2	57.9	49.6	49.2	43.8	54.2
Roundup Pro .75	1 lb	5.0	17.8	36.7	50.0	52.5	59.2	65.8	59.2	65.8	52.5	58.8	46.7	53.2
$LSD_{0.05}$		NS	NS	NS	NS	11.3	NS	16.8	NS	15.3	17.8	23.4	18.4	NS

[1]For each sampling date these data represent the mean percentage area per plot covered by *Poa trivialis* for all four subplots.

Table 6. Percentage perennial ryegrass cover[1] on plots treated with CGA-362 and Roundup Pro showing treatment differences for each date.

Material	Rate a.i./A	June 22	June 27	July 7	July 20	July 27	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Sept 12	Mean
CGA-362 75WG	20 g	43.3	38.3	26.7	25.4	26.3	43.3	30.8	20.0	20.8	13.3	14.2	8.3	32.2
CGA-362 75WG	40 g	36.7	36.7	28.8	34.2	29.2	48.3	38.3	22.9	19.6	13.3	26.7	13.3	34.6
Roundup Pro .75	1 lb	36.7	53.9	43.8	44.2	32.5	52.1	37.5	27.9	40.0	35.8	34.6	30.0	40.9
$LSD_{0.05}$		NS	8.6	9.8	14.2	NS	NS	NS	6.5	11.2	10.2	12.5	9.8	NS

[1]For each sampling date these data represent the mean percentage area per plot covered by ryegrass for all four subplots.
DAT = days after treatment application; 3 DAT overseeding was performed on June 9, 7 DAT on June 13, 14 DAT on June 20, and 21 DAT on June 27, 2000.

Drive Bentgrass Seeding Study

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

This study was designed to evaluate the safety of quinclorac (Drive 0.75DF) on spring-seeded creeping bentgrass. The trial was conducted at the Iowa State University research station on a bare soil plot that was plowed, tilled, and prepared Spring 2000. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.1% organic matter, 84 ppm K, 16 ppm P, and a pH of 7.15. Three bentgrass cultivars were sown: L93 (Cultivar 1), Penneagle (Cultivar 2), and Penncross (Cultivar 3). Seeding rate was 1 lb/1000 ft^2.

The experimental design was a 2 x 7 factorial in a split plot design. Bentgrass cultivar was the main block and the six herbicide treatments were the subplot factors. Individual plot size was 5 x 5 ft with 3 ft barrier strips between rows. Assignment of bentgrass cultivar and treatment to plots within reps was made according to instructions followed at the other sites. Preparation of the site included tilling and raking. The soil was enriched with urea (46-0-0) at 1 lb N/1000 ft^2 and with triple super phosphorous at 1lb P/1000 ft^2.

Drive 0.75DF was applied 7 days prior to seeding (7 DBS), immediately following seeding (0 DBS), and 14 and 28 days after emergence (14 and 28 DAE). Emergence was defined as the time at which approximately 50% germination had occurred. Siduron was applied immediately following seeding at the highest label rate. No methylated soy oil (MSO) or other surfactant was used with Drive 75DF for this study. Sprayables were diluted in water and applied at an equivalent rate of 2 gal water/1000 ft^2. All treatments were watered in with 0.1 - 0.2 in water within 72 hours post application.

Seven days before seeding treatments were applied on 10 May 2000. It was cool (65° F) and mostly sunny with a light wind. The materials were applied between 12:00 and 12:30 pm using a carbon dioxide backpack sprayer equipped with TeeJet #8006 flat fan nozzles at 30-35 psi. Seeding was performed on 17 May 2000. Individual plots were hand-seeded and then raked. Immediately following, the O DBS treatments were applied. Seeding and treatment were finished by 2:30 pm. It was 75° F and mostly cloudy with SW wind gusts 15-20 mph. Seedling and application were performed between gusts so there was no drift of either seed or herbicides. A heavy rainfall occurred within 48 hours of seeding and some washout of seed into the barrier areas was observed.

Bentgrass emergence began on 25 May with grass observed in a few plots. By 29 May, bentgrass was present in all plots and this date was considered the seedling emergence date for the timing of additional herbicide treatments. The 14 DAE treatments were applied on 13 June. It rained 0.2 in approximately 3 hours post application. The 28 DAE treatments were applied on 27 June. It was 70° F and sunny with NW winds at 10 mph.

Percentage bentgrass and phytotoxicity data were taken weekly beginning 2 June. Bentgrass emergence was measured by estimating the percentage bentgrass cover within individual plots. Phytotoxicity and visual quality were assessed using a 9 to 1 scale with 9 = best quality, 6 = lowest acceptable, and 1 = worst turf quality.

By 8 June, broadleaf weeds were emerging. Purslane and prostrate pigweed were the predominate species. Beginning 15 June, percentage weed cover data also were taken and final weed cover data were taken 8 August. Weed populations were assessed by estimating the percentage weed cover per individual plot.

Data were analyzed using Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Treatment effects on bentgrass cover, weed cover, and visual quality were tested using Fisher's Least Significant Difference (LSD) test.

Slight differences in quality for all three cultivars were evident on 22 June (Table 1). Bentgrass treated with Drive 75DF on 13 June had a slightly faded appearance. This symptom was not observed on 15 June and was not apparent on 30 June.

None of the herbicide treatments significantly reduced the percentage cover of 'L93' bentgrass (Table 2). On 8 June, cover of 'Penneagle' bentgrass was less than the untreated control for all treatments except for the 28 DAE Drive 75DF application. Percentage cover of 'Penncross' treated with Drive 75DF at 7 DBS was higher than the untreated control on 7 July and 25 July. Treatment with Siduron at 0 DBS resulted in significantly more 'Penncross' cover than the untreated control on 7 July. Mean bentgrass cover data reflect no overall effect of the herbicide treatments on percentage bentgrass cover for the three cultivars.

There were significant decreases in percentage weed cover in treated versus untreated bentgrass on 2 August for all three cultivars (Table 3). Weed cover in 'Penneagle' was significantly reduced by Siduron 50WP on 14 July, 25 July, and 2 August as compared with the untreated controls. Siduron 50WP reduced percentage weed cover in 'Penncross' for the entire period except 15 June when compared with the untreated control.

Table 1. Visual quality[1] of creeping bentgrass treated for the 2000 Drive Bentgrass Seeding Study.

'L93'

	Material	Timing[2]	June 2	June 8	June 15	June 22	July 7	July 14	July 25	Aug 2	Aug 8	Mean
1.	Untreated control	NA	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
2.	Drive 75DF	7 DBS	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
3.	Drive 75DF	0 DBS	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
4.	Siduron 50WP	0 DBS	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
5.	Drive 75DF	14 DAE	9.0	9.0	9.0	7.3	9.0	9.0	9.0	9.0	9.0	8.8
6.	Drive 75DF	28 DAE	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
	$LSD_{0.05}$		--	--	--	0.6	--	--	--	--	--	--

'Penneagle'

	Material	Timing	June 2	June 8	June 15	June 22	July 7	July 14	July 25	Aug 2	Aug 8	Mean
1.	Untreated control	NA	9.0	9.0	9.0	8.7	9.0	9.0	9.0	9.0	9.0	8.9
2.	Drive 75DF	7 DBS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
3.	Drive 75DF	0 DBS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
4.	Siduron 50WP	0 DBS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
5.	Drive 75DF	14 DAE	9.0	9.0	9.0	7.3	9.0	9.0	9.0	9.0	9.0	8.8
6.	Drive 75DF	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
			--	--	--	0.6	--	--	--	--	--	0.1

'Penncross'

	Material	Timing	June 2	June 8	June 15	June 22	July 7	July 14	July 25	Aug 2	Aug 8	Mean
1.	Untreated control	NA	9.0	9.0	9.0	8.0	9.0	9.0	9.0	9.0	9.0	8.9
2.	Drive 75DF	7 DBS	9.0	9.0	9.0	8.0	9.0	9.0	9.0	9.0	9.0	8.9
3.	Drive 75DF	0 DBS	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
4.	Siduron 50WP	0 DBS	9.0	9.0	9.0	8.7	9.0	9.0	9.0	9.0	9.0	9.0
5.	Drive 75DF	14 DAE	9.0	9.0	9.0	7.3	9.0	9.0	9.0	9.0	9.0	8.8
6.	Drive 75DF	28 DAE	9.0	9.0	9.0	8.3	9.0	9.0	9.0	9.0	9.0	8.9
			--	--	--	0.8	--	--	--	--	--	0.9

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.
[2]Timing of application is based on seeding and emergence. Seven days before seeding treatments (7 DBS) were applied on May 10, at seeding treatments (O DBS) were made on May 17 after seeding was performed. Emergence was May 29 and the 14 days after emergence treatments (14 DAE) were made on June 13 and the 28 days after emergence on June 27(28 DAE).

Table 2. Percentage creeping bentgrass cover[1] in plots treated for the 2000 Drive Bentgrass Seeding Study.

'L93'

	Material	Timing[2]	June 2	June 8	June 15	June 22	July 7	July 14	July 25	Aug 2	Aug 8	Mean
1.	Untreated control	NA	30.0	35.0	53.3	66.7	73.3	80.0	80.0	78.3	90.0	65.2
2.	Drive 75DF	7 DBS	28.3	38.3	58.3	60.0	70.0	70.0	75.0	80.0	85.0	62.8
3.	Drive 75DF	0 DBS	23.3	33.3	53.3	61.7	71.7	76.7	76.7	80.0	90.0	63.0
4.	Siduron 50WP	0 DBS	25.0	31.7	43.3	51.7	76.7	78.3	78.3	85.0	88.3	62.0
5.	Drive 75DF	14 DAE	26.7	33.3	53.3	48.3	63.3	66.7	68.3	78.3	85.0	58.1
6.	Drive 75DF	28 DAE	23.3	31.7	50.0	53.3	65.0	70.0	78.3	78.3	90.0	60.0
	$LSD_{0.05}$		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

'Penneagle'

	Material	Timing	June 2	June 8	June 15	June 22	July 7	July 14	July 25	Aug 2	Aug 8	Mean
1.	Untreated control	NA	25.0	28.3	36.7	43.3	66.7	70.0	71.7	78.3	85.0	56.1
2.	Drive 75DF	7 DBS	20.0	23.3	28.3	46.7	63.3	73.3	71.7	73.3	85.0	53.9
3.	Drive 75DF	0 DBS	21.7	21.7	35.0	43.3	58.3	75.0	75.0	78.3	85.0	54.8
4.	Siduron 50WP	0 DBS	21.7	23.3	30.0	38.3	61.7	76.7	76.7	83.3	85.0	55.2
5.	Drive 75DF	14 DAE	20.0	21.7	33.3	46.7	63.3	70.0	73.3	80.0	85.0	54.8
6.	Drive 75DF	28 DAE	20.0	28.3	31.7	43.3	60.0	66.7	66.7	76.7	81.7	52.8
			NS	4.3	NS	NS	NS	NS	NS	NS	NS	NS

'Penncross'

	Material	Timing	June 2	June 8	June 15	June 22	July 7	July 14	July 25	Aug 2	Aug 8	Mean
1.	Untreated control	NA	25.0	30.0	41.7	51.7	65.0	75.0	70.0	80.0	85.0	58.1
2.	Drive 75DF	7 DBS	33.3	33.3	53.3	66.7	78.3	80.0	81.7	83.3	88.3	66.5
3.	Drive 75DF	0 DBS	30.0	35.0	43.3	51.7	68.3	70.0	73.3	83.3	83.3	59.8
4.	Siduron 50WP	0 DBS	25.0	35.0	43.3	51.7	76.7	80.0	78.3	88.3	88.3	63.0
5.	Drive 75DF	14 DAE	26.7	33.3	50.0	61.7	75.0	70.0	78.3	81.7	83.3	62.2
6.	Drive 75DF	28 DAE	25.0	26.7	43.3	50.0	60.0	63.3	65.0	80.0	83.3	55.2
			NS	NS	NS	NS	8.6	NS	9.6	NS	NS	NS

[1]These data represent the percentage area per plot covered by bentgrass.
[2]Timing of application is based on seeding and emergence. Seven days before seeding treatments (7 DBS) were applied on May 10, at seeding treatments (O DBS) were made on May 17 after seeding was performed. Emergence was May 29 and the 14 days after emergence treatments were made on June 13 (14 DAE) and the 28 days after emergence on June 27 (28 DAE).

Table 3. Percentage weed cover[1] in plots treated for the 2000 Drive Bentgrass Seeding Study.

'L93'

	Material	Timing[2]	June 15	June 22	July 7	July 14	July 25	August 2	August 8	Mean
1.	Untreated control	NA	4.0	5.3	6.7	20.0	21.7	31.7	23.3	16.1
2.	Drive 75DF	7 DBS	4.0	4.0	10.3	20.3	21.7	28.3	21.7	15.8
3.	Drive 75DF	0 DBS	5.7	5.3	8.3	18.3	15.0	18.3	15.0	12.3
4.	Siduron 50WP	0 DBS	2.0	2.0	2.3	10.3	10.3	9.0	6.7	6.1
5.	Drive 75DF	14 DAE	2.3	2.3	7.0	21.7	18.3	25.0	18.3	13.6
6.	Drive 75DF	28 DAE	4.0	10.0	11.7	35.0	30.0	30.0	28.3	21.3
	$LSD_{0.05}$		NS	4.6	NS	NS	NS	14.7	NS	NS

'Penneagle'

	Material	Timing[2]	June 15	June 22	July 7	July 14	July 25	August 2	August 8	Mean
1.	Untreated control	NA	2.7	6.7	15.0	33.3	31.7	35.0	28.3	21.8
2.	Drive 75DF	7 DBS	4.0	7.0	18.3	21.7	23.3	23.3	25.0	17.5
3.	Drive 75DF	0 DBS	4.3	11.7	16.7	21.7	20.0	25.0	21.7	17.3
4.	Siduron 50WP	0 DBS	0.7	1.0	2.3	3.7	5.0	5.3	8.3	3.8
5.	Drive 75DF	14 DAE	1.7	5.0	13.3	21.7	21.7	33.3	23.3	17.1
6.	Drive 75DF	28 DAE	2.7	8.3	20.0	25.0	28.3	33.3	26.7	20.6
			NS	NS	NS	11.7	11.6	15.2	NS	5.5

'Penncross'

	Material	Timing[2]	June 15	June 22	July 7	July 14	July 25	August 2	August 8	Mean
1.	Untreated control	NA	8.7	12.0	18.3	36.7	31.7	38.3	28.3	24.9
2.	Drive 75DF	7 DBS	5.3	13.3	11.7	20.0	16.7	21.7	20.0	15.5
3.	Drive 75DF	0 DBS	8.7	15.0	18.3	26.7	28.3	33.3	28.3	22.7
4.	Siduron 50WP	0 DBS	1.0	1.0	3.7	5.0	5.0	7.0	6.7	4.2
5.	Drive 75DF	14 DAE	8.7	13.3	18.3	41.7	23.3	30.0	25.0	22.9
6.	Drive 75DF	28 DAE	9.0	13.3	26.7	51.7	43.3	38.3	38.3	31.5
			NS	8.8	10.4	20.2	17.4	19.8	17.3	11.1

[1]These data represent the percentage area per plot covered by broadleaf and grass weed species.
[2]Timing of application is based on seeding and emergence. Seven days before seeding treatments (7 DBS) were applied on May 10, at seeding treatments (O DBS) were made on May 17 after seeding was performed. Emergence was May 29 and the 14 days after emergence treatments (14 DAE) were made on June 13 and the 28 days after emergence (28 DAE) on June 27.

Table 4. Percent cover of creeping bentgrass and weeds[1] when treated with siduron and quinclorac at various times before and after seeding in Iowa.

			Creeping bentgrass cover[2]				Weed cover[2]		
	Herbicide	Timing[3]	7 DAE	21 DAE	35 DAE	49 DAE	21 DAE	35 DAE	49 DAE
1.	Check	--	25	43	62	75	5	13	28
2.	Siduron	7 DBS	24	39	69	78	1	3	7
3.	Quinclorac	7 DBS	26	47	67	74	4	13	21
4.	Quinclorac	0 DBS	25	43	60	74	6	14	21
5.	Quinclorac	14 DAE		46	59	69	4	13	21
6.	Quinclorac	28 DAE			58	67		19	34
	$LSD_{0.05}$		NS	NS	6	NS	3	6	9

[1]These figures represent the percentage area per plot covered by either bentgrass or broadleaf and grass weed species.
[2]Means over 3 replications and 3 cultivars of creeping bentgrass.
[3]Timing of application is based on seeding and emergence. Seven days before seeding treatments (7 DBS) were applied on May 10, at seeding treatments (O DBS) were made on May 17 after seeding was performed. Emergence was May 29 and the 14 days after emergence treatments were made on June 13 (14 DAE) and the 28 days after emergence on June 27 (28 DAE).

2000 Drive Seeding Tolerance Study

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

This study was undertaken to screen perennial ryegrass and Kentucky bluegrass for seedling tolerance to Drive 75DF and Drive + starter fertilizer formulations. This study was conducted at the Iowa State University Horticulture Research Station in a bare soil area. The soil was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with 4.2% organic matter, 79 ppm K, 7 ppm P, and a pH of 6.5.

The design was a split plot with turf species as the main plot factor and herbicide and/or fertilizer treatment as the subplot factor. Two turfgrass species, 'Brightstar' perennial ryegrass (tested Jan 98) and 'Limousine' Kentucky bluegrass (Williams Seed - tested Jan 99) were seeded into a newly tilled and prepared bare soil plot. Seeding rates were 1.5 lb/1000 ft^2 for bluegrass and 5.0 lb/1000 ft^2 for ryegrass. There were two rows per replication with one turf species per row and three replications. Three-foot barrier areas were placed between rows within replications and between replications.

Three materials were screened: L-0384 Drive 0.43% + Novex starter fairway fertilizer (16-24-11), Drive 75DF, and Novex starter fairway fertilizer (16-24-11) as the standard. An untreated control was included. Treatment applications were made at specific intervals throughout the study based on seedling emergence. Seeding was performed May 25 and immediately following seeding and raking, the at seeding (0 DAS) materials were applied. Granular materials were applied with containers used as 'shaker dispensers' to ensure uniform distribution. Sprayables were applied using a carbon dioxide powered backpack sprayer equipped with TeeJet #8006 nozzles at a spray pressure of 30-40 psi. Ryegrass emergence was on May 30 and the 7 days after emergence (7 DAE) treatments were applied on June 7, the 14 DAE on June 19, and the 28 DAE on June 30, 2000. Bluegrass emergence was on June 12 and the 7 DAE materials were applied on June 19, the 14 DAE on June 27, and the 28 DAE on July 11, 2000.

Seedling tolerance was monitored throughout the season. Turf quality was visually assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality (Tables 1 and 2). Turf tolerance was further measured by estimating percentage turf cover per individual plot for ryegrass (Tables 3 and 4) and bluegrass (Tables 5 and 6). Weed populations were assessed by estimating the percentage cover for all weed species (Tables 7 and 8). Quality, turf cover, and weed cover data were taken from June 8 through September 12. In addition, on September 12, weed populations per individual plot were assessed by species (Tables 9 and 10). The predominate species were witchgrass (*Panicum capillare*) and crabgrass.

Data were analyzed using the Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Additional analyses using the General Linear Model (GLM) procedure were conducted for ryegrass and bluegrass percentage turf cover omitting data for those plots not as yet treated. Treatment effects on seedling growth, weed populations, and turf quality were tested using Fisher's Least Significant Difference (LSD) test.

<u>Perennial ryegrass</u>

There were no phytotoxic symptoms found on ryegrass throughout the study. The only quality differences were observed on June 30 and July 7 (Table 1). On June 30, the worst quality was for ryegrass that was to receive 28 DAE applications. These treatments were applied on June 30 following data collection. By July 7, the quality of this turf had improved and was similar to other treated turf and to the fertilized control.

From June 8 through June 30 there were differences in percentage ryegrass cover between rye treated with Drive and rye treated with only the Novex fertilizer (Table 3). The significantly lower percentages were for ryegrass that was not as yet treated. By July 30, the 14 and 28 DAE treatments had been made and the data from July 7 show no differences in percentage cover between ryegrass treated with Drive + fertilizer formulations and ryegrass treated with fertilizer alone. The data suggest that from July 14 through the remainder of the season, differences in percentage cover between Drive treated and untreated ryegrass are related to the percentage weed cover.

The GLM analysis showed no differences in percentage cover among treatments for June 8 and June 15 (Table 4). On June 23, the percentage ryegrass cover treated at 14 DAE on June 20 was lower than the other treated ryegrass.

By July 7, all of the treatments had been applied and there were statistical differences in weed cover (Table 7). Drive 75DF and L-0384 Drive reduced weed cover as compared with the Novex fertilizer throughout the test. The mean data suggest that the best weed control was provided by the Drive products applied 7 DAE but these levels were not statistically different from control provided by 0 DAS, 14 DAE, and 28 DAE.

The predominant weed species throughout the plot were witchgrass and crabgrass (Table 9). There were statistical differences in witchgrass and crabgrass percentage cover among the treatments. The best witchgrass control was provided by Drive 75DF applied 0 DAS and 7 DAE. Crabgrass control was best in ryegrass treated with Drive 75DF at 0 DAS and 14 DAE or with L-0384 Drive at 7 DAE, 14 DAE and 28 DAE.

Kentucky bluegrass

The data for bluegrass show that none of the treatments affected turf quality as compared with the fertilized control (Table 2). Bluegrass quality remained constant throughout the growing season.

There were some statistical differences in percentage bluegrass cover (Table 5). Percentage cover for June 23, July 7, and August 8 was statistically higher than the fertilized control for bluegrass treated with Drive 75DF + fertilizer at seeding. For the balance of the duration, percentage cover was statistically similar for all bluegrass but cover remained numerically higher for grass treated with Drive 75DF + fertilizer at seeding than the fertilized controls. Mean data show that treatment with Drive 75DF + fertilizer produced a larger bluegrass cover than treatment with Novex fertilizer alone.

The GLM analysis of these data removed the statistical differences in cover for July 7 (Table 6). There were no other changes in significant effects of the treatments.

In general, percentage weed cover was much higher in the bluegrass plots than in the ryegrass (Table 8). Because bluegrass germination is much slower than ryegrass, weed populations were able to become established in bare plots not treated at seeding. There also was a significant replication effect on weed cover throughout the duration of the test. Percentage weed cover was higher in replication 3 than in the other replications.

Through June 30, percentage weed cover was low in bluegrass treated with either Drive 75DF or L-0384 Drive formulations at seeding. From July 7 through August 8 and August 29 through September 12 there were statistical differences in percentage weed cover. Weed cover was greater than 50% in all bluegrass plots for much of the duration of the test. Mean data show that all applications of Drive 75DF reduced weed cover as compared with the Novex control. The L-0384 Drive formulation provided similar weed control when applied 7 DAE. Witchgrass and crabgrass infestation levels were similar in all bluegrass plots (Table 10). Treatment with either Drive 75DF or L-0384 Drive did not significantly reduce the populations of these weed species. Numerically, the least crabgrass was in bluegrass treated at 28 DAE with Drive 75DF.

Table 1. Visual quality of perennial ryegrass[1] seeded for the 2000 Lesco Drive Seeding Tolerance Study.

	Material	Timing of application[2]	June 2	June 8	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	8.0	8.3	9.0	9.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	8.7	7.7	9.0	9.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	8.0	8.7	9.0	9.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	7.0	8.7	9.0	9.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	8.7	9.0	9.0	9.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	8.7	8.3	9.0	9.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	8.0	8.3	9.0	9.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	7.0	9.0	9.0	9.0
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	8.0	8.0	9.0	9.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	8.0	7.7	9.0	9.0
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	7.7	9.0	9.0	9.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	7.0	9.0	9.0	9.0
	$LSD_{0.05}$		--	--	--	--	1.2	0.9	--	--

	Material	Timing of application[2]	Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	8.8
2	NOVEX starter fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.8
3	NOVEX starter fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.9
4	NOVEX starter fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.8
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.9
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.9
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.8
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	8.8
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.8
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.9
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	8.8
	$LSD_{0.05}$		--	--	--	--	--	--	NS

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.
[2]DAS = days after seeding. DAE = days after seedling emergence. PR emergence was on May 30. 0 DAS treatments were applied on May 25, 7 DAE on June 7, 14 DAE on June 20, and 28 DAE on June 30, 2000.

