1991 Iowa Turfgrass Research Report

IOWA STATE UNIVERSITY
EXTENSION

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Introduction

N. E. Christians and M. L. Agnew

The following research report is the 11th annual 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.

The 1990 season was a time of major renovation at the research area. Following the 1990 turf field day, many of the older trials at the station were terminated and replaced by new studies. Among the new trials established in the fall of 1990 were a new low-maintenance Kentucky bluegrass trial, a new high-maintenance Kentucky bluegrass trial, a new perennial ryegrass trial, a new green-height creeping bentgrass trial, a new bermudagrass trial, and a new creeping bentgrass green for fungicide trials. The irrigation system on another one acre of turf area was automated with a new Weather-Matic irrigation system provided at a reduced cost by Weather-Matic Corporation and BH & L Irrigation of Lincoln, Nebraska. The Toro irrigation system was updated with a new Network 8000 Satellite controller donated by Toro Inc. and Tri-State Turf and Irrigation.

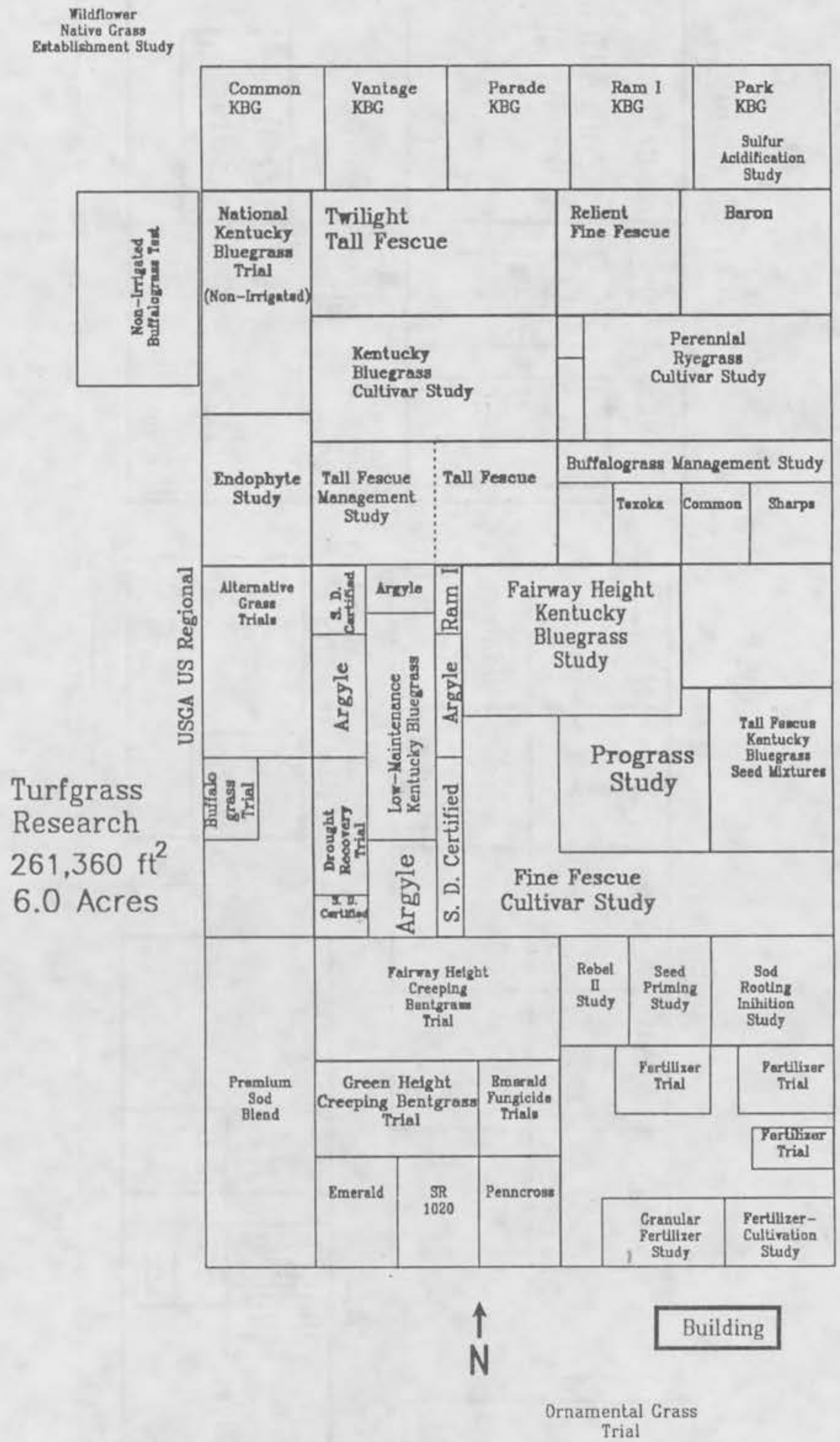
A new feature of this year's research report is a section titled "Environmental Research". This section is included to inform the public of our many research projects aimed at the environmental issues that face the turf industry. In the past two years this has become a major thrust of the research program and many of our more extensive, in-depth projects are now aimed at environmental issues.