Table 2. Visual quality of Kentucky bluegrass[1] seeded for the 2000 Lesco Drive Seeding Tolerance Study.

	Material	Timing of application[2]	June 2	June 8	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	$LSD_{0.05}$		--	--	--	--	--	--	--	--

	Material	Timing of application[2]	Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	9.0	9.0	9.0	9.0	9.0	9.0	9.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	$LSD_{0.05}$		--	--	--	--	--	--	--

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.
[2]DAS = days after seeding. DAE = days after seedling emergence. KB emergence was on June 9. 0 DAS treatments were applied on May 25, 7 DAE on June 19, 14 DAE on June 27, and 28 DAE on July 11, 2000.

Table 3. Percentage perennial ryegrass cover[1] treated for the 2000 Lesco Drive Seeding Tolerance Study (ANOVA analysis).

	Material	Timing of application	June 2	June8	June1 5	June2 3	June3 0	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	16.7	50.0	63.3	76.7	75.0	83.3	76.7	75.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	16.7	46.7	58.3	70.0	76.7	73.3	73.3	70.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	15.0	43.3	46.7	50.0	68.3	75.0	70.0	70.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	16.7	43.3	40.0	50.0	60.0	78.3	71.7	65.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	18.3	58.3	68.3	71.7	76.7	80.0	80.0	76.7
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	16.7	50.0	68.3	73.3	78.3	86.7	83.3	78.3
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	15.0	43.3	43.3	53.3	71.7	78.3	80.0	75.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	13.3	40.0	40.0	50.0	65.0	81.7	76.7	68.3
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	16.7	50.0	66.7	71.7	76.7	80.0	78.3	75.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	13.3	46.7	63.3	61.7	73.3	81.7	80.0	70.0
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	13.3	36.7	33.3	48.3	68.3	80.0	80.0	70.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	16.7	40.0	53.3	63.3	60.0	86.7	78.3	78.3
	$LSD_{0.05}$		NS	11.1	16.5	11.1	7.9	NS	8.1[3]	NS

	Material	Timing of application	Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	81.7	80.0	88.3	88.3	81.7	81.7	72.7
2	NOVEX starter fertilizer (16-24-11)	7 DAE	76.7	80.0	85.0	85.0	78.3	78.3	69.2
3	NOVEX starter fertilizer (16-24-11)	14 DAE	76.7	78.3	90.0	90.0	80.0	80.0	66.7
4	NOVEX starter fertilizer (16-24-11)	28 DAE	75.0	80.0	85.0	85.0	78.3	78.3	64.8
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	78.3	80.0	90.0	90.0	80.0	80.0	73.5
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	81.7	85.0	91.7	91.7	85.0	85.0	75.4
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	78.3	80.0	88.3	88.3	80.0	80.0	68.2
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	80.0	80.0	88.3	88.3	81.7	81.7	66.8
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	78.3	78.3	90.0	90.0	80.0	80.0	72.3
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	78.3	80.0	88.3	88.3	78.3	80.0	70.2
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	76.7	81.7	88.3	88.3	80.0	80.0	66.1
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	81.7	81.7	93.3	93.3	86.7	86.7	71.4
	$LSD_{0.05}$		NS	NS	5.0[3]	5.0[3]	NS	NS	5.0

[1]These data represent the percentage area per plot covered by P. ryegrass.
[2]DAS = days after seeding. DAE = days after seedling emergence. PR emergence was on May 30. 0 DAS treatments were applied on May 25, 7 DAE on June 7, 14 DAE on June 20, and 28 DAE on June 30, 2000.
[3]P > F = 0.08 for these data.

Table 4. Percentage perennial ryegrass cover[1] treated for the 2000 Lesco Drive Seeding Tolerance Study (GLM analysis).

	Material	Timing of application	June 2	June 8	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	16.7	50.0	63.3	76.7	75.0	83.3	76.7	75.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	--	46.7	58.3	70.0	76.7	73.3	73.3	70.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	--	--	--	50.0	68.3	75.0	70.0	70.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	--	--	--	--	60.0	78.3	71.7	65.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	18.3	58.3	68.3	71.7	76.7	80.0	80.0	76.7
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	--	50.0	68.3	73.3	78.3	86.7	83.3	78.3
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	--	--	--	53.3	71.7	78.3	80.0	75.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	--	--	--	--	65.0	81.7	76.7	68.3
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	16.7	50.0	66.7	71.7	76.7	80.0	78.3	75.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	--	46.7	63.3	61.7	73.3	81.7	80.0	70.0
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	--	--	--	48.3	68.3	80.0	80.0	70.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	--	--	--	--	60.0	86.7	78.3	78.3
	$LSD_{0.05}$		NS	NS	NS	10.9	7.9	NS	8.1[3]	NS

	Material		Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	81.7	80.0	88.3	88.3	81.7	81.7	72.7
2	NOVEX starter fertilizer (16-24-11)	7 DAE	76.7	80.0	85.0	85.0	78.3	78.3	69.2
3	NOVEX starter fertilizer (16-24-11)	14 DAE	76.7	78.3	90.0	90.0	80.0	80.0	66.7
4	NOVEX starter fertilizer (16-24-11)	28 DAE	75.0	80.0	85.0	85.0	78.3	78.3	64.8
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	78.3	80.0	90.0	90.0	80.0	80.0	73.5
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	81.7	85.0	91.7	91.7	85.0	85.0	75.4
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	78.3	80.0	88.3	88.3	80.0	80.0	68.2
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	80.0	80.0	88.3	88.3	81.7	81.7	66.8
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	78.3	78.3	90.0	90.0	80.0	80.0	72.3
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	78.3	80.0	88.3	88.3	78.3	80.0	70.2
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	76.7	81.7	88.3	88.3	80.0	80.0	66.1
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	81.7	81.7	93.3	93.3	86.7	86.7	71.4
	$LSD_{0.05}$		NS	NS	5.0[3]	5.0[3]	NS	NS	5.0

[1]These data represent the percentage area per plot covered by P. ryegrass.
[2]DAS = days after seeding. DAE = days after seedling emergence. PR emergence was on May 30. 0 DAS treatments were applied on May 25, 7 DAE on June 7, 14 DAE on June 20, and 28 DAE on June 30, 2000.
[3]P > F = 0.08 for these data.

Table 5. Percentage Kentucky bluegrass cover[1] treated for the 2000 Lesco Drive Seeding Tolerance Study (ANOVA analysis).

	Material	Timing of application	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	20.0	16.7	18.3	30.0	23.7	25.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	15.0	11.7	13.3	20.0	20.3	20.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	16.7	11.7	11.7	21.7	15.3	20.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	18.3	15.0	15.0	20.0	20.0	21.7
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	23.3	25.0	31.7	36.7	30.0	36.7
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	16.7	13.3	18.3	26.7	25.0	30.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	16.7	15.0	13.3	23.3	18.3	25.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	16.7	15.0	15.0	18.3	21.7	23.3
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	20.0	18.3	25.0	25.0	23.3	30.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	18.3	13.3	16.7	23.3	21.7	23.3
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	15.0	11.7	18.3	23.3	21.7	25.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	18.3	11.7	13.3	18.3	20.0	18.3
	$LSD_{0.05}$		NS	7.9[3]	10.3	9.4	NS	NS

	Material		Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	26.7	33.3	36.7	36.7	40.0	41.7	29.1
2	NOVEX starter fertilizer (16-24-11)	7 DAE	28.3	26.7	31.7	33.3	36.7	36.7	24.5
3	NOVEX starter fertilizer (16-24-11)	14 DAE	23.3	33.3	33.3	36.7	33.3	46.7	25.3
4	NOVEX starter fertilizer (16-24-11)	28 DAE	26.7	36.7	43.3	46.7	50.0	51.7	30.4
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	45.0	46.7	53.3	61.7	61.7	65.0	43.1
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	25.0	33.3	41.7	43.3	51.7	50.0	31.3
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	28.3	28.3	26.7	36.7	45.0	41.7	26.5
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	31.7	36.7	43.3	51.7	53.3	58.3	32.1
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	33.3	36.7	38.3	56.7	43.3	48.3	33.2
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	31.7	28.3	40.0	41.7	55.0	50.0	30.3
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	30.0	35.0	36.7	36.7	41.7	38.3	27.8
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	23.3	30.0	40.0	41.7	50.0	41.7	27.2
	$LSD_{0.05}$		NS	11.1[3]	NS	NS	NS	NS	10.0

[1]These data represent the percentage area per plot covered by Kentucky bluegrass.
[2]DAS = days after seeding. DAE = days after seedling emergence. KB emergence was on June 9. 0 DAS treatments were applied on May 25, 7 DAE on June 19, 14 DAE on June 27, and 28 DAE on July 11, 2000.
[3]P > F = 0.07 for these data.

Table 6. Percentage Kentucky bluegrass cover[1] treated for the 2000 Lesco Drive Seeding Tolerance Study (GLM analysis).

	Material	Timing of application	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	20.0	16.7	18.3	30.0	23.7	25.0
2	NOVEX starter fertilizer (16-24-11)	7 DAE	--	11.7	13.3	20.0	20.3	20.0
3	NOVEX starter fertilizer (16-24-11)	14 DAE	--	--	11.7	21.7	15.3	20.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	--	--	--	--	20.0	21.7
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	23.3	25.0	31.7	36.7	30.0	36.7
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	--	13.3	18.3	26.7	25.0	30.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	--	--	13.3	23.3	18.3	25.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	--	--	--	--	21.7	23.3
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	20.0	18.3	25.0	25.0	23.3	30.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	--	13.3	16.7	23.3	21.7	23.3
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	--	--	18.3	23.3	21.7	25.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	--	--	--	--	20.0	18.3
	$LSD_{0.05}$		NS	7.9	10.0	NS	NS	NS

	Material		Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	26.7	33.3	36.7	36.7	40.0	41.7	29.1
2	NOVEX starter fertilizer (16-24-11)	7 DAE	28.3	26.7	31.7	33.3	36.7	36.7	24.5
3	NOVEX starter fertilizer (16-24-11)	14 DAE	23.3	33.3	33.3	36.7	33.3	46.7	25.3
4	NOVEX starter fertilizer (16-24-11)	28 DAE	26.7	36.7	43.3	46.7	50.0	51.7	30.4
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	45.0	46.7	53.3	61.7	61.7	65.0	43.1
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	25.0	33.3	41.7	43.3	51.7	50.0	31.3
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	28.3	28.3	26.7	36.7	45.0	41.7	26.5
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	31.7	36.7	43.3	51.7	53.3	58.3	32.1
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	33.3	36.7	38.3	56.7	43.3	48.3	33.2
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	31.7	28.3	40.0	41.7	55.0	50.0	30.3
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	30.0	35.0	36.7	36.7	41.7	38.3	27.8
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	23.3	30.0	40.0	41.7	50.0	41.7	27.2
	$LSD_{0.05}$		NS	11.1[3]	NS	NS	NS	NS	10.0

[1]These data represent the percentage area per plot covered by Kentucky bluegrass.
[2]DAS = days after seeding. DAE = days after seedling emergence. KB emergence was on June 9. 0 DAS treatments were applied on May 25, 7 DAE on June 19, 14 DAE on June 27, and 28 DAE on July 11, 2000.
[3]P > F = 0.07 for these data.

Table 7. Percentage weed cover[1] in perennial ryegrass treated for the 2000 Lesco Drive Seeding Tolerance Study.

	Material	Timing of application	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	3.7	2.7	8.3	10.0	16.7	21.7
2	NOVEX starter fertilizer (16-24-11)	7 DAE	3.0	4.3	11.7	16.7	16.7	31.7
3	NOVEX starter fertilizer (16-24-11)	14 DAE	1.7	2.0	8.3	13.3	23.3	28.3
4	NOVEX starter fertilizer (16-24-11)	28 DAE	1.3	1.3	6.7	10.0	20.0	25.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	1.3	1.3	5.0	5.0	8.3	10.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	0.3	0.7	3.7	2.3	2.3	5.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	1.3	1.3	5.0	6.7	10.0	11.7
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	1.3	1.3	6.7	3.7	8.3	8.3
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	1.0	1.7	5.0	6.7	10.0	10.0
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	0.0	0.7	2.3	2.3	4.0	8.3
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	0.7	1.0	2.3	5.0	8.3	10.0
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	2.3	1.7	6.7	6.7	13.3	16.7
	$LSD_{0.05}$		1.7	NS	NS	7.5	7.7	12.1

	Material		Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	28.3	26.7	13.3	13.3	25.0	25.0	16.2
2	NOVEX starter fertilizer (16-24-11)	7 DAE	30.0	28.3	23.3	23.3	30.0	30.0	20.8
3	NOVEX starter fertilizer (16-24-11)	14 DAE	30.0	30.0	23.3	23.3	25.0	26.7	19.6
4	NOVEX starter fertilizer (16-24-11)	28 DAE	28.3	28.3	26.7	26.7	30.0	30.0	19.5
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	8.3	13.3	15.0	15.0	6.7	6.7	8.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	5.0	5.0	6.7	6.7	11.7	13.3	5.2
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	16.7	10.0	11.7	11.7	10.0	11.7	9.0
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	5.0	8.3	8.3	8.3	11.7	11.7	6.9
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	16.7	20.0	13.3	13.3	21.7	21.7	11.8
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	5.3	8.3	5.0	5.0	6.7	8.3	4.7
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	13.3	15.0	10.0	10.0	8.3	8.3	7.7
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	20.0	18.3	15.0	15.0	16.7	16.7	12.4
	$LSD_{0.05}$		14.7	10.1	13.6[3]	13.6[3]	13.9	12.9	7.3

[1]These data represent the percentage area per plot covered by broadleaf and grass weed species.
[2]DAS = days after seeding. DAE = days after seedling emergence. PR emergence was on May 30. 0 DAS treatments were applied on May 25, 7 DAE on June 7, 14 DAE on June 20, and 28 DAE on June 30, 2000.
[3]P > F = 0.06 for these data.

Table 8. Percentage weed cover[1] in Kentucky bluegrass treated for the 2000 Lesco Drive Seeding Tolerance Study.

	Material	Timing of application[2]	June 15	June 23	June 30	July 7	July 14	July 27
1	NOVEX starter fertilizer (16-24-11)	0 DAS	13.7	21.7	35.0	45.0	70.0	81.7
2	NOVEX starter fertilizer (16-24-11)	7 DAE	9.0	20.0	38.3	51.7	71.7	79.7
3	NOVEX starter fertilizer (16-24-11)	14 DAE	9.0	16.7	35.0	48.3	73.3	76.3
4	NOVEX starter fertilizer (16-24-11)	28 DAE	9.0	18.0	25.0	41.7	55.0	65.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	2.3	11.7	15.0	31.7	60.0	55.0
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	9.0	4.3	6.7	21.7	50.0	60.0
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	7.3	14.3	21.7	25.0	36.7	56.7
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	9.0	14.7	25.0	33.3	46.7	51.7
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	2.3	11.7	20.0	38.3	55.0	63.3
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	7.3	8.0	10.0	20.0	40.0	50.0
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	9.0	11.3	23.3	26.7	51.7	61.7
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	5.7	15.0	25.0	43.3	60.0	63.3
	$LSD_{0.05}$		NS	NS	NS	18.4	19.2	17.4

	Material		Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Sept 12	Mean
1	NOVEX starter fertilizer (16-24-11)	0 DAS	76.7	78.3	73.3	78.3	71.7	68.3	59.5
2	NOVEX starter fertilizer (16-24-11)	7 DAE	83.0	88.0	83.3	81.7	78.3	78.3	63.6
3	NOVEX starter fertilizer (16-24-11)	14 DAE	78.0	80.0	76.7	58.3	78.3	78.3	59.0
4	NOVEX starter fertilizer (16-24-11)	28 DAE	71.7	84.7	73.3	76.7	70.0	70.0	55.0
5	Drive 75DF + fertilizer (16-24-11)	0 DAS	60.0	63.3	55.0	55.0	50.0	50.0	42.4
6	Drive 75DF + fertilizer (16-24-11)	7 DAE	70.0	70.0	71.7	68.3	61.7	61.7	46.3
7	Drive 75DF + fertilizer (16-24-11)	14 DAE	61.7	61.7	70.0	61.7	58.3	58.3	44.4
8	Drive 75DF + fertilizer (16-24-11)	28 DAE	63.3	65.0	56.7	51.7	43.3	41.7	41.8
9	L-0384 0.43% + fertilizer (16-24-11)	0 DAS	70.0	81.7	81.7	73.3	66.7	66.7	52.6
10	L-0384 0.43% + fertilizer (16-24-11)	7 DAE	63.3	70.0	71.7	66.7	51.7	51.7	42.5
11	L-0384 0.43% + fertilizer (16-24-11)	14 DAE	63.3	66.7	81.7	66.7	73.3	70.0	50.4
12	L-0384 0.43% + fertilizer (16-24-11)	28 DAE	73.0	79.7	63.3	70.0	56.7	56.7	51.9
	$LSD_{0.05}$		14.9[3]	13.5	NS	17.7	18.7	19.7	9.0

[1]These data represent the percentage area per plot covered by broadleaf and grass weed species.
[2]DAS = days after seeding. DAE = days after seedling emergence. KB emergence was on June 9. 0 DAS treatments were applied on May 25, 7 DAE on June 19, 14 DAE on June 27, and 28 DAE on July 11, 2000.
[3]P > F = 0.07 for these data.

Table 9. Percentage witchgrass (*Panicum capillare*) and crabgrass cover[1] in perennial ryegrass treated for the 2000 Lesco Drive Seeding Tolerance Study on September 12, 2000.

	Material	Rate (lb a.i./A)	Timing of application[2]	Witchgrass	Crabgrass
1	NOVEX starter fertilizer (16-24-11)	NA	0 DAS	10.0	20.0
2	NOVEX starter fertilizer (16-24-11)	NA	7 DAE	5.0	23.3
3	NOVEX starter fertilizer (16-24-11)	NA	14 DAE	6.7	21.7
4	NOVEX starter fertilizer (16-24-11)	NA	28 DAE	5.0	23.3
5	Drive 75DF + fertilizer (16-24-11)	0.75	0 DAS	3.3	8.3
6	Drive 75DF + fertilizer (16-24-11)	0.75	7 DAE	1.7	15.0
7	Drive 75DF + fertilizer (16-24-11)	0.75	14 DAE	5.0	8.3
8	Drive 75DF + fertilizer (16-24-11)	0.75	28 DAE	5.0	10.0
9	L-0384 0.43% + fertilizer (16-24-11)	0.75	0 DAS	5.0	21.7
10	L-0384 0.43% + fertilizer (16-24-11)	0.75	7 DAE	5.0	5.0
11	L-0384 0.43% + fertilizer (16-24-11)	0.75	14 DAE	5.0	8.3
12	L-0384 0.43% + fertilizer (16-24-11)	0.75	28 DAE	5.0	8.3
	$LSD_{0.05}$			3.6	11.6

Table 10. Percentage witchgrass (*Panicum capillare*) and crabgrass cover[1] in Kentucky bluegrass treated for the 2000 Lesco Drive Seeding Tolerance Study on September 12, 2000.

	Material	Rate (lb a.i./A)	Timing of application[2]	Witchgrass	Crabgrass
1	NOVEX starter fertilizer (16-24-11)	NA	0 DAS	10.0	66.7
2	NOVEX starter fertilizer (16-24-11)	NA	7 DAE	8.3	63.3
3	NOVEX starter fertilizer (16-24-11)	NA	14 DAE	16.7	60.0
4	NOVEX starter fertilizer (16-24-11)	NA	28 DAE	18.3	53.3
5	Drive 75DF + fertilizer (16-24-11)	0.75	0 DAS	8.3	40.0
6	Drive 75DF + fertilizer (16-24-11)	0.75	7 DAE	18.3	53.3
7	Drive 75DF + fertilizer (16-24-11)	0.75	14 DAE	21.7	46.7
8	Drive 75DF + fertilizer (16-24-11)	0.75	28 DAE	13.3	33.3
9	L-0384 0.43% + fertilizer (16-24-11)	0.75	0 DAS	11.7	58.3
10	L-0384 0.43% + fertilizer (16-24-11)	0.75	7 DAE	8.3	43.3
11	L-0384 0.43% + fertilizer (16-24-11)	0.75	14 DAE	10.0	58.3
12	L-0384 0.43% + fertilizer (16-24-11)	0.75	28 DAE	11.7	46.7
	$LSD_{0.05}$			NS	NS

[1]These data represent the percentage area per plot covered by witchgrass and crabgrass.
[2]DAS = days after seeding. DAE = days after seedling emergence. KB emergence was on June 9. 0 DAS treatments were applied on May 25, 7 DAE on June 19, 14 DAE on June 27, and 28 DAE on July 11, 2000.

2000 Plant Growth Regulator Study

Mark J. Howieson and Nick E. Christians

Proxy 2SL (*ethephon*) was compared to Primo 1EC (*trinexapac-ethyl*) to evaluate their effects on growth suppression and visual quality, e.g., color, density and uniformity, of '1020' creeping bentgrass (*Agrostis palustris* Huds.). The trial was organized as a completely randomized block design, which was replicated three times. There were five treatments within each block- two Proxy 2SL and Primo 1EC treatments and an untreated control. Application timing and rate differed between the plant growth regulator treatments. Proxy 2SL was applied either at two- or six-week intervals. Two-week interval treatments were made at a rate of 2.5 fl oz/1000 ft^2 and six-week interval treatments were applied at a rate of 5.0 fl oz/1000 ft^2. Similarly, Primo 1EC treatments were also made at two- or six-week intervals. Two-week treatments were applied at rates of 0.125 fl oz/1000 ft^2, while the six-week treatments were made at 0.25 fl oz/1000 ft^2.

Treatment applications began on May 10, with subsequent applications occurring at either two- or six-week intervals, depending on the treatment protocol. Plant growth regulator applications were made to 5x5 ft plots using a $C0_2$-powered backpack sprayer. The sprayer was calibrated to apply 3.0 gallons of material/1000 ft^2. Established stands of '1020' creeping bentgrass at the Iowa State University Horticulture Research Station were used for the study. The turf was maintained at a height of $^1/_2$ inch and watered as necessary to facilitate normal growth and prevent desiccation. The turfgrass stand was grown in a medium consisting of $^1/_3$ Nicollet soil, $^1/_3$ peat and $^1/_3$ sand. The medium had a pH of 8.05, an organic matter content of 3.04%, 3 ppm of nitrogen, 2 ppm of phosphorus and 41 ppm of potassium.

Turf evaluations of color, density, uniformity, and clipping yield were performed on a weekly basis following initial chemical treatment. Visual quality ratings were determined using a 1 to 9 scale, with 9=best, 6=lowest acceptable and 1=worst. Clipping yield was a measurement of the fresh weight, in grams, of clippings obtained from mowing the treated turf at 0.50 inch. The weekly evaluations for color are located in Table 1. In general, both application intervals and rates of Primo improved the color ratings of creeping bentgrass. Proxy, on the other hand, resulted in a slight, but acceptable, reduction in color. Proxy treated plots appeared to have a florescent yellow hue. Primo applied at two-week intervals consistently produced the highest color ratings. Additionally, phytotoxicity was not noted after any of the plant growth regulator treatments.

Proxy at both application intervals enhanced the density of creeping bentgrass (Table 2). Both Primo treatments also improved density, but not as much as the Proxy treatments. Changes in density associated with Proxy treatments did not appear until the third week of the study, but continued throughout the remainder of the study. Proxy applied at a two-week interval resulted in the most consistent enhancement of turfgrass density, although Proxy applied at six-week intervals produced similar results. The uniformity of the grass plots was also influenced by plant growth regulator treatments (Table 3). Proxy and Primo treated plots produced a grass stand that was far less grainy, with a more consistent color and density than the untreated controls. Primo treatments did not impact uniformity as much as Proxy treatments, and occasionally resulted in lowered uniformity ratings in comparison to controls. Proxy treated plots, however, appeared to be much tighter and denser, with a more consistent color– more uniform. Once again, Proxy applied at a two-week interval produced the highest uniformity ratings.

Growth regulator treatments also affected clipping yield, although the extent and persistence was variable and treatment-dependant (Table 4). Primo applied at six-week intervals initially resulted in a dramatic decrease in a relative clipping yield, but after four weeks there was an equally dramatic post-inhibition stimulation of growth that lasted until the next chemical application. Primo treatments applied at two-week intervals produced much more consistent reductions in clipping yields than those achieved with the six-week application interval. Both of the Proxy treatments resulted in an initial flush of growth the week after the first chemical application. Relative clipping yields in the Proxy six-week treatments were reduced in the ensuing 17 weeks of the study. Proxy two-week treatments, however, resulted in a flush of growth for two weeks after initial chemical applications and did not result in a satisfactory reduction in relative clipping yield until the sixth week of the study. Primo two-week treatments produced the most consistent reduction in relative clipping yield and were not susceptible to the post-inhibition growth response associated with the Primo six-week treatments.

Primo and Proxy are both plant growth regulators that can be used as part of a balanced maintenance program to reduce mowing costs and improve efficiency. An additional benefit is improvement in turf quality. While Primo readily improves the color of treated turf, Proxy greatly improves density and uniformity. Two main drawbacks, however, associated with Proxy are its reduction of turf color and the flush of growth after initial application. Future research considerations should look at ways to mask or reduce Proxy's effect on turf color, such as addition of supplemental iron or magnesium. Moreover, it may be possible to limit the initial growth flush, while maintaining improvements in density and uniformity, with the addition of a type II plant growth regulator. The growth flush is most likely the result of either increased production of, or sensitivity to, gibberellic acid or to the accumulation of carbohydrates during growth suppression. Addition of a type II plant growth regulator could potentially counteract the Proxy-induced stimulation of internode cell elongation and limit the initial growth flush.

Table 1. Visual assessment [1] regarding the color of '1020' creeping bentgrass

Treatment	Wk	1	2[2]	3	4[2]	5	6[2,3]	7	8[2]	9	10[2]	11	12[2,3]	13	14[2]	15	16[2]	17	18
Control		7.0	8.0	8.7	7.7	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.3	8.3	8.0	8.0
Primo (6 week)		7.0	9.0	9.0	9.0	8.7	8.3	8.0	6.7	8.3	9.0	9.0	8.0	8.0	8.0	8.3	8.7	9.0	8.3
Proxy (6 week)		7.0	8.0	7.7	7.7	7.7	8.0	7.0	7.0	7.0	7.7	7.0	7.7	7.0	7.0	7.7	8.0	8.0	7.3
Primo (2 week)		7.0	9.0	9.0	9.0	8.7	9.0	9.0	9.0	8.7	9.0	9.0	8.7	9.0	9.0	9.0	8.7	9.0	9.0
Proxy (2 week)		7.0	8.0	8.0	8.0	8.0	8.0	7.3	8.0	7.3	7.7	8.0	7.0	7.0	7.0	7.0	7.0	7.3	7.0
$LSD_{0.05}$		**NS**	**0.1**	**0.6**	**0.7**	**NS**	**0.5**	**0.5**	**0.5**	**0.9**	**0.7**	**0.1**	**NS**	**0.1**	**0.1**	**0.9**	**NS**	**0.5**	**0.7**

Table 2. Visual assessment [1] regarding the density of '1020' creeping bentgrass

Treatment	Wk	1	2[2]	3	4[2]	5	6[2,3]	7	8[2]	9	10[2]	11	12[2,3]	13	14[2]	15	16[2]	17	18
Control		7.0	7.0	8.0	8.0	7.3	7.0	7.3	7.7	8.0	7.0	7.0	7.3	7.3	7.0	7.0	7.0	7.0	7.7
Primo (6 week)		7.0	7.0	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	8.0	7.7	7.0	8.0	7.3	8.3	8.0	7.7
Proxy (6 week)		7.0	7.0	9.0	9.0	9.0	8.0	9.0	9.0	8.0	9.0	9.0	9.0	8.0	9.0	9.0	8.3	9.0	9.0
Primo (2 week)		7.0	7.0	8.3	8.0	7.7	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.0	8.0	7.0	8.0	8.0	8.0
Proxy (2 week)		7.0	7.0	9.0	9.0	9.0	9.0	8.3	8.7	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
$LSD_{0.05}$		**NS**	**NS**	**0.5**	**0.1**	**0.7**	**0.1**	**NS**	**NS**	**0.1**	**0.1**	**0.1**	**0.8**	**0.5**	**0.1**	**0.5**	**0.7**	**0.1**	**0.7**

Table 3. Visual assessment [1] regarding the uniformity of '1020' creeping bentgrass

Treatment	Wk	1	2[2]	3	4[2]	5	6[2,3]	7	8[2]	9	10[2]	11	12[2,3]	13	14[2]	15	16[2]	17	18
Control		7.0	7.0	8.0	8.0	7.3	7.3	8.0	7.7	8.0	7.0	7.0	7.3	7.3	7.0	7.3	7.0	7.0	7.7
Primo (6 week)		7.0	7.0	8.0	8.3	7.3	7.7	7.7	7.0	8.0	8.0	8.0	7.7	7.0	7.0	8.0	8.3	8.0	7.7
Proxy (6 week)		7.0	7.0	8.7	8.7	8.7	8.0	9.0	9.0	9.0	8.7	9.0	9.0	8.7	9.0	9.0	8.3	9.0	9.0
Primo (2 week)		7.0	7.0	8.3	8.0	7.0	7.7	7.0	7.0	9.0	8.0	8.0	8.0	7.0	8.0	8.0	8.0	8.0	8.0
Proxy (2 week)		7.0	7.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
$LSD_{0.05}$		**NS**	**NS**	**0.6**	**NS**	**0.7**	**0.9**	**0.5**	**0.5**	**0.1**	**0.5**	**0.1**	**0.8**	**0.6**	**0.1**	**NS**	**0.7**	**0.1**	**0.7**

Table 4. Relative yield [1] of '1020' creeping bentgrass treated with Primo 1EC and Proxy 2SL

Treatment	Wk	1	2[2]	3	4[2]	5	6[2,3]	7	8[2]	9	10[2]	11	12[2,3]	13	14[2]	15	16[2]	17	18
Control		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Primo (6 week)		101.4	68.9	83.3	101.8	143.2	113.7	55.4	40.9	74.7	97.6	113.8	143.5	54.4	29.8	84.2	85.4	107.4	116.6
Proxy (6 week)		121.6	86.6	75.9	70.3	66.9	69.2	52.6	72.0	87.3	97.1	85.5	74.9	79.7	42.7	57.1	88.8	72.4	66.0
Primo (2 week)		94.6	77.2	58.4	74.1	49.2	54.1	65.4	66.0	56.8	58.4	51.2	73.9	57.5	79.9	52.2	113.9	67.4	60.0
Proxy (2 week)		124.0	166.5	96.9	91.5	95.9	52.6	69.7	81.1	116.6	92.2	89.7	62.6	54.4	37.8	75.6	87.6	78.7	92.2
$LSD_{0.05}$		**NS**	**34.8**	**20.6**	**22.4**	**NS**	**36.0**	**23.6**	**28.4**	**34.7**	**21.0**	**NS**	**36.4**	**NS**	**31.9**	**NS**	**NS**	**22.2**	**NS**

[1]Visual quality ratings were assigned using a 9 to 1 scale with 9=best, 6=lowest acceptable and 1=worst
[2]Two-week Primo and Proxy treatments were applied on this date
[3]Six-week Primo and Proxy treatments were applied on this date
[4]Relative to clipping yield of the untreated control
NS –Fischer's LSD test is not applicable, the differences between means are not significantly different when α=0.05

Effects of Trinexapac-ethyl (Primo) and Mower Adjustment on Creeping Bentgrass Mowing Quality

Mark J. Howieson and Nick E. Christians

The objectives of this study were to determine the effects of mower adjustment and Primo 1EC on the quality of creeping bentgrass (*Agrostis palustris*). Mowing quality and Primo response was assessed using a visual rating of the overall turf quality, a measurement of the leaf tip shredding, leaf tissue chlorophyll content, and evolved ethylene.

Materials and Methods

This study was conducted at the Iowa State University Horticulture Research Station using 'Penneagle' creeping bentgrass established on a $^1/_3$ peat, $^1/_3$ sand and $^1/_3$ Nicollet soil growth medium.

Toro Greensmaster 1000 walk behind reel mowers were utilized in the study. The mowers had a cutting width of 21 inches and were bench set to a cutting height of $^1/_2$ inch. The mowers were sharpened and backlapped to Toro specifications at the factory prior to the initiation of the study.

Four different mower adjustments were examined in this study (Table 1). Mowers A and C were maintained with slight reel-to-bedknife contact for the duration of the trial. Additionally, Mower C was operated for eight hours prior to the initiation of mowing treatments. This was to simulate a slightly dull mower that should be backlapped to perform optimally. Mower A represented a recently serviced mower that was adjusted and maintained with slight reel-to-bedknife contact, per manufacturer specifications.

Mowers B and D were adjusted so that there was no reel-to-bedknife contact. Mower D was also operated for eight hours to mimic a mower that needed backlapping. Mower B characterizes an alternative mower adjustment prevalent in the golf course industry. Many mechanics adjust mowers with no reel-to-bedknife contact in order to extend the time between scheduled mower maintenance. It is assumed that since the reel is not making contact with the bedknife, friction and heat buildup will be reduced, allowing the bedknife to remain sharp for an extended period of time. Mower D was a slightly dull mower that was adjusted according to this philosophy.

The reel-to-bedknife contact of mowers A and C was adjusted as necessary during the study so that the mowers were capable of cutting 20-lb. office paper the entire length of the bedknife. Similarly, Mowers B and D were adjusted over the duration of the trial so that they would cut cardstock along the entire length of the bedknife. Mowing treatments were performed three times a week beginning June 8, 2000.

Primo treatments were made at a four-week interval using a CO_2- powered backpack sprayer calibrated to apply 3.0 gallons of material/1000 ft^2. Primo was applied at a rate of 0.25 fl. oz. of product/1000 ft^2 and compared to an untreated control. Primo applications were initiated on June 10, 2000 and a total of four applications were made over the duration of the study.

Turf assessments were made on a weekly interval. Data collected included an overall visual rating and a measurement of mowing injury. The overall visual rating was based on a comprehensive measure of the color, density and uniformity of the turfgrass. Ratings were assigned on a 9 to 1 scale, with 9=best, 6=lowest acceptable turf quality and 1=worst.

Mowing injury was determined by measuring the amount of shredding and browning on the tips of leaf blades that were randomly selected from each plot. This leaf damage evaluation was measured in millimeters under a microscope.

The chlorophyll content of grass samples from each treatment plot was determined every two-weeks. Chlorophyll content was determined as a means to quantify mowing injury. The necrotic and brown tissue damaged by mowing will not yield chlorophyll. Therefore, leaf tips that are torn and shredded rather than cut cleanly, will have larger brown and necrotic areas and will not contain as much chlorophyll.

To further quantify turfgrass mowing injury, ethylene production rates of grass samples from each treatment were determined. Ethylene production is induced when the turfgrass plant is stressed or damaged. Mechanical stress, such as mowing, will initiate ethylene production, and the amount of ethylene produced will increase as the severity of the injury increases.

Results

Visual Quality

The turfgrass quality of the Primo and untreated control PGR treatments can be found in Table 2. The untreated control plots rated higher in visual quality than the Primo treated plots. The reduction in visual quality associated with the Primo treated plots was primarily the result of minor discoloration the week after each PGR application. In the week following PGR application, Primo treated plots acquired a gray hue, causing a slight, but acceptable, reduction in visual quality. Primo treated plots achieved visual quality ratings similar to the untreated control the remaining three weeks between PGR treatments.

Mower A (reel-to-bedknife contact) and Mower C (reel-to-bedknife contact with 8 hours of use mower adjustments), generally resulted in the highest visual ratings of the mower adjustment treatments. Mowers B and D produced the lowest visual quality ratings. Mower B was adjusted with no reel-to-bedknife contact while Mower D was adjusted with no reel-to-bedknife contact with eight hours of use (Table 3). Necrotic, ragged, and frayed leaf tips caused by Mower D significantly lowered the visual quality of the affected turf.

Mowing Injury
No statistically significant differences in mowing injury were observed among the Primo and untreated control PGR treatments (Table 2).

Mower A consistently produced the smallest amount of mowing injury of the four mower adjustments, while Mower D, the no reel-to-bedknife contact with 8 hours of use adjustment, produced the largest (Table 3). Mowers B and C produced intermediate amounts of mowing injury, although at times Mower C resulted in mowing injury similar to Mower A.

Chlorophyll Content
Compared to the untreated controls, Primo treated plots had higher total chlorophyll concentrations (Table 2). Primo applications slightly reduced the visual quality of treated turf for one week after the treatment was applied. However, the Primo plots attained a darker color the remaining three weeks until the next application. This is reflected in the chlorophyll concentration data. Primo clearly increased the chlorophyll concentration of treated turfgrass.

Mowers A and C resulted in the highest chlorophyll content of the mower adjustment treatments, while Mowers B and D produced the lowest (Table 4). The numbers of frayed and shredded edges were limited in the Mower A and C plots. This resulted in higher chlorophyll content. Remember that brown or necrotic tissue damaged by mowing does not contain appreciable quantities of chlorophyll. The leaf tips of grass plants mown with the B and D mower adjustments were visibly damaged. Accordingly, their chlorophyll concentration was much lower.

Ethylene Production
Primo had no significant effect on the ethylene production rate as compared to the untreated control (Table 3). Mower A, however, consistently resulted in the smallest ethylene production rate of the four mower adjustments. Ethylene production increases as a result of stress, or wounding, and the amount of ethylene produced increases as the severity of the stress increases. Mower D had the highest ethylene production rate. Therefore, Mower A resulted in the least amount of stress, while Mower D resulted in the highest amount stress of the four mower adjustments (Table 3).

Discussion

Primo had little affect on mowing quality, although it did cause a slight, but acceptable reduction in visual quality. This reduction was due primarily to the discoloration of the turfgrass the week immediately following Primo applications. In the three weeks before the next Primo application, however, the treated plots regained a healthy green color that at times surpassed the visual quality of the untreated control. This is reflected in the chlorophyll content data. Primo application increased the chlorophyll content of treated plots above that of the untreated control.

Mower adjustment had the greatest influence on mowing quality. Mower A, the reel-to-bedknife contact adjustment, consistently achieved superior mowing quality ratings as assessed by visual quality, mowing injury, chlorophyll content and ethylene production rate. Mower A most often resulted in the highest visual rating and chlorophyll content, while it produced the least amount of mowing injury and had the lowest ethylene production rates.

Mower D, the no reel-to-bedknife contact adjustment with eight hours of use, produced the worst mowing quality. This mower adjustment produced the lowest visual ratings, as well as the lowest chlorophyll content. Mower D also produced the largest amount of mowing injury and the highest ethylene production rate. These results indicate that the mowers utilized in this study should be maintained with reel-to-bedknife contact, per manufacturer's specifications, to ensure the highest mowing quality.

Table 1. Mower Adjustment Treatments

Mower	Reel-to-bedknife contact	Operation Prior to Treatment
A	Slight	None
B	None	None
C	Slight	8 hours
D	None	8 hours

Table 2. Average PGR Treatment Assessments

PGR Treatment	Visual Quality[1]	Mowing Injury[2]	Chlorophyll Content[3]	Ethylene Production Rate[4]
Control	8.50	1.61	16.35	0.622
Primo	8.18	1.54	16.98	0.581
$LSD_{0.05}$	0.25	NS	0.50	NS

Table 3. Average Mower Adjustment Treatment Assessments

Mower Treatment	Visual Quality[1]	Mowing Injury[2]	Chlorophyll Content[3]	Ethylene Production Rate[4]
A	8.68	0.83	17.46	0.541
B	8.20	1.85	15.73	0.593
C	8.41	1.28	17.12	0.603
D	8.07	2.35	16.34	0.669
$LSD_{0.05}$	0.16	0.24	0.71	0.073

[1] Quality was assessed using a 9 to 1 scale, with 9=best, 6=lowest acceptable and 1=worst.
[2] Mowing injury was measured under a microscope in millimeters of shredded tissue from the tip.
[3] Reported as mg/L of the 30 mL combined acetone extracts per Bruinsma (1961).
[4] Reported as $\mu g\ hr^{-1}\ g^{-1}$ of clipping fresh weight.
NS: Means are not significant per Fischer's LSD test when α=0.05

Kentucky Bluegrass Fertility Trial

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

This study was designed to screen new Sustane formulations on Kentucky bluegrass. The trial was conducted at the Iowa State University Horticulture Research Station in established 'Park' Kentucky bluegrass. The soil in this area was a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with an organic content of 4.0, a pH of 7.1, 8 ppm P, and 81 ppm K. The experimental design was a randomized complete block with three replications. Individual plot size was 5 x 5 ft with 3 ft barrier rows between replications.

Four medium grade Sustane formulations were provided. Sustane 5-2-4 + Fe, Sustane 18-1-8 + Fe (with Nutralene & PCSCU), Sustane 10-1-2 (all organic), and Sustane + Novex 12-2-12 experimental were screened with corn gluten meal and an untreated control. All materials were applied at a yearly rate of 2 lb N/1000 ft^2 in split applications of 1 lb N/1000 ft^2 on May 22 and August 2, 2000. The fertilizers were applied using cardboard cartons as 'shaker dispensers' to ensure uniform application and were watered in.

The study was monitored weekly for visual quality from June 2 through September 12 (Table 1). Rainfall in October caused a 'greenup' so additional quality data were taken on October 27. Quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable and 1 = worst quality.

Fresh clipping weight data were taken from June 2 through September 12 (Table 2). Because of the extremely dry season, modifications were made so data were taken when sufficient growth had occurred.

Data were analyzed using the Statistical Analysis System (SAS Institute Inc., 1989-1996) and the Analysis of Variance (ANOVA) procedure. Treatment effects on fresh clipping weight and visual quality were tested using Fisher's Least Significant Difference (LSD) test.

There were significant differences in turf quality from June 2 through June 30 (Table 1). During this period, however, some fertilizers did not produce better quality than the untreated control. Between July 7 and August 2 quality was similar for treated and untreated turf. Following the sequential applications on August 2, the quality of the treated turf improved. The quality of turf treated with the all natural fertilizers, Sustane 10-1-2 and corn gluten meal, did not improve as rapidly as turf treated with the other fertilizers. Data from the late 'greenup' in October show that all fertilizers improved quality as compared with the untreated control. The best quality according to the mean data was for turf treated with Sustane 18-1-8 + Fe (with Nutralene & PCSCU).

Fresh clipping weights were similar for treated and untreated turf from June 2 through August 2 (Table 2). On August 16, turf treated with either Sustane 5-2-4 + Fe, Sustane 18-1-8 + Fe (with Nutralene & PCSCU), or Sustane + Novex 12-2-12 had significantly more clippings than the untreated control. On August 29 and September 12, Sustane 18-1-8 + Fe (with Nutralene & PCSCU) and corn gluten meal produced the most clippings.

Table 1. Turf quality[1] of 'Park' Kentucky bluegrass treated for the 2000 Sustane Kentucky Bluegrass Fertility Trial.

	Material	June 2	June 8	June 15	June 23	June 30	July 7	July 14	July 27	Aug 2
1.	Untreated control	6.3	6.0	6.0	6.0	6.0	6.3	6.7	6.3	6.0
2.	Sustane 5-2-4 + Fe, medium grade	8.7	8.0	8.0	7.7	7.3	7.0	7.7	7.3	7.0
3.	Sustane 18-1-8 + Fe, medium grade (includes Nutralene & PCSCU)	8.3	8.3	8.3	8.3	8.0	7.7	7.3	7.3	7.0
4.	Sustane 10-1-2 all organic, medium grade	6.7	7.0	7.0	7.0	7.3	6.7	6.7	6.7	7.0
5.	Sustane + Novex 12-2-12 medium grade	8.3	7.3	7.0	7.0	7.3	7.0	7.3	7.3	7.0
6.	Corn gluten meal	7.0	8.3	9.0	8.3	8.0	7.0	7.7	7.0	7.0
	$LSD_{0.05}$	1.0	1.4	0.4	1.1	0.7	NS	NS	NS	NS

	Material	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Sept 12	Oct 27	Mean
1.	Untreated control	6.0	6.0	6.0	6.0	6.3	5.0	6.0	6.1
2.	Sustane 5-2-4 + Fe, medium grade	8.0	8.0	8.0	7.7	6.3	5.3	7.3	7.5
3.	Sustane 18-1-8 + Fe, medium grade (includes Nutralene & PCSCU)	8.3	8.7	8.7	8.7	7.0	7.0	8.7	8.0
4.	Sustane 10-1-2 all organic, medium grade	6.7	7.0	7.0	7.0	6.7	5.3	7.3	6.8
5.	Sustane + Novex 12-2-12 medium grade	8.0	8.3	8.0	8.0	7.0	5.7	7.3	7.4
6.	Corn gluten meal	6.3	7.3	7.3	8.3	7.0	6.3	8.7	7.5
	$LSD_{0.05}$	1.4	1.1	1.1	1.1	NS	0.9	0.9	0.4

[1]Turf quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst quality.
All products were applied at an annual rate of 2 lb N/1000 ft^2. Initial applications were made on May 22 and sequential on August 2, 2000.
NS = Means are not different at the 0.05 level.

Table 2. Fresh clipping weights[1] of 'Park' Kentucky bluegrass treated for the 2000 Sustane Kentucky Bluegrass Fertility Trial.

	Material	June 2	June 15	June 23	June 30	July 14	Aug 2	Aug 16	Aug 29	Sept 12	Mean
1.	Untreated control	571.0	289.7	142.8	125.5	354.4	208.3	197.6	150.6	101.4	237.9
2.	Sustane 5-2-4 + Fe, medium grade	597.1	414.2	190.4	161.3	430.8	209.7	323.6	205.1	106.2	293.2
3.	Sustane 18-1-8 + Fe, medium grade (includes Nutralene & PCSCU)	735.8	446.1	217.6	178.2	496.9	255.1	372.7	251.7	130.7	342.8
4.	Sustane 10-1-2 all organic, medium grade	572.5	383.8	190.6	155.7	450.0	227.0	252.3	206.2	111.4	283.3
5.	Sustane + Novex 12-2-12 experimental, medium grade	676.0	396.8	181.3	154.5	422.2	221.5	353.4	206.2	99.3	301.3
6.	Corn gluten meal	623.8	440.7	212.9	162.6	479.0	241.5	261.5	240.6	139.2	311.3
	$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	68.0	67.0[2]	23.1	NS

[1]These data are expressed in grams fresh clipping weight.
[2]$P > F = 0.08$
All products were applied at an annual rate of 2 lb N/1000 ft^2. Initial applications were made on May 22 and sequential on August 2, 2000.
NS = Means are not different at the 0.05 level.

2000 Granular Spoon-Feeding Study

Mark J. Howieson and Nick E. Christians

Historically, spoon-feeding fertilizer programs have necessitated the use of liquid fertilizers, as granular materials commonly contain high nitrogen concentrations, which make it difficult to achieve acceptable levels of uniformity applied at low rates. With the advent of new production methods and formulations, however, granular materials have been created that could potentially be utilized in a spoon-feeding regimen. This experiment was performed to determine the feasibility of using granular materials in a spoon-feeding fertilizer program.

The trial was initiated on the 'Penncross' creeping bentgrass (*Agrostis palustris* Huds) USGA green at the Iowa State University Research Station. A randomized complete block design with three replications was utilized to organize the study. Each individual block consisted of ten 5x5 ft treatment plots containing nine fertilizer treatments and an untreated control. The nine products utilized in the study included three Lesco Novex fertilizers with analyses 18-2-18, 19-2-19 and 32-0-0, a 10-2-10 Sustäne and Nutralene experimental material, a 12-2-12 Sustäne and Novex experimental material, a 17-3-17 PPSCU Lesco granular fertilizer, a 19-3-19 Scotts Contec fertilizer, a 14-14-14 UHS material and a liquid fertilizer composed of urea and potassium sulfate (46-0-0 and 0-0-50, respectively). All of the fertilizers were applied at a rate of 0.25-lb of N/1000 ft^2 every ten days. In addition, potassium was applied at a rate of 0.25-lb/1000 ft^2 in the liquid fertilizer treatment. Granular fertilizers were applied to each individual 5x5 ft plot by hand, and in two different directions to ensure uniform coverage. The liquid fertilizer applications were made using a CO_2-powered backpack sprayer calibrated to deliver 3.0 gallons of material/1000 ft^2. The first fertilizer treatment applications were made on May 22 with subsequent applications made at ten-day intervals.