We would like to acknowledge Richard Moore, manager of the turfgrass research area; Mark Stoskopf, superintendent of the ISU Horticulture Research Station; Sue Kassmeyer, technical assistant; Doug Campbell, technical assistant; and all others employed at the field research area in the past year for their efforts in building the turf program.

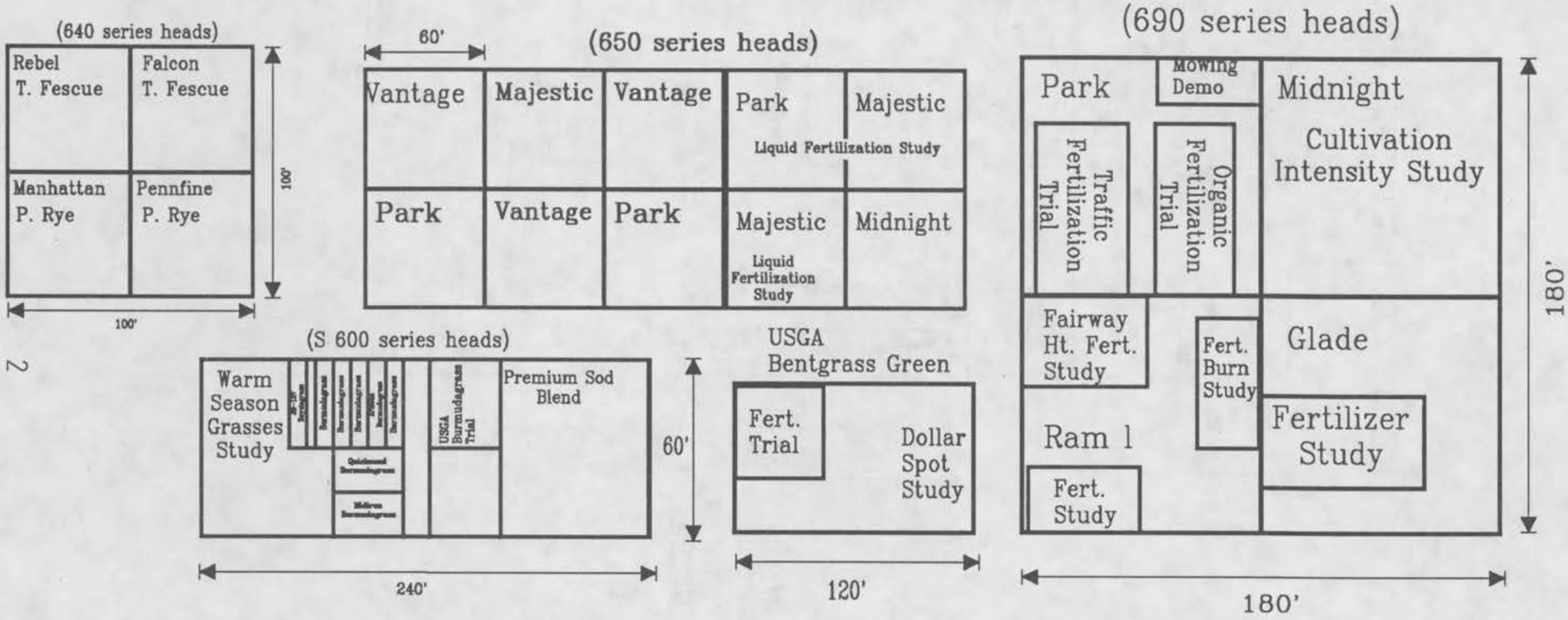
Special thanks to Jane Punke and Barb Erickson for their work in typing and helping to edit this publication.