Weekly, visual turf evaluations of color and uniformity were made on a scale from 1 to 9, with 9=best, 6=lowest acceptable and 1=worst. In addition, tissue samples were taken from each treatment plot every 30 days and analyzed for total nitrogen content. The Iowa State University Horticulture Plant Nutrition Laboratory used the Kjeldahl method to determine the total nitrogen content.

Weekly color ratings indicated that, while all three of the Novex materials and the Sustäne and Novex 12-2-12 experimental fertilizer produced high color ratings, the liquid fertilizer consistently resulted in the best color ratings (Table 1). The UHS 14-14-14 fertilizer and the untreated control resulted in the lowest color ratings and the Sustäne and Nutralene 10-2-10, Lesco PPSCU 29-0-0 and Scotts Contec 19-3-19 produced intermediate ratings.

The liquid fertilizer also consistently produced the highest uniformity ratings (Table 2). On the other end of the spectrum, was the UHS 14-14-14 fertilizer. UHS 14-14-14 treatment plots oftentimes exhibited several small green spots of over-stimulated turf, a sign of poor nitrogen distribution characteristics. Only the untreated control received lower uniformity ratings then the UHS 14-14-14 fertilizer. The remaining seven fertilizer materials achieved uniformity ratings that were intermediate between the liquid and UHS 14-14-14 fertilizer treatments. It is acknowledged that the UHS 14-14-14 is not designed for, nor is it recommended by the manufacturer for spoon-feeding. This fertilizer was included in the study only as an example of the poor nitrogen response characteristics resulting when a fertilizer with a large particle size is applied at low rates and in no way is indicative of the quality of UHS products.

Little significant data can be interpreted from the tissue sample total nitrogen content, other than that treatment plots receiving fertilizer application generally resulted in a higher concentration of total nitrogen in tissue samples than the untreated control (Table 3).

Of all of the fertilizer treatments, the liquid material resulted in the highest ratings, both in color and uniformity. Other fertilizer materials, such as the three Novex materials, both of the Sustäne materials and the 19-3-19 Scotts Contec materials, however, also produced high color and uniformity ratings. The greatest difference between the liquid fertilizer treatment and these materials was a slight reduction in uniformity. These materials produced similar color ratings, but did not result in as high a level of uniformity throughout their plots. The UHS 14-14-14 was not designed, nor intended, for use in a spoon-feeding program and did not perform as well as the other products. When applied in larger quantities the UHS 14-14-14 fertilizer produces turf of high quality. The three Novex materials and the Sustäne and Novex 12-2-12 materials resulted in plots of excellent quality, similar in color to the liquid and with only a slight reduction in the uniformity. The Sustäne and Nutralene 10-2-10, LESCO PPSCU 29-0-0 and Scotts Contec 19-3-19 produced plots of intermediate quality. While superior to the UHS 14-14-14 and untreated control treatments, they seemed to lag slightly behind the liquid, Novex and Sustäne and Novex treatments, never quite achieving the same level of visual quality.

Table 1. Color[1] of 'Penncross' creeping bentgrass treated with the following fertilizers.

Treatment	June 7	June 14	June 21	June 28	July 5	July 12	July 19	July 26	Aug 2	Aug 9	Aug 16	Aug 23	Aug 30	Sep 7
Novex 19-2-19	8.33	8.00	8.67	8.67	9.00	8.67	8.67	9.00	9.00	9.00	9.00	9.00	9.00	8.67
Novex 32-0-0	8.67	9.00	8.67	8.00	8.00	8.33	8.33	8.67	8.33	8.33	9.00	9.00	9.00	8.33
Novex 18-2-18	8.33	8.00	8.67	8.00	8.67	8.67	8.67	8.67	8.67	9.00	9.00	9.00	8.67	8.33
Sustäne and Novex 12-2-12	8.33	8.67	8.67	8.67	8.67	8.67	8.33	9.00	9.00	9.00	8.67	9.00	8.67	8.67
Sustäne and Nutralene 10-2-10	8.00	7.33	8.33	8.00	8.00	7.67	7.67	8.00	8.00	8.33	8.33	8.67	8.67	8.67
Liquid[2]	9.00	8.33	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
LESCO PPSCU 29-0-0	7.67	8.00	8.33	7.67	8.00	8.00	8.00	8.00	8.33	8.33	8.33	8.67	8.33	8.00
UHS Signature 14-14-14	7.33	7.00	7.00	7.00	7.00	7.00	7.00	7.00	6.00	7.00	7.00	7.00	7.00	7.00
Scott's Contec 19-3-19	8.33	7.33	7.67	7.33	8.00	7.67	8.00	8.33	7.67	8.67	8.33	8.00	8.00	8.00
Untreated Control	7.00	6.33	6.00	6.00	6.00	6.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
$LSD_{0.05}$	**0.82**	**0.64**	**0.80**	**0.79**	**0.68**	**0.08**	**1.03**	**0.56**	**0.66**	**0.65**	**0.65**	**0.42**	**0.54**	**0.80**

[1] Color ratings were assigned using a 1 to 9 scale, with 9=Best, 6=Lowest Acceptable and 1=Worst.
[2] Comprised of urea (46-0-0) and potassium sulfate (0-0-50)
NS - Means between treatments are not statistically significant per Fischer's LSD test when α=0.05.

Table 2. Uniformity[1] of 'Penncross' creeping bentgrass treated with the following fertilizers.

Treatment	June 7	June 14	June 21	June 28	July 5	July 12	July 19	July 26	Aug 2	Aug 9	Aug 16	Aug 23	Aug 30	Sep 7
Novex 19-2-19	8.00	8.00	8.00	8.00	7.67	8.00	8.00	7.67	8.00	8.00	8.00	8.00	8.00	8.00
Novex 32-0-0	8.00	9.00	8.00	8.00	8.00	8.00	8.00	7.67	8.00	8.00	8.00	8.00	8.00	8.00
Novex 18-2-18	8.00	8.00	8.33	8.00	7.67	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Sustäne and Novex 12-2-12	8.00	8.67	8.00	8.00	7.33	8.00	8.00	8.00	8.00	8.00	8.00	8.33	8.00	8.00
Sustäne and Nutralene 10-2-10	8.00	7.33	8.00	8.00	7.67	7.67	7.67	8.00	8.00	8.00	7.67	7.67	8.00	7.67
Liquid[2]	8.67	8.33	9.00	8.67	9.00	8.67	9.00	9.00	9.00	9.00	9.00	8.67	9.00	9.00
LESCO PPSCU 29-0-0	7.67	8.00	8.00	7.67	7.67	8.00	7.67	7.33	7.67	7.67	8.00	7.67	8.00	8.00
UHS Signature 14-14-14	7.33	7.00	7.00	7.00	7.00	7.00	7.00	5.00	5.00	6.00	7.00	6.33	7.00	7.00
Scott's Contec 19-3-19	8.00	7.33	7.33	8.00	8.00	8.00	8.00	8.00	8.33	8.00	8.00	8.00	8.00	8.00
Untreated Control	7.00	7.00	6.33	6.67	6.67	6.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
$LSD_{0.05}$	**0.50**	**0.60**	**0.57**	**0.54**	**0.76**	**0.46**	**NS**	**0.53**	**0.86**	**0.31**	**0.31**	**0.71**	**0.01**	**0.31**

[1] Uniformity ratings were assigned using a 1 to 9 scale, with 9=Best, 6=Lowest Acceptable and 1=Worst.
[2] Comprised of urea (46-0-0) and potassium sulfate (0-0-50)
NS - Means between treatments are not statistically significant per Fischer's LSD test when α=0.05.

Table 3. Total nitrogen[1] of 'Penncross' creeping bentgrass treated with the following fertilizers.

Treatment	May 22	June 11	July 11	August 10	Sept 9
Novex 19-2-19	2.695	3.2470	2.6148	3.2452	2.0777
Novex 32-0-0	2.695	2.9608	3.0545	2.9072	2.3120
Novex 18-2-18	2.695	2.4842	3.0657	3.3815	2.6253
Sustäne and Novex 12-2-12	2.695	3.0715	3.0908	2.9480	2.5477
Sustäne and Nutralene 10-2-10	2.695	3.0158	2.3878	3.2730	2.6290
Liquid[2]	2.695	3.2572	3.0082	2.8718	2.4662
LESCO PPSCU 29-0-0	2.695	2.9887	3.0067	2.9287	2.2875
UHS Signature 14-14-14	2.695	3.2148	2.7452	3.3113	2.8990
Scott's Contec 19-3-19	2.695	2.0928	3.0300	3.2632	2.7565
Untreated Control	2.695	2.8183	2.5047	2.3628	1.6582
$LSD_{0.05}$	**NS**	**NS**	**NS**	**NS**	**0.4799**

[1] Total Nitrogen was determined using the Kjeldahl method and is reported as the percentage of nitrogen per gram of dry weight of tissue.
[2] Comprised of urea (46-0-0) and potassium sulfate (0-0-50)
NS - Means between treatments are not statistically significant per Fischer's LSD test when α=0.05.

Evaluation of Fungicides for Control of Brown Patch in Creeping Bentgrass - 2000

Mark L. Gleason

Trials were conducted at Veenker Golf Course on the campus of Iowa State University. Fungicides were applied to creeping bentgrass maintained at 5/32-inch cutting height, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1,000 ft^2. The experimental design was a randomized complete block with four replications. All plots measured 4 ft x 5 ft. Fungicide applications began on June 16. Subsequent applications were made on June 23 and 30, and July 6, 14, 21, and 28.

Rainfall and air temperatures were slightly below normal through June and July. Brown patch symptoms were first observed on July 1. *Brown patch* development on untreated check plots – expressed on a 0-5 scale (0=no disease, 1=1-5%, 2=5-10%, 3=10-25%, 4=25-50%, 5=>50%) was light on July 1 and July 8, and to severe on July 24. Most, but not all, fungicide treatments exhibited significantly (LSD, P=0.05) less disease than the untreated check on all dates. *Dollar spot* development on the brown patch plot, also depicted in the Table, was light on July 1 and 8 and moderate on July 24. *NOTE: The dollar spot data is provided for your information. The fungicides selected for the trial were aimed primarily against brown patch.*

No phytotoxicity symptoms were observed during the trials.

BROWN PATCH TRIAL B 2000
WOI Greens, ISU Campus (creeping bentgrass)

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

Trt #	*Company*	*Product*	*Rate/1,000 ft^2*	*Interval (days)*	*Brown patch sev (1-5 scale) 7/1/00*	*Brown patch sev (1-5 scale) 7/8/00*	*Brown patch sev (1-5 scale) 7/24/00*	*Dollar spot sev (%) 7/1/00*	*Dollar spot sev (%) 7/8/00*	*Dollar spot sev (%) 7/24/00*
1	Check	----------	-----------	--------	1.25	0.75	4.75	0.85	3.00	8.50
2	Tomen Agro	TM-41702 40WP	0.10 oz	14	1.50	0.50	5.00	2.60	1.28	1.65
3	Tomen Agro	TM-41702 40WP	0.25 oz	14	1.00	0.25	2.50	0.30	0.00	0.10
4	Tomen Agro	TM-41702 40WP	0.50 oz	14	0.50	0.00	3.75	0.10	0.00	0.03
5	Tomen Agro	TM-41702 40WP	0.70 oz	14	0.50	0.00	4.00	0.05	0.00	0.00
6	Tomen Agro	Daconil Ultrex 82.5WG	1.8 oz	14	0.75	0.50	4.00	0.50	0.40	3.75
7	Tomen Agro	Daconil Ultrex 82.5 WDG	1.8 oz	14	0.00	0.00	0.00	0.30	0.05	3.53
		+ Heritage 50WG	0.2 oz							
8	Tomen Agro	TM-41702 40WP	0.25 oz	14	0.00	0.00	0.00	0.13	0.23	0.15
		+ Heritage 50WG	0.2 oz							
9	Tomen Agro	TM-41702 40WP	0.5 oz	14	0.00	0.00	0.00	0.03	0.00	0.00
		+ Heritage 50WG	0.2 oz							
10	Tomen Agro	TM-430 50SC	0.267 gal/A	14	0.25	0.00	2.75	0.28	1.05	4.50
11	Tomen Agro	TM-430 50SC	0.535 gal/A	14	0.25	0.00	3.00	0.93	2.30	6.00
12	Tomen Agro	TM-430 50SC	0.962 gal/A	14	0.75	0.00	3.50	1.33	1.55	5.50
13	Tomen Agro	Heritage 50WG	0.3 oz	14	0.00	0.00	0.00	3.95	8.25	18.30
14	Tomen Agro	Daconil Ultrex 82.5WDG	3.8 oz	14	0.00	0.00	0.75	0.03	0.00	0.00
15	Novartis	CGA 279202 0.42MEC	1.45 fl oz	14	0.00	0.00	0.00	0.03	0.00	0.00
		+ Banner MAXX 1.3MEC	1.0 fl oz							
16	Novartis	Compass 50WG	0.15 oz	14	0.00	0.00	0.00	0.03	0.00	0.00
		+ Banner MAXX 1.3 MEC	1.0 fl oz							
17	CONFIDENTIAL			7	1.75	1.50	4.75	2.83	6.50	8.75
18	CONFIDENTIAL			7	1.25	0.75	5.00	0.30	3.25	4.75
19	Aventis	Chipco Aliette Signature 80WG	4.0 oz	14	0.00	0.00	1.25	0.00	0.00	0.08
		+ Chipco 26GT 2SC	4.0 fl oz							
20	Aventis	Chipco Aliette Signature 80WG	4.0 oz	14	0.00	0.00	0.00	0.13	0.00	0.00
		+ Daconil Ultrex 82.5WG	3.8 oz							
21	Zeneca	Heritage 50WG	0.4 oz	28	0.25	0.25	0.00	2.40	7.75	18.75
22	Tomen Agro	TM-43801	4.0 oz	14	0.75	0.25	0.50	3.15	7.75	21.25
23*	AgraQuest	Serenade	226 g	7	1.00	0.75	3.50	0.78	5.53	4.50
	LSD (0.05)				**1.01**	**0.65**	**1.38**	**3.10**	**6.46**	**10.45**

Evaluation of Fungicides for Control of Dollar Spot in Penncross Creeping Bentgrass - 2000

Mark L. Gleason

Trials were conducted at the Turfgrass Research Area of Iowa State University's Horticulture Research Farm, Gilbert, IA. Fungicides were applied to Penncross creeping bentgrass maintained at 5/32-inch cutting height, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized complete block with four replications. All plots measured 4 ft x 5 ft.

After inoculation of the entire plot with pathogen-infested rye grain on June 8, spray applications began on June 14. Subsequent applications were made at specified intervals on June 29 and July 12.

Weather during June and July was slightly below normal in temperature and rainfall. Dollar spot symptoms appeared in the plot within 2 weeks after the first spray treatment. Disease development was light on both rating dates (June 29 and July 24). Most, but not all, treatments exhibited significantly less disease than the untreated control on July 24.

DOLLAR SPOT TRIAL – 2000
ISU Horticulture Farm (Penncross creeping bentgrass)

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

Trt #	Company	Product	Rate/1,000 ft^2	Interval (days)	Dollar spot sev (%) 6/29/00	Dollar spot sev (%) 7/24/00
1	Check	----------	-------------	---------	2.75	3.50
2	Bayer	Lynx 45WP	0.56 oz	14	0.08	0.00
3	Bayer	Lynx 45WP	0.28 oz	14	0.53	0.00
		+ Daconil Ultrex 82.5WG	1.82 oz			
4	Rohm and Haas	Eagle 40WSP	0.6 oz	14	0.93	0.00
5	Rohm and Haas	Eagle 40WSP	1.2 oz	28	0.93	0.10
6	Rohm and Haas	Fore Rainshield	8 oz	14	1.55	1.88
7	Rohm and Haas	Fore Rainshield	6 oz	14	2.50	0.00
8	Rohm and Haas	RH-0611 (Manhandle)	10 oz	14	0.13	0.00
9	Novartis	Banner MAXX	2.0 oz	14	0.00	0.00
10	Bayer	Bayleton 25WP	0.5 oz	14	0.80	0.03
11	Aventis	Daconil Ultrex 82.5WG	3.2 oz	14	3.75	2.50
12	Tomen Agro	TM-41702 40WP	0.10 oz	14	3.53	1.53
13	Tomen Agro	TM-41702 40WP	0.25 oz	14	1.80	0.15
14	Tomen Agro	TM-41702 40WP	0.50 oz	14	1.65	0.03
15	Tomen Agro	TM-41702 40WP	0.70 oz	14	0.90	0.03
16	Tomen Agro	Daconil Ultrex 82.5WG	1.8 oz	14	1.30	3.63
17	Tomen Agro	Daconil Ultrex 82.5 WDG	1.8 oz	14	6.78	4.28
		+ Heritage 50WG	0.2 oz			
18	Tomen Agro	TM-41702 40WP	0.25 oz	14	0.40	0.00
		+ Heritage 50WG	0.2 oz			
19	Tomen Agro	TM-41702 40WP	0.5 oz	14	0.20	0.00
20	Tomen Agro	TM-430 50SC	0.267 gal/A	14	3.75	4.75
21	Tomen Agro	TM-430 50SC	0.535 gal/A	14	4.20	3.13
22	Tomen Agro	TM-430 50SC	0.962 gal/A	14	1.63	2.50
23	Tomen Agro	Heritage 50WG	0.3 oz	14	2.00	1.78
24	Tomen Agro	Daconil Ultrex 82.5WDG	3.8 oz	14	2.28	0.80
	LSD (0.05)				**2.71**	**2.83**

1991 Corn Gluten Meal Crabgrass Control Study - Year 10

Barbara R. Bingaman, Troy R. Oster, and Nick E. Christians

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 4.2%, a pH of 6.75, 17 ppm P, and 103 ppm K.

Individual experimental plots are 5 x 5 ft and there are 5 treatments with 3 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 2000, applications were made on April 18.

Turf quality was monitored from April 26 through August 24 (Table 1). Visual turf quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality. Additional quality data were taken on October 27 because above normal temperatures and moderate rainfall resulted in a 'greenup' of the turf.

Weed populations were measured by either counting the number of plants or estimating the percentage cover per individual plot. Crabgrass plants in the 1- to 3-leaf stage were found in late June. Crabgrass count data represent the number of plants per individual plot. The crabgrass plants were large enough by July 14 to count the number per plot. Subsequent counts were made on July 25, August 2, August 8, August 16, August 24, and September 12 (Table 2).

The predominate broadleaf species were dandelion and clover. 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. Dandelion and clover cover data were taken on May 2, June 2, June 15, June 22, June 30, July 7, July 14, July 25, August 2, August 8, August 16, August 24, and September 12. These numbers were converted to represent the percentage reductions as compared with the untreated controls (Tables 3 and 4).

Data were analyzed with the Statistical Analysis System (SAS, Version 6.12) and the Analysis of Variance (ANOVA) procedure. Effects of CGM on bluegrass quality and weed control were examined using Fisher's Least Significant Difference (LSD) means comparison tests.

Spring 2000 was quite warm and dry with above-average temperatures and below-average rainfall. At spring greenup in April, there were slight quality differences between treated and untreated turf but by mid-May, the differences were quite distinct (Table 1). Quality differences between CGM-treated turf and untreated turf were significantly different for the entire season but on some dates, the quality of turf treated at various CGM levels was not different from the untreated control. By mid- to late-July, the quality of all treated and untreated turf began to deteriorate because of the lack of rainfall. Some rainfall improved turf quality by late August. Late season data from October 27 show a definite CGM effect in turf treated with CGM at 60 lb/1000 ft^2 and above.

Treatment with CGM resulted in numeric reductions in crabgrass populations for the entire season but the differences were not statistically significant (Table 2). Mean crabgrass reductions for the entire season were ≥ 98% for all CGM rates except 20 lb/1000 ft^2 (Table 2). In 1997 through 1999, crabgrass counts were higher in turf treated with 20 lb/1000 ft^2 than in untreated turf. In 2000, crabgrass counts were higher in untreated turf and CGM at 20 lb/1000 ft^2 provided a 63.3% reduction in crabgrass (Table 5). Reductions in crabgrass counts for 2000 were higher than in 1997, 1998, and 1999 at all other CGM levels.

Dandelion counts were significantly reduced by CGM at all levels except 20 lb/1000 ft^2 as compared with the untreated control (Table 3). Mean reductions were at least 89.5% for CGM at 40 lb/1000 ft^2 and higher and greater than 96% for CGM at 60 lb/1000 ft^2 and higher. In 2000, CGM at 20 and 40 lb/1000 ft^2 reduced dandelion populations more than in 1997, 1998, and 1999. Dandelion control at the other CGM rates was similar to the levels in 1999 (Table 6).

Percentage clover cover was significantly reduced in turf treated with CGM as compared with the untreated controls for the entire season except July 14 (Table 4). Mean reductions in clover cover were > 79% as compared with the untreated controls in turf treated with CGM at all levels except 20 lb (Table 7). Clover control in 2000 was similar to that in previous years except at 20 lb/1000 ft^2. At this rate, the level of clover control was higher than in 1998 and 1999.

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	April 26	May 2	May 10	May 17	May 23	June 2	June 8	June 15
1	Untreated control	0	0	5.3	5.0	5.3	5.3	6.0	5.3	5.3	5.7
2	Corn gluten meal	20	2	6.0	5.3	6.3	6.7	6.3	6.7	6.7	6.7
3	Corn gluten meal	40	4	6.0	6.0	6.7	7.3	7.0	7.7	7.3	7.7
4	Corn gluten meal	60	6	5.7	6.7	7.0	7.7	7.7	8.3	7.7	8.0
5	Corn gluten meal	80	8	6.0	6.0	8.0	8.3	8.0	8.7	8.3	7.7
6	Corn gluten meal	100	10	7.0	7.0	7.7	8.0	8.3	8.3	8.0	8.7
7	Corn gluten meal	120	12	7.0	7.3	8.0	8.7	8.3	8.0	8.0	8.0
	$LSD_{0.05}$			1.1	0.9	1.2	1.1	0.7	1.0	1.1	0.8

	Material	lbs CGM /1000 ft^2	June 22	June 30	July 7	July 14	July 25	Aug 2	Aug 16	Aug 24	Oct 27	Mean
1	Untreated control	0	6.0	5.3	5.3	6.0	6.3	6.3	6.3	6.3	5.3	5.7
2	Corn gluten meal	20	6.7	6.7	6.0	6.3	6.3	6.0	6.7	6.3	5.7	6.4
3	Corn gluten meal	40	8.0	8.0	7.0	6.7	6.7	6.7	7.0	7.0	6.7	7.0
4	Corn gluten meal	60	8.7	8.7	7.3	7.0	7.0	7.0	7.0	7.3	8.0	7.4
5	Corn gluten meal	80	9.0	9.0	8.7	7.0	7.0	6.7	7.0	7.7	8.0	7.7
6	Corn gluten meal	100	9.0	9.0	8.7	7.7	7.7	7.7	7.7	8.3	9.0	8.0
7	Corn gluten meal	120	9.0	9.0	8.7	8.3	7.7	8.0	7.3	8.0	8.7	8.1
	$LSD_{0.05}$		0.6	0.7	0.7	1.0	0.8	0.9	0.7	0.8	0.8	0.4

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.

Table 2. Percentage crabgrass count reductions[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	July 14	July 25	August 2	August 8	August 16	August 24	Sept 12	Mean
1	Untreated control	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Corn gluten meal	20	71.8	58.2	59.6	68.2	61.6	66.3	72.5	63.3
3	Corn gluten meal	40	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	Corn gluten meal	60	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
5	Corn gluten meal	80	89.1	100.0	100.0	97.7	100.0	100.0	100.0	98.1
6	Corn gluten meal	100	95.5	100.0	100.0	97.0	100.0	100.0	100.0	98.9
7	Corn gluten meal	120	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$LSD_{0.05}$		NS	NS	NS	NS	NS	NS	NS	NS

[1]These values represent percentage reductions in the number of crabgrass plants per plot as compared to the untreated control.
NS = means are not significantly different at the 0.05 level.

Table 3. Percentage dandelion count reductions[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study.

	Material	lbs CGM /1000 ft^2	May 2	June 2	June 15	June 22	June 30	July 7
1	Untreated control	0	0.0	0.0	0.0	0.0	0.0	0.0
2	Corn gluten meal	20	31.5	11.6	44.3	35.1	43.9	4.9
3	Corn gluten meal	40	81.9	91.8	84.6	88.8	93.6	87.3
4	Corn gluten meal	60	91.7	97.3	96.2	97.0	96.8	97.5
5	Corn gluten meal	80	94.7	97.3	95.2	95.5	96.0	97.5
6	Corn gluten meal	100	93.2	97.3	98.1	94.0	96.0	96.2
7	Corn gluten meal	120	100.0	98.2	99.0	98.5	99.2	100.0
	$LSD_{0.05}$		48.9	48.6	42.6	55.2	52.8	65.5

	Material	lbs CGM /1000 ft^2	July 14	July 25	Aug 2	Aug 8	Aug 24	Sept 12	Mean
1	Untreated control	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Corn gluten meal	20	34.0	8.0	7.8	43.0	25.3	48.0	33.2
3	Corn gluten meal	40	92.8	93.4	90.8	92.2	92.0	88.6	89.5
4	Corn gluten meal	60	99.0	98.4	93.9	96.0	97.3	96.2	96.3
5	Corn gluten meal	80	100.0	93.4	90.8	96.0	97.3	97.5	96.0
6	Corn gluten meal	100	96.9	96.7	96.9	100.0	98.7	96.2	96.5
7	Corn gluten meal	120	100.0	100.0	96.9	100.0	98.7	100.0	99.2
	$LSD_{0.05}$		57.5	52.3	58.5	52.6	44.4	44.2	48.5

[1]These values represent percentage reductions in the number of dandelion plants per plot as compared to the untreated control.

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

	Material	lbs CGM /1000 ft²	May 2	June 2	June 15	June 22	June 30	July 7
1	Untreated control	0	0.0	0.0	0.0	0.0	0.0	0.0
2	Corn gluten meal	20	78.5	70.8	70.0	64.3	63.1	69.5
3	Corn gluten meal	40	85.7	87.5	81.8	81.4	73.9	84.5
4	Corn gluten meal	60	64.2	66.7	73.5	82.2	78.3	80.0
5	Corn gluten meal	80	98.6	82.5	93.5	95.0	95.2	94.5
6	Corn gluten meal	100	92.8	91.7	93.5	89.3	93.0	93.5
7	Corn gluten meal	120	92.8	95.8	85.3	92.9	88.7	94.5
	$LSD_{0.05}$		18.4	43.1	27.0	36.1	32.7	24.7

	Material	lbs CGM /1000 ft²	July 14	July 25	Aug 2	Aug 8	Aug 24	Sept 12	Mean
1	Untreated control	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Corn gluten meal	20	60.0	57.1	64.7	70.8	84.0	76.4	68.6
3	Corn gluten meal	40	80.0	74.3	74.1	78.3	78.4	63.5	79.0
4	Corn gluten meal	60	70.0	85.7	82.3	90.8	84.0	82.3	78.7
5	Corn gluten meal	80	79.0	93.3	94.6	100.0	99.2	98.8	93.9
6	Corn gluten meal	100	84.0	85.7	82.3	90.8	88.0	88.2	90.2
7	Corn gluten meal	120	89.0	90.5	92.9	95.0	95.2	92.9	91.8
	$LSD_{0.05}$		61.6	40.7	58.3	40.5	33.2	51.1	27.7

[1]These values represent percentage reductions in the clover cover per plot as compared to the untreated control.

Table 5. Comparisons of the mean crabgrass count reductions[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study for 1991 through 2000.

	Material	lbs CGM /1000 ft²	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	Untreated control	0	0	0	0	0	0	0	0	0	0	0
2	Corn gluten meal	20	58	85	91	70	36	15	0	0	0	63
3	Corn gluten meal	40	86	98	98	97	88	97	79	91	99	100
4	Corn gluten meal	60	97	98	93	98	93	85	82	92	99	100
5	Corn gluten meal	80	87	93	93	87	75	69	54	56	95	98
6	Corn gluten meal	100	79	94	95	86	75	87	79	83	96	99
7	Corn gluten meal	120	97	100	100	98	84	97	82	76	97	100
	$LSD_{0.05}$		26	44	31	39	40	60	NS	NS	68	NS

[1]These values represent reductions in crabgrass plants per plot as compared with the untreated controls.
NS = means are not significantly different at the 0.05 level.

Table 6. Comparisons of the mean percentage dandelion count reductions[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study for 1994 through 2000.

	Material	lbs CGM /1000 ft²	1994	1995	1996	1997	1998	1999	2000
1	Untreated control	0	0	0	0	0	0	0	0
2	Corn gluten meal	20	71	49	33	24	5	1	33
3	Corn gluten meal	40	100	77	75	76	72	77	90
4	Corn gluten meal	60	100	89	79	84	83	92	96
5	Corn gluten meal	80	98	96	95	93	91	94	96
6	Corn gluten meal	100	100	98	96	88	89	97	97
7	Corn gluten meal	120	100	100	100	97	97	99	99
	$LSD_{0.05}$		50	65	60	61	37	25	49

[1]These values represent the reductions in dandelion counts per plot as compared with the untreated controls.

Table 7. Comparisons of the mean percentage clover cover reductions[1] in Kentucky bluegrass treated in the 1991 Corn Gluten Meal Weed Control Study for 1994 through 2000.

	Material	lbs CGM /1000 ft²	1994	1995	1996	1997	1998	1999	2000
1	Untreated control	0	0	0	0	0	0	0	0
2	Corn gluten meal	20	81	56	71	63	27	40	69
3	Corn gluten meal	40	90	64	82	87	84	82	79
4	Corn gluten meal	60	98	93	93	95	85	82	79
5	Corn gluten meal	80	100	76	90	95	93	92	94
6	Corn gluten meal	100	94	84	92	76	90	90	90
7	Corn gluten meal	120	90	93	93	93	90	88	92
	$LSD_{0.05}$		NS	48	29	26	21	27	28

[1]These values represent reductions in percentage clover cover per plot as compared with the untreated controls.
NS = means are not significantly different at the 0.05 level.

1995 Corn Gluten Meal Rate Weed Control Study - Year 6

Barbara R. Bingaman and Nick E. Christians

Corn gluten meal (CGM) is being screened for efficacy as a natural product herbicide in turf. This long-term study was begun in 1995 at the Iowa State University Horticulture Research Station north of Ames, IA. The experimental is in established 'Ram 1' Kentucky bluegrass. The soil is a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with an organic matter content of 4.2%, a pH of 6.85, 6 ppm P, and 120 ppm K. Prior to treatment in 1995, the percentage broadleaf weed cover within the study perimeter exceeded 50%.

Individual experimental plots are 10 x 10 ft with three replications. The experimental design is a randomized complete block design. 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 of 10 lb/1000 ft^2, and a single application of 40 lb/1000 ft^2 are included with an untreated control.

Initial applications for 2000 were made on April 18 before crabgrass germination. It was warm (65°) and sunny with a SW wind and the temperatures remained warm with only 0.13" rainfall for the remainder of April. The second application of treatment 2 was made on June 19 under sunny skies with a high temperature of 83° and a SW wind. The third application of treatment 2 and the second of treatments 3 and 4 were made on July 27. It was 86°, sunny and dry. There was no rain until August 4 and only 2.43" of rainfall for the entire month of August. The final application of treatment 2 was made on September 5. Temperatures remained above normal for the entire month of September and rainfall amounts were below normal.

The experimental plot was checked for phytotoxicity after each treatment. Turf quality data were taken weekly from spring greenup on April 26 through September 12. Visual quality was measured using a 9 to 1 scale with 9 = best and 6 = lowest acceptable, and 1 = worst quality (Table 1).

Crabgrass was first observed on June 27. Population data were recorded on July 14, July 25, August 2, August 8, August 16, August 24, August 29 and September 12 (Tables 2 and 3).

Broadleaf data were taken from April 26 through September 12. Dandelion and clover were the predominate broadleaf weed species within the experimental plot. Dandelion populations were measured counting the number of plants per plot Tables 4 and 5). Clover infestations were estimated by determining the percentage area in each individual plot covered by clover (Tables 6 and 7).

Data were analyzed with the Statistical Analysis System (SAS, Version 6.12) and the Analysis of Variance (ANOVA) procedure. Means comparisons were made with Fisher's Least Significant Difference test (LSD). Crabgrass, clover, and dandelion population data were converted to percentage reductions as compared with the untreated controls (Tables 3, 5, and 7).

The 2000 growing season was extremely dry. As a result there was less response to the nitrogen in the corn gluten meal than in previous years. Supplemental irrigation was used as required to keep the bluegrass from entering dormancy. In spite of the growing conditions, turf quality was significantly better in bluegrass treated with CGM than in the untreated control for most of the season (Table 1). By September 5, the turf was dormant but rainfall in late October resulted in significant greening so additional data were taken on October 27. On this date, turfgrass that received sequential applications (treatments 2, 3, and 4) had better quality than the untreated control and treated turf that received only an initial CGM treatment. Mean visual quality for the entire season was better for bluegrass treated with CGM than the untreated grass.

Crabgrass populations were statistically reduced by CGM at all application rates as compared with the untreated control from August 2 through September 12 (Table 2). The best crabgrass control was in turf treated with split applications of 20 lb CGM but this level of control was not statistically different from the other CGM treatments. Mean reductions in crabgrass counts were > 85% in all CGM treated turf as compared with the untreated control (Table 3).

In 2000, crabgrass counts in CGM treated turf were statistically lower than in the untreated control (Table 8). Crabgrass control was better at all CGM treatment levels than in previous years. Four sequential applications of 10 lb CGM provided 85% reduction in crabgrass counts in 2000 but only 28, 0, 48, 42, and 67% in 1995, 1996, 1997, 1998, and 1999, respectively. Split applications of 20 lb CGM provided 100% crabgrass reductions in 2000 as compared to 45, 33, 50, 86, and 95% in 1995, 1996, 1997, 1998, and 1999, respectively. A single 40 lb CGM application decreased crabgrass counts by 92% in 2000.

Dandelion numbers were significantly lower in all CGM treated turf as compared with the untreated controls for the entire 2000 season (Table 4). The highest level of dandelion control (88.4% reduction) was in turf treated with split applications of 20 lb CGM but this control was not different from the other CGM treatments. Mean crabgrass reductions were similar for all CGM treatments and ranged from 77.8 to 88.4% (Table 5). Dandelion control was equal to or slightly better than control in previous years (Table 10). Dandelion reductions were 48, 50, 66, and 69% in 1996, 1997, 1998, and 1999, respectively as compared with 78% in 2000.

Clover cover fluctuated throughout the season because of the dry conditions. Clover populations were significantly lower in all CGM treated turf than in untreated on all data collection dates except May 2 and June 2 (Table 6). Mean reductions for all CGM treatments were > 94% and all were statistically different from the untreated controls (Table 7). Clover control in 2000 was approximately equal to control in 1999. At all CGM treatment levels, control was better than control in 1996, 1997 and 1998 (Table 11).

Table 1. Visual quality[1] of Kentucky bluegrass treated with corn gluten meal in the 1995 Corn Gluten Meal Rate Weed Control Study (April 26 - October 27).

	Material	Rate lb product/1000 ft^2	April 26	May 2	May 10	May 17	May 23	June 2	June 8	June 15	June 22	June 30
1.	Untreated control	NA	6.0	5.7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	8.7	8.7	7.7	7.7	7.3	7.3	7.0	7.0	7.0	7.0
3.	Corn gluten meal	20 fb 20	7.0	8.3	7.7	8.3	8.3	7.7	7.7	7.7	7.7	8.0
4.	Corn gluten meal	30 fb 10	6.7	7.7	7.3	8.3	9.0	8.3	8.7	8.3	8.7	8.7
5.	Corn gluten meal	40	6.3	6.7	8.0	8.3	9.0	8.7	8.7	8.7	9.0	8.3
	$LSD_{0.05}$		0.8	1.1	NS	1.0	0.7	1.1	0.8	0.9	0.7	0.8

	Material	Rate lb product/1000 ft^2	July 7	July 14	July 25	Aug 2	Aug 8	Aug 24	Aug 29	Sept 5	Oct 27	Mean
1.	Untreated control	NA	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	8.0	8.7	7.7	8.3	8.3	8.0	8.0	7.0	8.3	7.8
3.	Corn gluten meal	20 fb 20	7.3	7.0	7.3	7.0	7.3	8.3	8.0	7.0	8.3	7.7
4.	Corn gluten meal	30 fb 10	8.0	8.0	7.7	8.3	7.7	8.3	8.7	7.0	8.0	8.1
5.	Corn gluten meal	40	8.7	8.3	8.3	8.7	8.0	7.3	7.7	7.0	7.3	8.1
	$LSD_{0.05}$		1.2	0.8	NS	1.2	1.6[2]	1.3	1.5	NS	1.6	0.5

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
[2]For these data P > F=0.07
Initial applications were made on April 18. Sequential applications of treatment 2 were made on June 29, July 27, and September 5. Sequential applications of treatments 3 & 4 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 with corn gluten meal in the 1995 Corn Gluten Meal Rate Weed Control Study.

	Material	Rate lb product/1000 ft^2	July 14	July 25	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 12	Mean
1.	Untreated control	NA	4.3	13.0	15.7	47.0	59.0	39.3	55.0	34.0	33.4
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	5.7	1.7	1.7	10.0	6.0	5.0	5.0	4.3	4.9
3.	Corn gluten meal	20 fb 20	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.2
4.	Corn gluten meal	30 fb 10	0.0	0.0	0.0	4.3	2.7	3.3	5.3	3.3	2.4
5.	Corn gluten meal	40	1.0	0.3	2.0	3.0	3.3	2.3	4.3	5.3	2.7
	$LSD_{0.05}$		NS	NS	12.6[2]	36.2[2]	38.9	24.8	36.0	16.7	21.0

[1]These values represent the number of crabgrass plants per plot.
[2]For these data P > F = 0.08.
NS = means are not significantly different at the 0.05 level.

Table 3. Crabgrass count reductions[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 14	July 25	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 12	Mean
1.	Untreated control	NA	0.0	0.0	0.	0.0	0.0	0.0	0.0	0.0	0.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	0.0	87.2	89.4	78.7	89.8	87.3	90.9	87.3	85.3
3.	Corn gluten meal	20 fb 20	100.0	100.0	100.0	99.3	99.4	99.2	99.4	100.0	99.5
4.	Corn gluten meal	30 fb 10	100.0	100.0	100.0	90.8	95.5	91.5	90.3	90.2	92.9
5.	Corn gluten meal	40	76.7	97.4	87.3	93.6	94.4	94.1	92.1	84.3	91.9
	$LSD_{0.05}$		NS	NS	80.5[2]	77.0[2]	65.9	63.1	65.4	49.1	63.0

[1]These values represent the percentage reduction in crabgrass plants per plot as compared with the untreated control.
[2]For these data $P > F = 0.08$.
NS = means are not significantly different at the 0.05 level.

Table 4. 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	April 26	May 2	May 17	June 2	June 15	June 22	June 30	July 7
1.	Untreated control	NA	65.7	71.3	61.3	58.3	59.3	78.3	68.7	68.3
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	17.0	19.7	9.3	16.3	15.7	23.0	17.3	17.7
3.	Corn gluten meal	20 fb 20	10.7	11.3	8.3	9.0	7.7	9.0	7.7	6.3
4.	Corn gluten meal	30 fb 10	18.0	21.3	11.7	16.3	13.7	18.0	13.0	13.7
5.	Corn gluten meal	40	18.0	17.7	11.3	15.0	13.7	24.3	14.7	14.3
	$LSD_{0.05}$		32.4	31.1	29.8	25.2	21.6	34.0	25.3	24.1

	Material	Rate lb product/1000 ft^2	July 14	July 25	Aug 2	Aug 8	Aug 24	Aug 29	Sept 12	Mean
1.	Untreated control	NA	61.7	68.0	68.7	67.3	54.3	48.7	56.3	63.8
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	9.7	14.7	14.7	10.3	8.0	9.0	9.7	14.1
3.	Corn gluten meal	20 fb 20	6.3	6.0	7.3	5.3	5.0	3.7	7.0	7.4
4.	Corn gluten meal	30 fb 10	6.7	11.0	12.0	7.0	7.3	8.7	12.0	12.7
5.	Corn gluten meal	40	9.0	11.3	12.3	9.3	9.0	10.7	12.7	13.6
	$LSD_{0.05}$		17.5	28.9	27.5	28.3	16.5	26.1	20.9	24.4

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

Table 5. Dandelion count reductions[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	April 26	May 2	May 17	June 2	June 15	June 22	June 30	July 7
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	74.1	72.4	84.8	72.0	73.6	70.6	74.8	74.1
3.	Corn gluten meal	20 fb 20	83.8	84.1	86.4	84.6	87.1	88.5	88.8	90.7
4.	Corn gluten meal	30 fb 10	72.6	70.1	81.0	72.0	77.0	77.0	81.1	80.0
5.	Corn gluten meal	40	72.6	78.2	81.5	74.3	77.0	68.9	78.7	79.0
	$LSD_{0.05}$		49.3	43.6	48.7	43.3	36.4	43.4	36.8	35.3

	Material	Rate lb product/1000 ft^2	July 14	July 25	Aug 2	Aug 8	Aug 24	Aug 29	Sept 12	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	84.3	78.4	78.7	84.6	85.3	81.5	82.8	77.8
3.	Corn gluten meal	20 fb 20	89.7	91.2	89.3	92.1	90.8	92.5	87.6	88.4
4.	Corn gluten meal	30 fb 10	89.2	83.8	82.5	89.6	86.5	82.2	78.7	80.1
5.	Corn gluten meal	40	85.4	83.3	82.0	86.1	83.5	78.1	77.5	78.8
	$LSD_{0.05}$		28.4	42.4	40.0	42.1	30.3	53.5	37.1	38.3

[1]These values represent the percentage reductions in dandelion counts per plot as compared with the untreated control.

Table 6. 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 ft²	April 26	May 2	May 17	June 2	June 15	June 22	June 30	July 7
1.	Untreated control	NA	0.7	3.7	30.0	13.7	13.3	13.3	30.0	38.3
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	0.0	0.3	0.0	0.7	0.0	0.7	0.3	0.3
3.	Corn gluten meal	20 fb 20	0.0	1.7	0.0	0.3	0.7	0.0	0.7	2.0
4.	Corn gluten meal	30 fb 10	0.0	0.3	0.0	0.3	0.3	0.3	0.7	2.3
5.	Corn gluten meal	40	0.0	0.3	2.0	0.7	0.3	0.7	1.0	0.3
	$LSD_{0.05}$		0.5	NS	16.6	NS	8.6	8.7	14.9	16.8

	Material	Rate lb product/1000 ft²	July 14	July 25	Aug 2	Aug 8	Aug 24	Aug 29	Sept 12	Mean
1.	Untreated control	NA	15.0	21.7	31.7	12.7	38.3	33.3	35.0	22.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	0.3	0.0	1.7	1.7	0.7	0.3	1.7	0.6
3.	Corn gluten meal	20 fb 20	0.3	0.3	0.7	1.0	0.0	0.7	2.0	0.7
4.	Corn gluten meal	30 fb 10	2.0	2.0	0.7	0.6	1.7	2.0	3.3	1.1
5.	Corn gluten meal	40	0.7	0.3	2.0	1.7	3.3	1.7	1.7	1.1
	$LSD_{0.05}$		7.4	8.6	7.0	7.8	10.4	12.9	8.1	6.9

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

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

Table 7. Percentage clover cover reductions[1] in Kentucky bluegrass treated with corn gluten meal in the 1995 Corn Gluten Meal Rate Weed Control Study.

	Material	Rate lb product/1000 ft²	April 26	May 2	May 17	June 2	June 15	June 22	June 30	July 7
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	100.0	91.0	100.0	95.1	100.0	95.0	98.9	99.1
3.	Corn gluten meal	20 fb 20	100.0	55.0	100.0	97.6	95.0	100.0	97.8	94.8
4.	Corn gluten meal	30 fb 10	100.0	91.0	100.0	97.6	97.5	97.5	97.8	93.9
5.	Corn gluten meal	40	100.0	91.0	93.3	95.1	97.5	95.0	96.7	99.1
	$LSD_{0.05}$		69.5	NS	55.2	NS	64.9	65.6	49.7	43.8

	Material	Rate lb product/1000 ft²	July 14	July 25	Aug 2	Aug 8	Aug 24	Aug 29	Sept 12	Mean
1.	Untreated control	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	97.8	100.0	94.7	84.9	98.3	99.0	95.2	97.4
3.	Corn gluten meal	20 fb 20	97.8	98.5	97.9	92.1	100.0	98.0	94.3	96.9
4.	Corn gluten meal	30 fb 10	86.7	90.8	97.9	97.4	95.6	94.0	90.5	95.1
5.	Corn gluten meal	40	95.6	98.5	93.7	86.9	91.3	95.0	95.2	94.9
	$LSD_{0.05}$		49.5	39.5	22.0	61.7	27.0	38.7	23.3	31.3

[1]These figures represent the percentage reductions in clover cover per plot as compared to the untreated control.

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

Table 8. Crabgrass counts[1] in Kentucky bluegrass treated in the 1995 Corn Gluten Meal Rate Weed Control Study for 1996 through 2000.

	Material	Rate lb product/1000 ft²	1996	1997	1998	1999	2000
1.	Untreated control	NA	4	36	19	102	33
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	7	19	11	33	5
3.	Corn gluten meal	20 fb 20	3	18	3	5	0
4.	Corn gluten meal	30 fb 10	1	14	4	17	2
5.	Corn gluten meal	40	5	37	9	10	3
	$LSD_{0.05}$		NS	NS	NS	NS	21

[1]These values represent the number of crabgrass plants per plot.

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

Table 9. Percentage crabgrass count reductions[1] in Kentucky bluegrass treated in the 1995 Corn Gluten Meal Rate Weed Control Study for 1995 through 2000.

	Material	Rate lb product/1000 ft^2	1995	1996	1997	1998	1999	2000
1.	Untreated control	NA	0	0	0	0	0	0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	28	0	48	42	67	85
3.	Corn gluten meal	20 fb 20	45	33	50	86	95	100
4.	Corn gluten meal	30 fb 10	44	67	61	78	86	93
5.	Corn gluten meal	40	54	0	0	53	90	92
	$LSD_{0.05}$		NS	NS	NS	NS	NS	63

[1]These values represent the percentage reductions in crabgrass plants per plot as compared with the untreated controls.
NS = means are not significantly different at the 0.05 level.

Table 10. Percentage dandelion count reductions[1] in Kentucky bluegrass treated in the 1995 Corn Gluten Meal Rate Weed Control Study for 1996 through 2000.

	Material	Rate lb product/1000 ft^2	1996	1997	1998	1999	2000
1.	Untreated control	NA	0	0	0	0	0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	48	50	66	69	78
3.	Corn gluten meal	20 fb 20	50	60	59	85	88
4.	Corn gluten meal	30 fb 10	28	28	69	76	80
5.	Corn gluten meal	40	50	58	62	79	79
	$LSD_{0.05}$		NS	NS	21	38	38

[1]These figures represent the percentage reductions in dandelion counts per plot as compared to the untreated control.
NS = means are not significantly different at the 0.05 level.

Table 11. Percentage clover cover reductions[1] in Kentucky bluegrass treated in the 1995 Corn Gluten Meal Rate Weed Control Study for 1996 through 2000.

	Material	Rate lb product/1000 ft^2	1996	1997	1998	1999	2000
1.	Untreated control	NA	0	0	0	0	0
2.	Corn gluten meal	10 fb 10 fb 10 fb 10	45	65	74	96	97
3.	Corn gluten meal	20 fb 20	69	82	72	99	97
4.	Corn gluten meal	30 fb 10	90	92	64	99	95
5.	Corn gluten meal	40	92	83	93	100	95
	$LSD_{0.05}$		NS	58	49	71	31

[1]These figures represent the percentage reductions in clover cover per plot as compared to the untreated control.
NS = means are not significantly different at the 0.05 level.

1999 Corn Gluten Meal/Urea Crabgrass Control Study - Year 2

Barbara R. Bingaman and Nick E. Christians

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 2000, initial applications of all urea and CGM treatments were made on April 21. Sequential applications of 1 lb N/1000 ft^2 were made on July 7, July 27, and September 5. The second applications of 2 lb N/1000 ft^2 for urea and CGM (Treatment 3 and 5) were made on July 27.

Turf quality was monitored from May 2 through September 12 (Table 1). Visual turf quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality. Additional quality data were taken on October 27 because above-normal temperatures and moderate rainfall resulted in a 'greenup' of the turf.

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

	Material	Number of applications	May 2	May 10	May 17	May 23	June 2	June 8	June 15	June 22	June 30	July 7
1	Untreated control	NA	7.0	6.7	6.7	6.7	6.0	6.3	6.0	6.0	6.7	7.0
2	Corn gluten meal	4	6.3	6.3	6.7	7.3	7.3	7.7	7.7	7.3	7.3	7.7
3	Corn gluten meal	2	6.0	6.7	6.7	7.0	8.0	8.0	8.3	8.7	8.0	8.0
4	Urea (46-0-0)	4	7.0	8.7	7.7	7.7	6.7	7.3	7.0	7.3	7.3	7.7
5	Urea (46-0-0)	2	7.7	8.3	7.7	8.3	8.0	7.7	8.3	8.3	8.7	8.3
	$LSD_{0.05}$		1.1[2]	1.2	NS	NS	1.0	1.0	1.3	0.9	NS	NS

	Material	Number of applications	July 14	July 25	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Sept 5	Sept 12	Oct 27	Mean
1	Untreated control	NA	6.3	7.0	6.3	6.3	6.0	6.0	6.0	6.3	4.7	5.0	6.3
2	Corn gluten meal	4	8.0	8.0	9.0	8.0	7.7	8.0	9.0	7.0	5.0	8.3	7.5
3	Corn gluten meal	2	7.0	7.3	7.0	7.3	7.7	7.7	7.7	7.3	5.0	6.7	7.3
4	Urea (46-0-0)	4	8.7	8.3	8.3	8.7	8.3	8.0	8.3	6.7	4.3	8.0	7.6
5	Urea (46-0-0)	2	6.7	7.0	7.0	7.7	8.7	8.7	7.7	6.7	5.0	6.7	7.7
	$LSD_{0.05}$		1.2	NS	1.8	1.4	0.6	1.1	0.8	NS	NS	1.2	0.6

[1]Visual quality was assessed using a 9 to 1 scale with 9 = best, 6 = lowest acceptable, and 1 = worst turf quality.
[2]These data are significantly different at the 0.06 level.
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.

Crabgrass plants in the 1- to 3-leaf stage were found in late June. Crabgrass data represent the number of plants per individual plot. Crabgrass counts were made on August 16, August 29, and September 12 (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 on April 26, May 17 (clover only), June 22, July 25, August 2, August 29, and September 12. 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, Version 6.12) and the Analysis of Variance (ANOVA) procedure. Effects of CGM and urea on bluegrass quality and weed control were examined using Fisher's Least Significant Difference (LSD) means comparison tests.

The 2000 growing season was quite warm and dry with above-average temperatures and below-average rainfall from April through September. Supplemental irrigation was required throughout the season to keep the bluegrass in good condition.

In early May, bluegrass quality was improved on grass treated with urea. Response to CGM treatment was slower but the quality of urea and CGM treated turf was similar through June and better than the untreated control. As expected, quality improved following the sequential treatments of CGM and urea in July and August. By September, the high temperatures and below-normal rainfall caused the bluegrass to enter dormancy. Rainfall and moderate temperatures in October caused a late season greenup and on October 27, grass treated with CGM or urea on September 5 (Treatments 2 and 4) had significantly better quality than grass not receiving treatments on that date. Mean data for the entire season show that all CGM and urea-treated grass had better quality than untreated.

There were no statistically significant differences in weed populations between the treated and untreated bluegrass. Crabgrass populations were low in all plots (Table 2). There were fewer crabgrass plants in untreated bluegrass than in treated because of increased competition from broadleaf weeds in the untreated grass. Dandelion populations were similar in treated and untreated bluegrass (Table 3). There were slight numerical differences but none were statistically different. Percentage clover cover also was similar in the treated and untreated bluegrass (Table 4). Through August 29, clover cover was numerically greater in bluegrass treated with CGM and urea in split applications of 2 lb/1000 ft^2 than in the untreated controls.

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	Aug 16	Aug 29	Sept 12	Mean
1	Untreated control	NA	NA	1.7	1.0	1.0	1.2
2	Corn gluten meal	4	4	5.0	2.7	2.7	3.4
3	Corn gluten meal	4	2	3.0	2.7	4.7	3.4
4	Urea (46-0-0)	4	4	6.3	3.3	1.7	3.8
5	Urea (46-0-0)	4	2	1.3	2.3	2.3	2.0
	$LSD_{0.05}$			NS	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	April 26	June 22	July 25	Aug 2	Aug 29	Sept 12	Mean
1	Untreated control	NA	20.0	23.0	20.3	21.3	23.0	26.7	22.4
2	Corn gluten meal	4	30.0	31.7	20.0	20.7	23.0	24.0	24.9
3	Corn gluten meal	2	21.7	29.7	17.7	19.7	17.7	20.3	21.1
4	Urea (46-0-0)	4	20.0	21.0	21.7	15.0	20.0	19.7	19.6
5	Urea (46-0-0)	2	18.3	21.7	17.3	19.3	22.7	25.0	20.7
	$LSD_{0.05}$		NS	NS	NS	NS	NS	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	April 26	May 17	June 22	July 25	Aug 2	Aug 29	Sept 12	Mean
1	Untreated control	NA	6.7	31.7	41.7	33.3	26.7	23.3	16.7	25.7
2	Corn gluten meal	4	17.3	36.7	28.7	33.3	33.3	30.0	16.7	28.0
3	Corn gluten meal	2	23.3	46.7	55.0	43.3	36.7	31.7	15.0	36.0
4	Urea (46-0-0)	4	18.7	36.7	33.7	33.3	20.0	13.7	6.7	23.2
5	Urea (46-0-0)	2	28.7	45.0	45.0	38.3	31.7	31.7	16.7	33.9
	$LSD_{0.05}$		NS	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.

2000-2001 Arbuscular Mychorrhizal *Poa annua* Control Study

Barbara R. Bingaman and Nick E. Christians

This study was designed to screen arbuscular mychorrhizal material for effectiveness in improving the quality of creeping bentgrass and in reducing the growth of *Poa annua*. The experimental plot was on an established 'Penncross' creeping bentgrass sand-based practice green at Veenker Golf Course in Ames, IA with a relatively uniform *Poa annua* infestation in spring 2000. The experimental design was a randomized complete block with three replications. Individual plot size was 5 x 5 ft. The mychorrhizal material was applied at 0, 20, and 40 g/m^2 timed to correspond with core aerification of the green.

A Ryan GA30 aerifier was used with 5/8" cores spaced 2-1/2 x 3". Following removal of the cores, sand topdressing was added and smoothed across each 5 x 5' individual plot. The mychorrhizal material was added to the sand in the treated plots and raked into the cores. The whole plot was then overseeded with 'Penncross' bentgrass at 1 lb/1000 ft^2. The plot was watered under the normal watering schedule for the practice green.

The mychorrizal material was applied in the spring on May 16 when the *Poa annua* infestation was 70 to 80%. Percentage *Poa annua* cover data were taken throughout the season (Table 1) and because no differences among treatments were found, the material was reapplied on September 20, 2000. Turf quality of the bentgrass also was monitored and no differences were noted (Table 2). Additional percentage *Poa annua* cover data were collected fall 2000 until the bentgrass was dormant and no differences were found. The study was surveyed April and May 2001 and no differences in *Poa annua* cover and visual quality were found between treated and untreated bentgrass.

Table 1. Percentage *Poa annua* cover[1] in creeping bentgrass treated for the 2000 Arbuscular Mychorrhizal *Poa annua* Control Study.

	Material	Rate g/m^2	May 16	July 27	Aug 18	Sept 7	Sept 20	Oct 12	Mean
1.	Untreated control	NA	78.3	48.3	25.0	25.0	20.0	23.3	36.7
2.	Arbuscular mychorrhizal	20	68.3	50.0	26.7	25.0	23.3	23.3	36.1
3.	Arbuscular mychorrhizal	40	76.7	46.7	26.7	26.7	23.3	25.0	37.5
	$LSD_{0.05}$		7.6	NS	NS	NS	NS	NS	NS

[1]These data represent the percentage area per plot covered by *Poa annua*.
Initial application of the mychorrhizal material was on May 16 and the material was reapplied on September 20, 2000.

Table 2. Visual quality[1] of creeping bentgrass treated for the 2000 Arbuscular Mychorrhizal *Poa annua* Control Study.

	Material	Rate g/m^2	May 16	July 27	August 18	Sept 7	Sept 20	Oct 12	Mean
1.	Untreated control	NA	9	9	9	9	9	9	9
2.	Arbuscular mychorrhizal	20	9	9	9	9	9	9	9
3.	Arbuscular mychorrhizal	40	9	9	9	9	9	9	9
	$LSD_{0.05}$		--	--	--	--	--	--	--

[1]These data were not applicable for means comparisons such as LSD.

1999 Kentucky Bluegrass Cultivar/Crabgrass Control Study

Barbara R. Bingaman and Nick E. Christians

This was the first year of an ongoing study that was established in 1999 to determine if 'Moonlight' Kentucky bluegrass could suppress crabgrass populations. The 1998 Preemergence Annual Weed Control Study was conducted in an area of 'Moonlight' that was seeded in the fall of 1997. At the time of treatment in April 1998, approximately 50% of the area was covered by 'Moonlight'. This cultivar quickly filled in the bare areas and at the end of the season, the plot was covered by very dense turf with no crabgrass even in the untreated areas. There were no additional herbicide treatments on this plot so it was speculated that this cultivar either may possess some allelopathic properties or could be particularly aggressive in the establishment year.

This study is being conducted at the Iowa State University Horticulture Research Station. Individual 5 x 5 ft plots in a prepared bare soil area were seeded with 'Moonlight', 'Kenblue', 'Blue Moon', 'Rugby II', and 'Park' Kentucky bluegrass at 1.5 lb/1000 ft^2 on October 5, 1999. The soil in this area is a Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll) with an 1.9% organic matter, pH of 7.25, 35 ppm P, and 62 ppm K. Seeding was done by hand for each individual plot to ensure uniform distribution. Each individual plot was carefully raked following seeding. Three replications were performed. No herbicides were applied prior to or following seeding.

Turf establishment was measured by estimating the percentage area per plot covered by turf. Percentage turfgrass cover data were taken from April 26 through August 29 (Table 1). Crabgrass populations were determined by estimating the percentage area per plot covered by crabgrass. Crabgrass data were taken on July 21, August 2, August 8, August 16, August 24, and August 29 (Table 2).

Data were analyzed using the Statistical Analysis System (SAS Institute Inc., 1996) and the Analysis of Variance (ANOVA) procedure. Means comparisons were made using Fisher's Least Significant Difference (LSD) test.

There were significant differences throughout the season in percentage turf cover (Table 1). 'Kenblue' and 'Park' established quicker than 'Moonlight', 'Blue Moon', and 'Rugby II'. By August 29, 'Moonlight' covered 51.7% of its plots while 'Kenblue' and 'Park' covered 85 and 76.7%, respectively.

Because there was less competition from turf plants, higher numbers of crabgrass plants were able to establish in plots with less turf cover (Table 2). There was significantly less crabgrass in 'Kenblue' than in 'Moonlight' plots for the entire season.

These establishment year data show that 'Moonlight' did not exhibit a more aggressive growth than the other tested cultivars. In addition, there was no indication of allelopathic properties for 'Moonlight'. The 2000 growing season was particularly dry and warm and it is possible that these climatic factors may have affected the establishment of the cultivars. Additional data for both turfgrass and crabgrass cover will be taken in 2001.

Table 1. Percentage turfgrass cover[1] in the 1999 Kentucky Bluegrass Crabgrass trial.

	Material	April 26	May 2	May 10	May 17	May 23	May 31	June 8	June 15	June 22
1.	Moonlight	13.3	10.0	13.3	16.7	16.7	20.0	25.0	25.0	28.3
2.	Kenblue	33.3	38.3	43.3	53.3	50.0	60.0	61.7	60.0	60.0
3.	Blue Moon	13.3	11.7	16.7	15.0	21.7	26.7	28.3	28.3	31.7
4.	Rugby II	15.0	15.0	21.7	23.3	20.0	30.0	38.3	28.3	38.3
5.	Park	28.3	36.7	36.7	43.3	36.7	48.3	53.3	50.0	46.7
	$LSD_{0.05}$	12.3	16.1	15.0	11.8	8.4	8.8	24.4	9.2	14.1

	Material	June 30	July 7	June 21	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Mean
1.	Moonlight	26.7	26.7	40.0	40.0	48.3	60.0	50.0	51.7	30.1
2.	Kenblue	70.0	75.0	76.7	81.7	83.3	86.7	86.7	85.0	65.0
3.	Blue Moon	33.3	33.3	46.7	50.0	58.3	61.7	61.7	53.3	34.8
4.	Rugby II	30.0	40.0	50.0	55.0	58.3	71.7	65.0	61.7	38.9
5.	Park	56.7	56.7	68.3	75.0	75.0	76.7	78.3	76.7	55.5
	$LSD_{0.05}$	17.7	16.9	20.0	23.6	21.0	19.3	19.7	20.3	11.7

[1]These figures represent the percentage area per plot covered by the desirable turfgrass species.

Table 2. Percentage crabgrass cover in the 1999 Kentucky Bluegrass Crabgrass trial.

	Material	July 21	Aug 2	Aug 8	Aug 16	Aug 24	Aug 29	Mean
1.	Moonlight	51.7	55.0	53.3	55.0	58.3	60.0	55.6
2.	Kenblue	23.3	18.3	20.0	23.3	25.0	25.0	22.5
3.	Blue Moon	43.3	38.3	36.7	50.0	43.3	45.0	42.8
4.	Rugby II	50.0	50.0	50.0	53.3	45.0	53.3	50.3
5.	Park	33.3	26.7	26.7	31.7	31.7	31.7	30.3
	$LSD_{0.05}$	19.1	21.6	19.4	20.8	17.4	16.6	16.8

[1]These figures represent the percentage area per plot covered by crabgrass.

Thermal Properties of Sand-based Rootzone Media Modified with Inorganic Soil Amendments

Deying Li, Nick E. Christians, and David D. Minner

Thermal properties of the root-zone media are very important physical factors that affect the energy balance and temperature distribution in the root-zone. Understanding the pattern of soil temperature is desired in helping make decisions as to when and how to apply water, fertilizers, chemicals, and soil amendments. The information also is important for predicting infestations such as weeds, diseases, and insect pests. The reason for this is that plant growth, fate of chemicals, and microbial population all are temperature dependent. Many of the turf management practices can affect the temperature and energy regime in turfgrass rootzones. The primary objective of this study, therefore, was to understand the thermal properties of sand-based media modified by inorganic amendments.

Materials And Methods

Treatments included the inorganic amendments calcined clay (Profile, Profile Products LLC, Buffalo Grove, IL.), calcined diatomaceous earth (CDE) (Axis, Eagle-Picher Minerals, Inc., Reno, NV), Zeolite clinoptilolite (ZeoponiX, Inc. Louisville, CO.), and polymer coated clay with a kelp material incorporated on the exterior of the polymer coating (PCC) (Bio-flex-a-clay, True Pitch Inc., Altoona, IA). Reed-sedge peat (Dakota Peat and Blenders, Grand Forks, ND) was used as a control because peat is commonly used as an organic amendment in golf greens. Inorganic soil amendments were oven-dried at 105° C for 24 hr before use. Fifteen percent of each inorganic amendment was mixed with 85% of sand (v/v). The mixtures were then filled into brass rings measuring 5.45 cm in diam. and 6 cm in length with a double cheesecloth layer attached to the bottom with a rubber band. The mixtures in the ring were then compacted following the USGA specifications. Each material had three replications. The sand mixtures were saturated from the bottom with water for 24 hr before they were set on a suction table. The suction table is a Plexiglas box with a sandwich of 10 cm of fine glass beads between the wire mesh at the bottom and a layer of block paper on the top, and a hanging water column connected to the bottom of the glass beads through a hole at the bottom of the box. Zero, -10, -25, -40, and -60 cm pressure head was applied to the suction table by positioning the outlet level of the hanging water column to the respective depth with reference to the top surface of the glass beads. At each pressure head, the volumetric water content and thermal properties were measured by a method and instrument established by Ren, Noborio, and Horton (1999). The volumetric water content was also measured at each pressure head by weighing the materials in the rings and weighing the oven-dried materials at the end of the experiment.

A field study was conducted at the Horticulture Research Station 15 miles to the north of Ames, Iowa. The green consisted of a 30 cm sand root zone placed over a 10 cm gravel blanket. No intermediate layer was used between the sand and the gravel blanket. A network of 10 cm diameter drain lines was trenched into the gravel blanket at 4.6 m intervals. The top 15 cm of sand from each plot was removed and combined with 5% peat on a volumetric basis. The field study consisted of a control with peat only and the 4 soil amendment treatments added at 10% on a volumetric basis. The treatments included calcined clay, CDE, ceramic, and PCC. The mixture was replaced on the plot area and allowed to settle during the winter. Treatments were replicated three times in a randomized complete block design with plots measuring 5 m^2. The area was seeded with 73 kg of 'Crenshaw' creeping bentgrass ha^{-1} on 13 May 1997. Fertilizer was applied at seeding to supply 50, 90, and 80 kg ha^{-1} of N, P and K, respectively. The treatment mixtures also were applied as topdressing once a year after establishment.

Copper-Constant thermal couples will be placed at the surface, 2.5, and 15 cm below the surface of the plots, respectively. The thermocouples will then be multiplexed to a data logger and the temperature will be recorded every 15 minutes. Water content of the profile will be measured with a TDR.

Thermal diffusivity (α) will be estimated for the 15 cm depth by the phase angle lag method (Horton, 1983). The calculated values will be compared with that measured in the laboratory and used to predict numerically the soil temperature in the 15 cm profile.

Results And Discussion

Volumetric water content (θ_v) measured by TDR and using Topp et al. (1980) equation gave under-estimations compared to the value of oven-dried method across all the materials used in this study. We pooled all the K_a data except PCC, a swell-and-shrink material, and did a linear regression to calibrate the equation. The θ_v values calculated based on the new equation were shown in Fig 1 and 2. The calibrated data of water content agree with the oven-dried data, suggesting that the discrepancy was due to the probe constant rather than chemical properties of the materials.

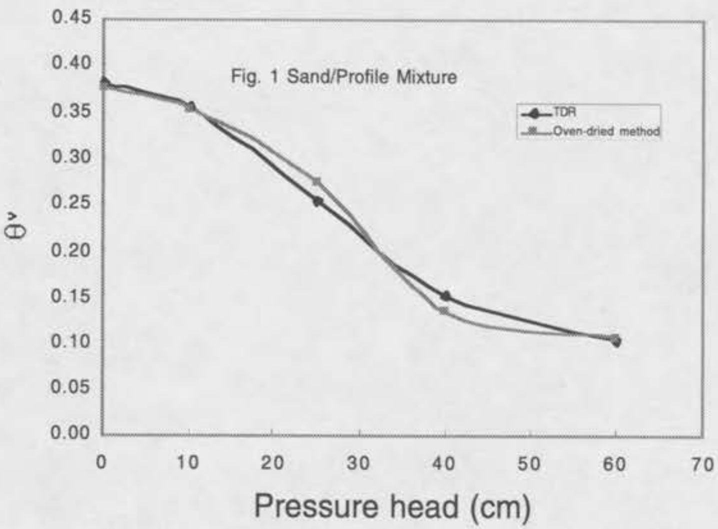
The water release curve for all the mixtures is shown in Fig. 3. It is obvious that all the inorganic materials increased the water holding capacity of the sand mixtures especially PCC and CDE.

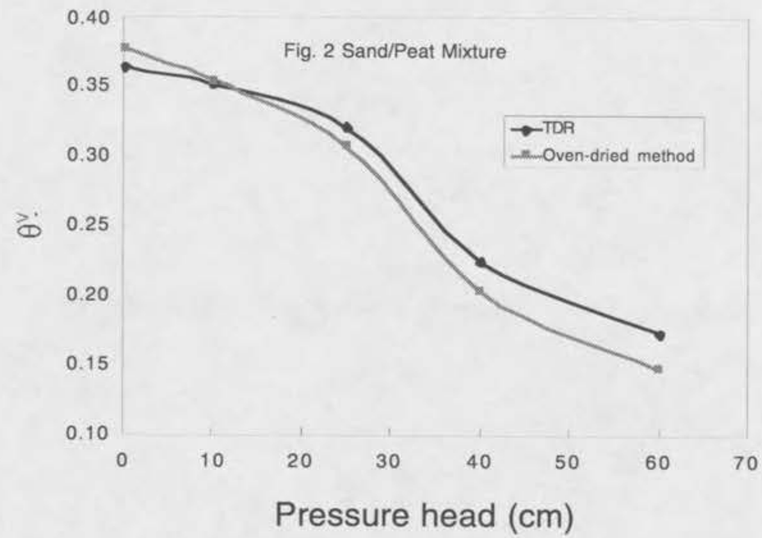
The volumetric heat capacity measured at different water content agrees well with that calculated from volumetric water content and heat capacity of dry materials (Fig. 4 and 5). Notice, however, that the volumetric heat capacity was under estimated for sand over a large range of water content (Fig. 6).

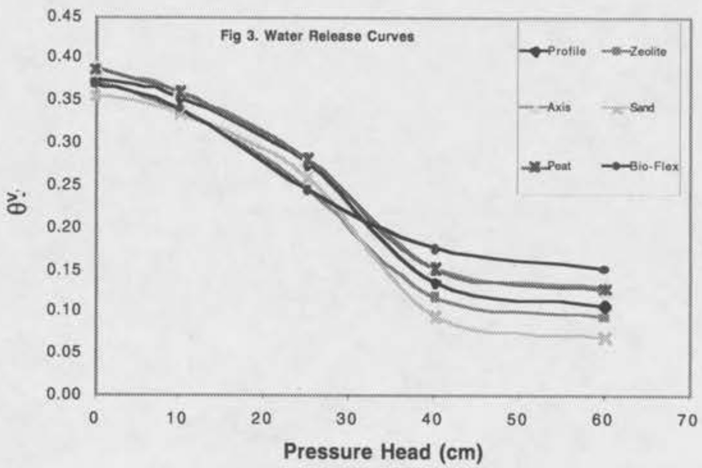
The α values measured by the thermal-time domain reflectometry probe at different water content are shown in Fig. 7 and 8.

Conclusion

The study showed clearly that inorganic soil amendments commonly used in golf course root-zone media can affect the soil thermal properties and cause different temperature status. Such temperature changes may be predicted based on the surface temperature and water content measurement. Furthermore, the thermal diffusivity curve established in the laboratory may be referenced for the prediction. The impact of the temperature difference caused by inorganic soil amendments on turfgrass growth, microbial activities, and chemical degradation in the rootzone needs further study.







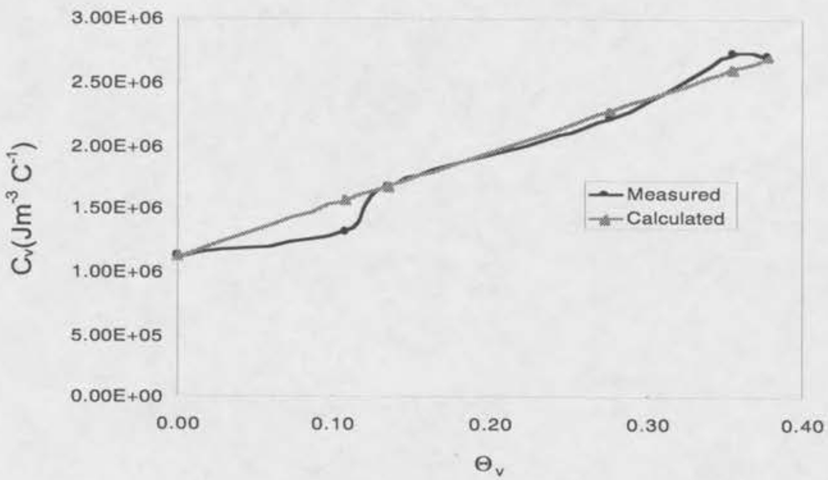


Fig. 4 Volumetric Heat Capacity of Profile Sand Mixture

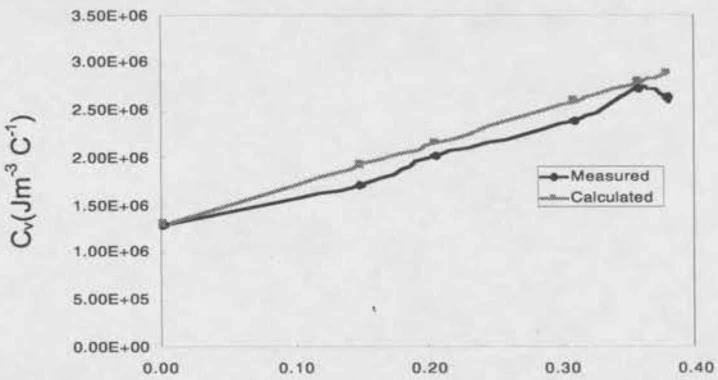


Fig. 5 Volumetric Heat Capacity of Sand Peat Mixture

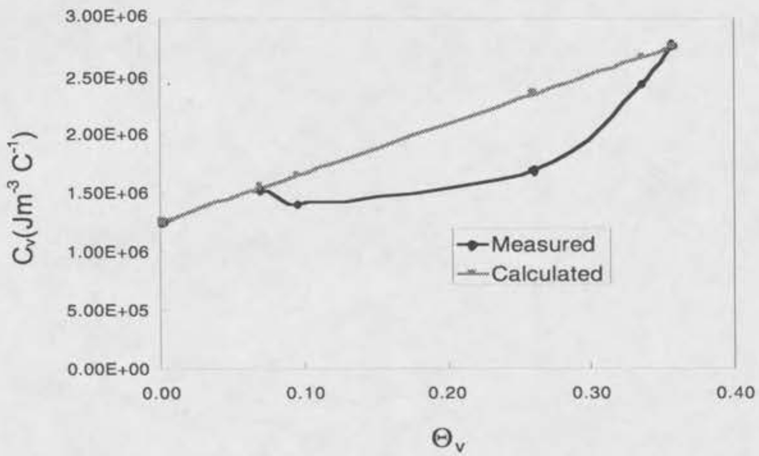


Fig. 6 Volumetric Heat Capacity of Sand

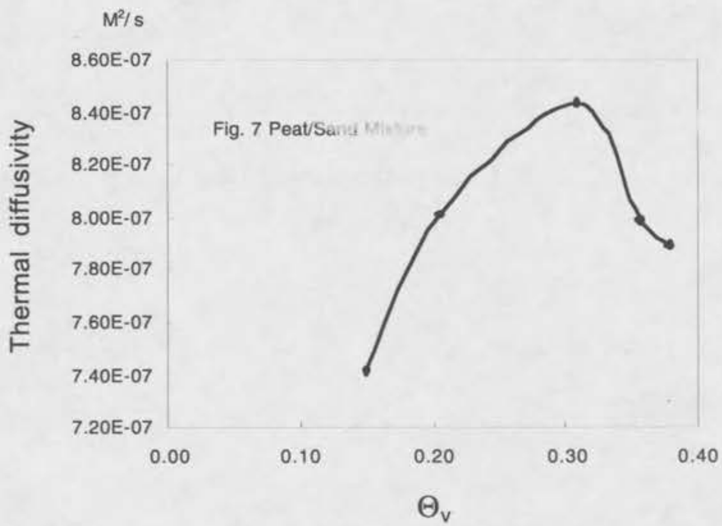


Fig. 7 Peat/Sand Mixture

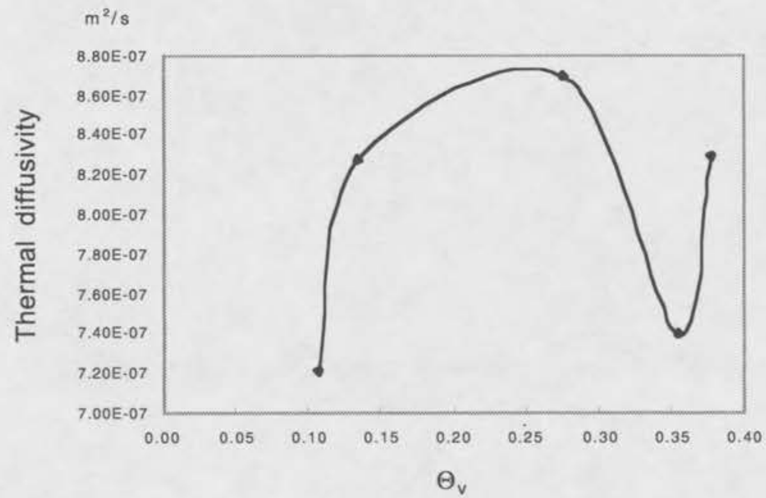


Fig. 8 Profile/Sand Mixture

Managing Bentgrass Stress on Putting Green Slopes –2000 Report

David D. Minner, Deying Li, and Nick E. Christians

A sloped research green (SRG) was constructed and established with 'Crenshaw' creeping bentgrass at the Horticulture Research Center, Ames, IA in July 1997 to evaluate bentgrass management under difficult and variable growing conditions. The objective of this project was to evaluate organic and inorganic amendments applied as topdressing. Iowa State University, Iowa Golf Course Superintendents Association and the Golf Course Superintendents Association of America fund this project. The SRG was erected to simulate the undulating topography that occurs on many putting greens - as opposed to a typical flat research green. The sand based portion of the SRG is 100 ft by 40 ft by 1 ft. The subgrade, gravel blanket, and sand rootzone all follow the same contour. The 12-inch sand rootzone contains no amendment and is positioned over a 4-inch gravel blanket with 4-inch drain lines. The SRG has four distinct micro-environments that will be simultaneously evaluated for nine different treatments. The micro-environments are: 1) cool slope - this 7.0% slope faces north and should be cooler in the summer but also colder in the winter, 2) knoll - the crown of the green is expected to have the most potential for scalping and dry spot injury in the summer, 3) hot slope - this 6.6% slope faces south and is expected to generate high surface temperatures, and 4) swale - the low portion of the green is expected to have excessively wet conditions. No amendments, organic or inorganic, were used to construct the 12-inch rootzone. The sand has a pH of 8.2 and is calcareous. Topdressing treatments will be routinely applied to 40 ft. by 6 ft. plots. The long and narrow plots are situated so that each treatment covers all four distinct micro-environments on the green. The five topdressing treatments are listed in Table 1. The inorganic amendments Axis, Profile, Zeolite, and Zeopro are being compared with the organic amendment sand plus Dakota Peat. Axis is a diatomaceous earth, Profile is a porous ceramic clay, Zeolite is an aluminosilicate mineral, and Zeopro is a nutrient loaded Zeolite. All of the products claim to improve cation exchange, and nutrient and water holding capacity.

Materials and Methods

Samples for soil nutrition were collected from three locations of the slope green; north slope, knoll, and swale. Since the topdressing materials were located in the top 2.5 cm, samples were collected from two different depths, 0 to 3.35 cm and 3.35 cm to 12.5 cm. Living roots were picked out and the sample before air drying and screening through a 2 mm sieve. Soil fertility analysis was conducted by Harris Lab, Lincoln, Nebraska. Light and frequent applications of topdressing treatments have resulted in 3.35 cm (1.32 inches) of topdressing being applied from 1998 through September 2000. From May through September 1.25 cm (.5 inches) of topdressing was applied from each treatment. Zeopro is a loaded amendment that contains additional N, P, and K. Table 1 shows the total amount of nutrition applied for each treatment in 2000. Similar to 1999, in 2000 water was restricted to impose artificial water stress. The first water stress was from 9 to 18 August 2000 and the second water stress was from 1 to 6 September 2000. Turf color and percent of the plot area covered with dry patches was evaluated every two weeks. Volumetric water content was measured at the 5 cm, 10 cm, and 20 cm depth before and after water stress.

Results

The topdressing treatments applied in this study are listed in Table 2. A program of light and frequent application of topdressing has resulted in a total topdressing dept of 3.35 cm (1.32 inches) applied from 1998 through September 2000.

Table 3 shows the turf color ratings and percent of area covered with dry patches during the spring and summer of 2000. The first water stress period occurred from 9 to 18 August 2000 by completely restricting irrigation. A second water stress period occurred from 1 to 6 September 2000 while maximum air temperature was above 32°C from September 1-3. In 2000 none of the inorganic topdressing treatments had an effect on the amount of dry patch compared to the sand/peat control. The only notable difference occurred in the spring of 2000 when Zeopro had significantly more dry patch (46%) compared to Zeolite (13.3%) and Axis (9%).

Table 4 shows the soil nutrient levels in the spring of 2000. Zeolite and Zeopro resulted in very high levels of K and twice as much Na compared to the control, Axis, and Profile treatments.

The realistic conditions of the SRG have demonstrated treatment differences that may not have been apparent on a flat research green. In 2000 the knoll area showed differences in dry patch that were not apparent on the north slope, south slope, and swale area of the green with respect to the amount of visible dry patch. It is important to simulate realistic conditions whenever possible in our turfgrass research programs.

Table 1. Amount of inorganic amendments and fertilizers applied in 2000.

	Amount put on	N	P	K	Mowing height
	Eq. Inches	lbs/1000 sq ft			inches
Control(Dakota Peat)	0.32	2.37	0.38	1.19	0.125
Axis	0.32	2.37	0.38	1.19	0.125
Profile	0.32	2.37	0.38	1.19	0.125
Zeolite	0.32	2.37	0.38	1.19	0.125
Zeopro	0.32	2.67	0.45	2.69	0.125

Table 2. Organic and inorganic amendments applied to the sloped putting green as topdressing treatments.

	Topdressing Treatment	Calcareous Sand	Inorganic Amendment	Organic Amendment
			% by volume	
1	sand + Dakota peat (control)	90	-	10
2	sand + Axis	80	20	-
3	sand + Profile	80	20	-
4	sand + Zeolite	80	20	-
5	sand + Zeopro	80	20	-

Table 3. Turfgrass color and occurance of dry patch and in 2000 for four microenvironments of a sloped green treated with inorganic amendments.

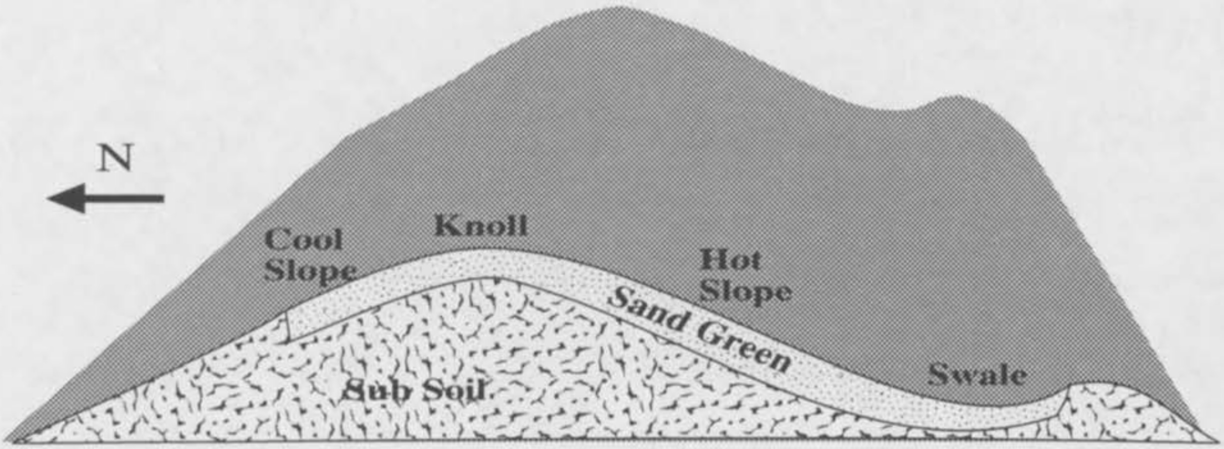
	Color 0-9 scale, 9 = best			% area covered with dry patches		
Treatment	spring	After 1st water stress	After 2nd water stress	spring	After 1st water stress	After 2nd water stress
	3-6-00	8-18-00	9-6-00	3-6-00	8-18-00	9-6-00
		Cool area			Cool area	
Control	5.7	7.0	6.0	0.0	0.0	1.0
Axis	6.0	6.7	6.0	2.0	0.0	1.7
Profile	4.7	7.0	6.0	0.7	0.0	2.3
Zeolite	5.3	6.3	6.0	1.7	2.0	3.0
Zeopro	5.3	7.0	6.0	2.0	0.0	1.3
LSD$_{0.05}$	NS	NS	NS	NS	NS	NS
		Knoll area			Knoll area	
Control	3.0	7.0	6.0	25.0	2.7	21.0
Axis	4.0	6.3	6.0	9.0	8.0	36.3
Profile	4.3	6.7	6.0	25.0	2.0	24.3
Zeolite	4.7	6.3	6.0	13.3	5.0	34.3
Zeopro	3.0	6.3	6.0	46.7	5.7	24.0
LSD$_{0.05}$	NS	NS	NS	30.0	NS	
		Hot area			Hot area	
Control	7.0	6.7	7.0	5.3	0.3	26.7
Axis	6.7	6.7	7.0	14.0	0.0	27.0
Profile	7.0	6.3	7.0	20.0	0.0	20.3
Zeolite	7.0	7.0	7.0	14.0	0.3	27.0
Zeopro	6.7	6.7	7.0	21.7	0.0	18.0
LSD$_{0.05}$	NS	NS	NS	NS	NS	NS
		Swale area			Swale area	
Control	7.7	7.0	7.0	0.0	3.3	7.0
Axis	7.7	7.0	7.0	0.3	0.3	5.3
Profile	7.7	7.0	7.0	0.0	0.7	4.3
Zeolite	7.7	7.0	7.0	0.3	0.2	1.3
Zeopro	7.7	7.0	7.0	0.3	0.3	5.3
LSD$_{0.05}$	NS	NS	NS	NS	NS	NS

Table 4. Spring 2000 soil nutrition in the surface topdressing zone (0-3.35 cm) compared to the lower portion of the original rootzone sand (3.35-12.5 cm).

	P		K		Na	
	T[1]	B[2]	T	B	T	B
Treatment			G Kg^{-1}			
Peat (control)	9.0	9.3	132.3	52.7	12.7	8.7
Axis	13.3	8.3	129.3	62.3	17.0	9.7
Profile	10.7	8.3	167.3	60.3	15.7	8.3
Zeolite	9.3	9.0	405.0	86.0	32.7	13.0
Zeopro	9.3	8.7	557.7	87.7	47.7	14.3
$LSD_{0.05}$	2.7	NS	158.0	NS	11.6	NS

[1]T = Top 3.35 cm of rootzone profile containing amendment treatments.
[2]B = Bottom (3.35-12.5 cm) of rootzone containing original sand construction.

Fig 1. Sloped Research



Quantitative Evaluation of Sand Shape and Roundness and Their Potential Effect on Stability of Sand-based Athletic Fields

Deying Li, David D. Minner, and Nick E. Christians

Playing surface stability of a sports field has often been a problem for sand-based media. Many factors, such as particle size, particle-size gradation, shape/roundness, water content, and plant materials may affect the surface stability. The relative importance of these factors is not clearly understood. The primary objective of this study was to evaluate shape and roundness of sand particles quantitatively so that they can be compared with other factors in terms of their contributions to the surface stability.

Materials and Methods

Mason sand, concrete sand, silica sand, crushed brick, and crushed stone were used in this study to cover a wide range of shapes and roundness based on visual observation. In order to test the methodology, we used glass beads as the base line. We also crushed glass to make a very angular sample. All materials were washed free of silt- and clay-sized particles and oven dried before use in evaluation. A roughness index (I_r) was proposed as the ratio of the particle surface area to the area of a sphere of the same volume. Surface areas were determined by coating the materials with aniline blue dye and measuring the light absorption of the dye washed off the particle surface. Angle at repose, coefficient of uniformity (CU), coefficient of friction (CF), and two-dimensional image analysis were also included in the evaluation of the materials.

Results

Principle component analysis indicated that only three factors — angle at repose, CU, and I_r,— are necessary to explain 98.5% of the variance contributing to surface stability of sand-based media. The results of this study showed that shape and roundness of sand grains could be expressed by I_r, which is sensitive and convenient for picking out the differences between materials. Two-dimensional image analysis, which returns form factor, roundness, and aspect ratio, provided insufficient separation of the diverse sands evaluated in this study.

Table 1. A comparison of the effectiveness of different factors for bulk samples in predicting sand stability.

Materials	Angle at repose	CU	CF	I_r	Form factor	Roundness	Aspect ratio
	degree						
Glass bead	23.4	6.44	0.60	1.00	0.89	0.95	1.06
Crushed glass	39.7	6.44	0.91	6.68	0.65	0.63	1.69
DF-1000	38.5	3.38	0.95	4.31	0.77	0.73	1.41
Florida superior 220	35.4	2.73	0.81	1.90	0.77	0.71	1.45
Silica sand	36.2	2.89	0.89	1.53	0.79	0.77	1.33
Crushed brick	38.9	131.25	1.04	-	0.74	0.70	1.50
Bunker white	36.2	3.27	0.85	2.11	0.77	0.73	1.42
Best 535	35.0	1.90	0.98	2.61	0.80	0.73	1.40
Sidley Pro/Angle	38.2	3.89	0.96	2.38	0.75	0.71	1.45
Construction sand	34.1	2.43	0.82	1.61	0.79	0.75	1.37
Concrete sand	34.9	2.67	0.91	1.58	0.79	0.75	1.36

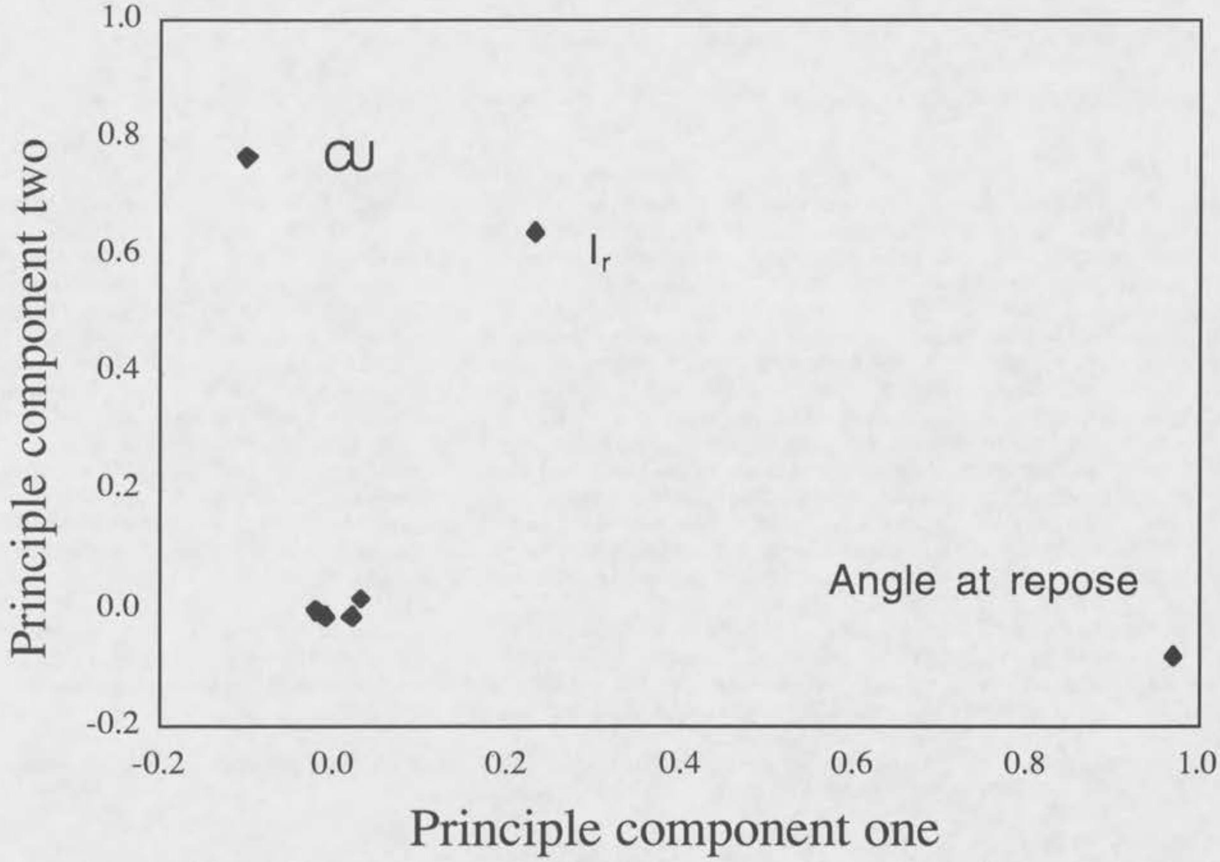


Fig.1. Principle component analysis based on the angle of repose, I_r, coefficient of friction, form factor, roundness, and aspect ratio of bulk samples.

Modifying Athletic Field Soils with Calcined Clay and Tillage

David D. Minner and Deying Li

The objective of this study was to evaluate calcined clay in a tilling renovation process and its effects on turfgrass growth.

A study was initiated in November 1997 at an Ames High School football practice field in Ames, Iowa, to evaluate calcined clay (Turface® MVP) in a tilled renovation procedure. The soil contained 54% sand, 7% silt, and 39% clay. The 15,750 sq. ft. experimental plot area was arranged between the hash marks and the goal lines. Each individual plot measured 15 ft. by 50 ft. and was centered on every yard line marker (goal line, 5, 10, 15, 20, etc.) (Table 1) such that 7.5 ft. was on one side of the yard line and 7.5 ft. was on the other side of the same yard line. Treatments consisted of calcined clay at 1 ton/1000 sq. ft., calcined clay at 2 tons/1000 sq. ft., and an untreated control (Table 2). Treatments were randomized in each block and replicated seven times. Each replication was 45 ft. by 50 ft. with three treatments. Treatments were topdressed at their respective rate and tilled into the top 4 inches of soil with a Rotadairon (Bryan Wood, Commercial Turf & Tractor). Each large plot was individually dragged with a steel mat to prepare the surface for seeding and prevent cross contamination of treatments. The study area was initially seeded in May 1998 at 3 lb/1000 sq. ft. with a bluegrass blend containing equal parts of 'Nublue', 'Limousine', and 'Touchdown'. The field was primarily used for autumn football practice (September through November) and spring soccer (April and May). As a routine maintenance practice, the field was hollow cored on 3-inch centers with 0.75-inch hollow tines each year in late November. The test area was drill seeded with perennial ryegrass at 10 lbs/1000 sq. ft. on 9 June 1999 and 5 June 2000. Each year the plot area located between the hash marks on the field began with a minimum of 90 percent turf cover in September and by May the following year there was exposed soil with less than 50 percent turf cover.

Three undisturbed soil columns measuring 5.2 cm in diameter and 6.1 cm in length were collected from the top 6.5 cm of each treatment for four blocks in November 1999 and September 2000. Saturated hydraulic conductivity (K_{sat}) at 34 cm constant water head and soil bulk density were determined for undisturbed field samples (Klute and Dirksen, 1986). The K_{sat} data were converted to values at 20°C before statistical analysis.

Means were separated using Fisher's least significant difference (LSD) in the analysis of variance (ANOVA) procedure in the Statistical Analysis System (SAS version 6.12, SAS Institute, 1996).

Bulk Density (BD)
Bulk density represents the weight of soil per unit volume and thus provides a direct measurement of soil compaction. Intense traffic from sport activities causes soils to be compressed near the surface resulting in the displacement of soil pores by soil solids. Higher BD represents less pore space, less favorable growing conditions, and harder playing surfaces. On 7 Nov 1999, after one year of traffic, there were no significant differences among treatments. By the end of the second year of field use, the soil amended with 1 or 2 tons/1000 sq. ft. of Turface resulted in a significant BD reduction. On 26 Sept 2000 the BD for the 1 or 2 ton/1000 sq. ft. rate of Turface was below 1.37 g cm^{-3} compared to the control that was at 1.53 g cm^{-3}. This indicates that soils amended with Turface maintain a more favorable BD for plant growth. This reduction in BD could reduce surface hardness and improve penetration by cleated shoes and tined aerifier equipment.

Water percolation

The K_{sat} is a measurement of how fast water flows through a soil profile under saturated conditions. Higher K_{sat} values indicated that excessive water will drain through the soil profile faster. In both years there was no difference in water movement between the control and the 1 ton/1000 sq. ft. rate of Turface, however, the 2 ton/1000 sq. ft. rate of Turface significantly increased K_{sat}. (Tables 3 and 4)

Water Content

The amount of water near the surface was measured two days after irrigation on 26 Oct 1999. Gravametric water content in the top 3 cm of the soil was significantly reduced when soil was amended with Turface at 2 tons/1000 sq. ft. (Table 3). The soil water measurements near the surface confirmed our observation that the Turface-treated plots usually appeared drier and produced less visible mud compared to the non-amended control plots. This is especially important under intense traffic conditions when the protective grass mat has been worn away and soils are exposed. Rain and routine irrigation to promote turf recovery can often leave the playing surface too wet. Turface-amended soil produced a drier and less muddy surface during the playing season.

Turf Cover

This study was conducted on a multi-use sports field that receives traffic from high school football and soccer practice as well as miscellaneous recess activities. The study area received 150 days of use per year and by the end of spring soccer in May there was very little grass cover left on the field. Coring and seeding in June provided a young stand of perennial ryegrass by the start of the 15 August football practice season. Under these conditions of intense traffic where nearly all of the grass was worn away, there was no increase in turf cover in the Turface plots compared to the no Turface control plots.

Conclusions

Turface had a favorable affect on growing conditions by reducing soil bulk density and increasing water movement. Turface also had a positive impact on the soil by reducing compaction and making the playing surface less muddy.

Turf cover was not affected by the use of Turface under the intense traffic conditions of this study.

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Table 1. Experimental plot layout of calcined clay tilled renovation. Treatments were applied on November 13, 1997.

	[Center of field]	Plot #	
Goal Line	3	1	Plot size is 50 x 15 ft
	1	2	REP 1
	2	3	
	1	4	Plots are centered Between hash marks
	3	5	REP 2
	2	6	
	3	7	Each 5-yard line is the Center of the plot
	1	8	REP 3
	2	9	
	1	10	
50-yd Line	2	11	REP 4
	3	12	
	1	13	
	2	14	REP 5
	3	15	
	1	16	
	3	17	REP 6
	2	18	
	3	19	
	2	20	REP 7
Goal Line	1	21	

Table 2. Treatment listing and respective rates.

	Treatment	Rate (tons/1000 ft^2)
1	Turface	1
2	Turface	2
3	Untreated control*	NA

Turface applied to plots with topdresser and then tilled with Rotadairon to 4-inch depth.
*Untreated control received no amendment but was tilled with the Rotadairon.

Table 3. Physical characteristics of soil amended with Turface at Ames High School Football Field, 1999.

Treatment	K_{sat} cm h^{-1}	Bulk Density g cm^{-3}	θ_m (0-3 cm) %
Control	4.43	1.30	24.25
1 ton/1000 ft^2	2.46	1.28	24.84
2 tons/1000 ft^2	8.20	1.07	18.56
$LSD_{0.05}$	2.20	NS	2.82

For water content test, samples were collected two days after irrigation on October 26, 1999.
K_{sat}, Saturated hydraulic conductivity samples were collected November 7, 1999.
θ_m, Gravimetric water content.

Table 4. Physical characteristics of soil amended with Turface at Ames High School Football Field, 2000.

Treatment	K_{sat} cm h^{-1}	Bulk Density g cm^{-3}
Control	0.15	1.53
1 ton/1000 ft^2	1.02	1.37
2 tons/1000 ft^2	2.35	1.27
$LSD_{0.05}$	1.70	0.15

Samples were collected Sept. 26, 2000.
K_{sat} , saturated hydraulic conductivity.

Sand-based Sport Field Stability Study

Deying Li, David D. Minner, and Nick E. Christians

Sports turf is an important area of turfgrass application. Unlike golf courses, most of the sports turf fields require a more stable playing surface to support the activities of players and facilities, and to provide protection against sports injuries. Playing surface quality is decided jointly by turfgrass and soil media (Canaway and Baker, 1993). Surface quality is usually expressed as friction, traction, stiffness, and resilience when the interaction between the surface and player is the main concern. It also can be evaluated from the ball bounce resilience and rolling resistance or ball speed when information about the behavior of sport facilities on a playing surface is needed (Bell et al., 1985; Baker et al., 1988; McClements and Baker, 1994). Of all the qualities of playing surface, perhaps the safety of the players is the most important consideration when constructing and evaluating a sports field. Many sports injuries are related to varying degree of surface stability (Valiant, 1988; Powell and Schootman, 1993; Waddington and McNitt, 1995). The interaction of several factors may contribute to surface displacement of sand-based fields. Some factors contributing to stability are; rooting, amount of traffic, compaction, sand characteristics, moisture content, shoe and athlete type, and many other factors. It is conventionally thought that a more rounded shape of sand contributes to surface instability and that this could reduce field safety. There is little information that directly relates sand type to field safety. Before any link can be made between sand type and field performance we must gain a better understanding of the role that sand shape plays in surface stability, even in the absence of grass and roots. The objective of this study is to evaluate the relative importance of sand particle size, particle-size distribution, particle shape and roundness, plant roots and root-zone water content in the stability of a sand-based sport field surface.

Materials and Methods

The study is established on an existing sand-based sports turf area at the Horticultural Research Station. The root zones were excaved from to form 5 X 10 ft plots 15 cm deep. Five treatments, Hallett mason sand, Hallett concrete sand, Sidley Proangle sand, Bunker white sand, and Hallett mason sand + 15% soil (v/v) were filled in the plots and compacted with a vibrating Whacker. The experimental design is a randomized complete block, with three replications.

Sand particle size, particle-size distribution, particle shape, and roundness was analyzed before the application of materials to the plots. We will measure the water content by TDR, penetration by a penetrometer, surface hardness by a B&K 2500 vibration equipment, traction by a torque wrench which is set on a disk-shaped football cleat. Bulk density will also be measured each time we measure the above parameters. We will seed and sod the plots with Kentucky bluegrass later on to evaluate the contribution of plant roots in the surface stability.

Preliminary Results

At this time, we are able to see the differences in stability between different treatments without the factor of plant roots. Particle shape and roundness seem to play a role but together with the other factors. Detailed analysis will be reported later this year.

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The Effect of Winter Covers on Autumn Established Kentucky Bluegrass

David D. Minner, Deying Li, and Federico Valverde

Objectives

The objective of this study was to determine if winter covering of autumn seeded Kentucky bluegrass had any effect on turf establishment by the following spring. Various tarp colors and cover materials were evaluated.

Background

The specific color of vinyl-coated polyester tarps used to protect baseball fields from rain has been shown to have a dramatic effect on turf color and growth when used for the entire winter as a protective cover on Kentucky bluegrass in Iowa (Minner et. al. 2001). The effect of tarp color on turf performance follows the general ranking from best to worst; red, yellow, orange > white, purple, light-blue, blue > gray/white, light-green, dark-green, white/black, black/white. There was a strong correlation (r = 0.78 to 0.99) between turf color and photosynthetic photon flux density for both the vinyl and polyethylene materials. Winter covering produced less injury than spring covering, especially for the light-green, dark-green, black/white, and white/black tarps. More investigation is needed to determine if tarp color has any effect on turf performance when covered for shorter intervals and under warmer conditions during the summer. The research mentioned above was conducted on mature stands of Kentucky bluegrass. Seedling turf is often present in late autumn as the result of overseeding after the autumn football season. This study was initiated to evaluate the effect of covering materials placed over seedling turf in the autumn and then removed in the spring.

Materials and Methods

Thirteen cover materials were used in this study (Table 1.) The experimental design was a randomized complete block with three replications. Individual covered plots were 5 ft by 5 ft. 'Unique' Kentucky bluegrass was planted in September 2000 at 3 lbs/1000 sq.ft. Turf covers were placed on 7 December 2000, approximately 70 days after seedling emergence. On 4 April 2001, all cover materials were shifted 2.5 ft so that half of the originally covered plot was uncovered and the remainder of the plot continued to be covered. Turf color was visually rated on a scale of 1 to 10, 10 = darkest green and 1 = no green color (white or brown tissue) and 6 = lowest acceptable color. Turf leaf growth was rated on a scale of 1 to 10, 10 = most vertical leaf growth and 1 = no vertical leaf growth. Turf cover was visually estimated as the percent of the plot area with living turf. Turf evaluations were made on 4 and 19 April, and 3 May 2001.

Data were analyzed using ANOVA and the results are listed in Tables 2, 3, and 4.

Results

On 4 April 2001 the yellow and orange tarps provided the best color when covered in the winter. When covered for a longer period of time (winter/spring) yellow, orange, and red tarps showed poor color and elongated growth on 19 April 2001. Even with this less desirable growth, the yellow and orange tarps had the highest amount of turf cover, 82% and 72% cover, respectively. On 19 April the winter covered grass had significantly more cover under the Typar black, Turf Defender, Evergreen, white, and red tarps when compared to the non-covered control plot. Enka Plus, light-green, purple, and the control had inferior turf cover on 19 April 2001 in the winter/spring covered plots.

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Table 1. Cover materials placed over autumn-established Kentucky bluegrass.

Cover Material	Description
1. Typar white	Nonwoven fabric composed of thermally bonded, continuous polypropylene
2. Typar black	Nonwoven fabric composed of thermally bonded, continuous polypropylene
3. Enkamat Plus	Enkamat Plus® is Enkamat with a geotextile fabric attached to one surface. Used primarily to protect field from traffic.
4. Enkamat Flat Back	Enkamat® is a bulky black mat made from nylon threads which are fused together where they cross. Although Enkamat is primarily used to physically protect turf or prevent erosion, the black color of Enkamat also may enhance turf greenup during the spring.
5. Turf Defender	Woven polypropylene
6. Covermaster Evergreen	Evergreen® turf enhancement cover high density, translucent polyethylene by Covermaster, Inc.
7. VCP Yellow	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).
8. VCP Dark blue	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).
9. VCP Light green	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).
10. VCP White	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).
11. VCP Orange	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).
12. VCP Red	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).
13. Control	No cover material
14. VCP Purple	7 oz./sq.yd. vinyl-coated polyester (274 gms/sq. meter).

Table 2. Turf color, growth, and % cover rated on 4 and 19 April 2001 for autumn established Kentucky bluegrass that was covered for various durations during the winter and/or spring.

	Winter Cover Covered 12-8-00 to 4-4-01 Rated 4-4-01		Winter Cover Covered 12-8-00 to 4-4-01 Rated 4-19-01			Winter/Spring cover Covered 12-8-00 to 5-3-01 Rated 4-19-01			Spring Cover Covered 4-4-01 to 5-3-01 Rated 4-19-01		
Treatment	Color	Growth	Color	Growth	% Cover	Color	Growth	% Cover	Color	Growth	% Cover
1	6	3	4	1	41.7	6	3	73.3	6	3	73.3
2	4	2	4	1	86.7	5	4	68.3	7	3	86.7
3	4	3	5	1	21.7	2	1	11.7	3	1	23.3
4	5	2	5	1	43.3	6	4	63.3	7	3	71.7
5	5	2	4	1	75.0	6	2	68.3	6	3	88.3
6	5	3	4	1	71.7	6	2	63.3	7	3	81.7
7	7	7	4	3	48.3	4	8	81.7	4	7	78.3
8	5	4	4	1	58.3	4	3	65.0	5	3	68.3
9	5	6	3	1	35.0	2	3	11.7	3	2	33.3
10	5	3	4	2	76.7	6	5	73.3	6	4	80.0
11	7	7	3	3	56.7	4	7	71.7	6	5	75.0
12	6	6	4	2	76.7	4	6	63.3	5	5	76.7
13	3	1	5	1	21.7	5	1	21.7	5	1	23.3
14	6	8	3	2	15.0	2	4	26.7	2	4	30.0
$LSD_{0.05}$	1.4	2.3	NS	0.9	35.0	1.4	1.8	20.3	1.5	1.3	24.5

Table 3. Turf color, growth, and % cover on 3 May 2001 for autumn established Kentucky bluegrass that was covered for various durations during the winter and/or spring.

	Dec. 8, 2000 to Apr. 4, 2001			Dec. 8, 2001 to May 3, 2001			Apr. 4, 2001 to May 3, 2001		
Treatment	Color	Growth	% Cover	Color	Growth	% Cover	Color	Growth	% Cover
1	5	6	46	6	9	57	6	9	57
2	5	6	38	7	5	55	7	5	62
3	4	6	25	1	1	12	2	5	12
4	5	6	52	7	7	60	7	8	58
5	5	6	40	5	8	53	6	8	63
6	5	6	50	6	8	83	6	9	85
7	5	6	37	9	6	73	8	6	65
8	5	5	35	3	2	25	3	2	17
9	5	7	18	1	1	0	1	1	0
10	5	6	37	8	6	53	7	7	52
11	5	6	38	7	5	55	7	5	60
12	5	6	55	7	5	55	7	6	57
13	5	7	43	5	7	45	5	7	45
14	4	6	40	2	1	32	2	1	32
$LSD_{0.05}$									

Table 4. Temperature under the cover materials.

	29-Mar			30-Mar			31-Mar			1-Apr			5-Apr			6-Apr		
Treatment	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Typar white	12.8	1.8	5.8	23.5	2.0	9.1	19.2	-0.2	7.3	26.8	-0.6	9.5	21.1	8.6	13.6	15.8	1.8	11.0
Typar black	10.1	0.3	3.8	23.1	0.9	7.5	16.4	-0.7	5.1	20.6	-1.1	6.4	18.8	7.4	12.0	14.3	0.0	9.8
Enkamat Plus	7.0	0.6	3.0	12.8	0.5	4.4	10.4	-0.3	3.8	14.7	-0.4	4.6	13.0	6.1	8.8	11.8	-2.3	7.5
Enkamat Flat Back	10.8	0.1	4.9	21.1	0.5	7.7	15.7	-1.6	5.6	23.2	-1.9	7.3	18.8	7.8	12.3	15.6	1.9	10.0
Turf Defender	11.1	0.3	4.7	22.4	0.3	7.6	18.1	-2.0	5.9	23.7	-2.5	7.3	20.9	8.3	13.3	15.8	2.0	9.9
Covermaster	14.3	0.2	5.3	25.6	0.4	8.7	19.2	-1.2	6.3	28.7	-1.5	8.4	21.4	8.1	13.0	15.7	1.8	10.0
Yellow	10.0	1.0	4.6	20.4	1.3	7.3	17.5	-0.7	6.4	20.5	-1.0	7.3	19.0	8.7	12.9	15.4	1.9	10.4
Dark blue	10.4	1.5	4.7	20.8	1.4	7.8	18.2	-0.6	6.6	26.3	-1.2	8.3	24.2	8.7	13.8	17.0	2.6	10.7
Light green	10.1	1.4	4.9	20.3	1.5	8.1	17.8	-0.3	6.7	22.5	-0.7	8.2	24.8	8.3	13.8	16.1	1.6	10.0
White	6.6	-0.5	3.1	14.8	0.6	5.1	13.9	-0.8	5.0	16.9	-1.3	5.7	15.6	7.8	11.3	14.2	0.7	9.3
Orange	11.0	0.5	4.7	22.2	0.7	7.4	19.5	-1.2	6.4	22.2	-1.5	7.2	21.5	8.5	13.0	15.3	1.2	9.7
Red	12.2	0.5	5.0	26.3	0.5	8.5	19.0	0.5	7.0	23.5	-0.2	8.6	18.3	8.4	12.1	14.7	-0.4	9.4
Control	15.1	0.2	5.2	19.0	1.0	7.6	16.1	-1.3	5.9	22.0	-1.9	7.1	20.6	9.0	13.5	17.2	3.7	10.6
$LSD_{0.05}$	3.6	1.1	0.8	6.3	NS	1.0	NS	NS	1.0	6.0	NS	1.3	2.7	0.9	1.0	1.5	1.5	1.4

Anti-Desiccant Winter Protection of Creeping Bentgrass Putting Greens - 2001 Results

David D. Minner and Federico Valverde

Objective

To determine the effect that anti-desiccants applied before winter would have on the quality of turfgrass at springtime.

Background

The three major types of winter turf injury are direct low temperature stress, winter desiccation, and low temperature fungi. Frozen conditions in the absence of snow cover can cause a slow but constant loss of moisture. This type of winter injury known as desiccation is especially damaging during sunny and windy conditions. It is known that artificial barriers between the grass and the environment can positively decrease the physiological damage. Protective covers or tarps are often placed over the turf just prior to ground freeze and are not removed in the spring until the surface thaws. For most winter conditions turf covers speed spring green-up and reduce winter injury.

An alternative to using plastic or any other kind of covers in turfgrass is the use of anti-dessicants (AD). These substances decrease the rate at which plant tissue would lose water.

Procedure

The study was initiated November 15, 2000 at the Horticulture Research Station on a USGA sand based putting green containing a mature stand of 'Penncross' creeping bentgrass. The trial had eight treatments (Table 1) and 3 replications. Each treatment was applied using a CO_2 sprayer on an area of 5 x 5 ft^2. The Evergreen Turf Cover was placed on the same day that anti-desiccant treatments were applied.

Table 1. Description of treatments.

	Treatment	(Rate oz/1000 ft^2)
1	GLAD	42
2	GLAD	17
3	GLAD	11
4	GLAD	8
5	Transfilm	8
6	Wilt-Pruf	42
7	Evergreen Turf Cover	~
8	Control	~

No other practice or treatment was applied to the trial. A foot of snow was on top of the trial for about 90 days. The first rating of the trial was done 26 March, and every ten days thereafter, for a total of 4 ratings. Turf color was visually evaluated using a scale from 1-10, where 1 is white-brown color and 10 dark green.

Results

The winter of 2000 – 2001 produced record snow cover with just over 90 days of snow cover between December and March. The extensive snow cover eliminated any chance of injury from winter desiccation. Gray Snow Mold was generally extensive throughout the state, but there was only minimal injury on this particular bentgrass research site.

Table 1 shows the summary of four evaluation dates in the spring. Turf color was used to evaluate the amount of winter injury as well as the rate of spring green-up. Normal spring green-up began during the first week of April. The untreated control and the Evergreen cover were used for comparison with the anti-desiccant materials. The Evergreen cover provided better turf color than the non-treated control. Lower turf color ratings for the anti-desiccant materials seemed to be associated with a lighter tan color of the turfgrass blades. There was no rate effect among the GLAD treatments.

While there were no significant differences between the control and any of the anti-desiccant materials, there appeared to be a non-statistical trend. This trend indicated that the anti-desiccant materials resulted in lower turf color ratings than the non-treated control. By 4 May all of the grass treated with anti-desiccants had recovered to a level equal to the non-treated control and the trend ceased to exist.

The anti-desiccant materials used in this trial did not improve the spring performance of putting green turf following the winter. The winter of 2000 - 2001 did not produce winter desiccation conditions.

Table 2. Turf color for various anti-desiccant treatments. Higher turf color values represent less winter injury.

Treatment	Rate oz/1000 ft^2	Turf Quality				
		3-26	4-4	4-14	4-24	Avg
GLAD	42	2.3	2.7	4.3	5.0	3.5
GLAD	17	3.7	3.0	4.3	4.7	4.2
GLAD	11	2.3	2.3	3.7	4.7	3.2
GLAD	8	3.3	3.3	5.0	5.7	4.3
Transfilm	8	2.3	2.3	3.7	4.3	3.3
Wilt-Pruf	42	3.3	2.7	4.7	5.7	4.1
Evergreen cover	--	7.0	7.0	7.0	8.0	7.2
Control	--	4.0	4.0	5.0	5.0	4.6
$LSD_{.05}$		1.9	2.3	2.2	1.7	1.7

The Effect of Inorganic Topdressing Amendments on Rootzone Temperature

Deying Li, David D. Minner, Nick E. Christians, and Natalie J. Canier

Objective

The objective of this study was to determine if the source of inorganic topdressing amendment has any impact on the rootzone temperature and the performance of creeping bentgrass putting greens.

Introduction

Thermal properties of the root-zone media of turfgrass are very important physical factors that affect the energy balance and temperature distribution in the root-zone. Understanding the pattern of soil temperature is useful to make decisions as to when and how to apply water, fertilizers, chemicals, and soil amendments. It is also important information for predicting development of pest problems such as weeds, diseases, and insect pests. The reason for this is that plant growth, fate of chemicals, microbial population all are temperature dependent. Many of the turf management practices can affect the temperature and energy regime of the turfgrass rootzone. We are specifically interested in heat dissipation in the top 1/4" layer of the media applied as topdressing. We will assess the thermal properties by measuring the temperature difference between the top and the bottom layers in soil profile at certain water content conditions.

Materials and Methods

The experiment was initiated at the Horticultural Research Station, Ames, IA on 14 September 2000. The USGA-type sand based putting green used in this study was established in 1996 with 'Crenshaw' creeping bentgrass. On 14 September 2000 the study area was verticut at a 0.75 cm depth and overseeded with 'Crenshaw' creeping bentgrass at 2 lbs/1000 ft^2 to make the study area more uniform with the heavy topdressing treatments. Treatments of pure Profile, Quickdry, Zeolite, Axis, sand, and a mixture of sand and peat (90%/10% v/v) were applied at a topdressing depth of 0.5 cm. After topdressing N, P_2O_5, and K_2O were at the rate of 1, 0.5, and 0.5 lbs/1000 ft^2, respectively. The experimental design was a randomized complete block with six treatments and three replications. Temperatures were measured at three depths from the surface (0, 1, and 6 inches) for each plot via automated thermalcouples. Water content was measured with a time domain reflectometer (TDR). Diurnal heat transfer and temperature distribution in the top 15 cm of the root-zone was recorded and the data were used to predict thermal properties. Creeping bentgrass turf quality was evaluated at various stages of development on a 1-10 scale, 10 = best turf.

Preliminary Results

To become familiar with the thermal properties of the inorganic amendments, temperatures were taken in the spring of 2001 (Table 1). Only slight differences in maximum temperature were detected. For example the sand/peat material was approximately 2° C higher than any of the other materials tested. The effect of these slight, but cumulative, differences in temperature is not well understood. Our intent is to measure thermal properties during the summer when higher surface temperatures are anticipated. The question we are trying to answer is "Do the different topdressing materials have different abilities to dissipate radiation energy and does this in turn result in a benefit to the plant?"

Table. 1. Daily maximum temperature (°C) from April 14 to 16, 2001.

Treatments	Depth		
	Surface	2.5 cm	15 cm
Sand	23.0	20.0	16.2
Zeolite	22.1	19.0	16.0
Axis	21.6	18.8	15.6
Sand/Peat	24.3	21.1	16.5
Profile	22.0	18.4	15.8
Quickdry	22.9	18.8	15.7

Introducing

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

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