Edited by Nick Christians, professor, Horticulture; Michael Agnew, associate professor, Horticulture.

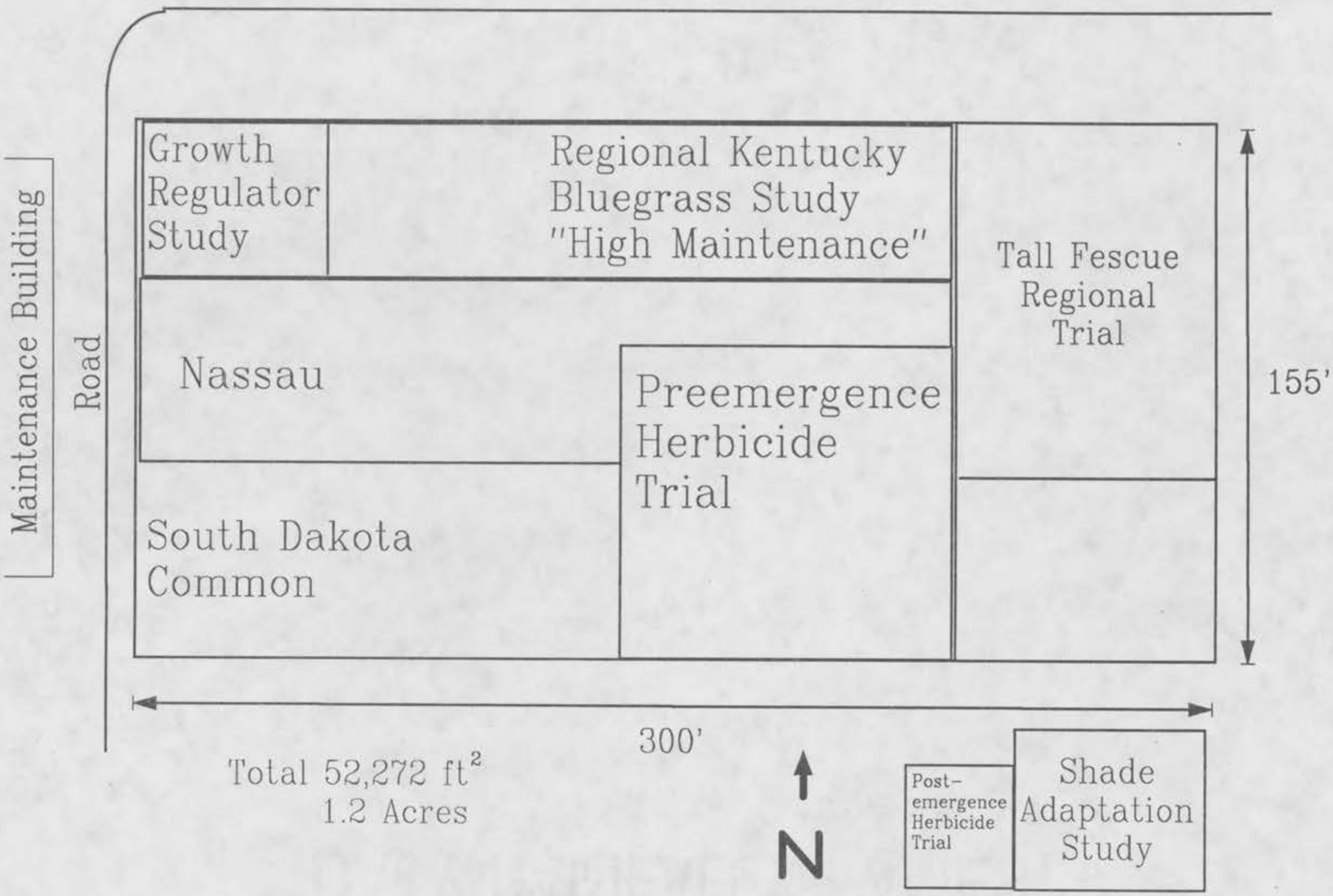
Table of Contents


Wildflower Native Grass Establishment Study
Common KBG
Vantage KBG
Parade KBG
Ram I KBG
Park KBG
Sulfur Acidification Study
Non-Irrigated Buffalograss Test
National Kentucky Bluegrass Trial (Non-Irrigated)
Twilight Tall Fescue
Relient Fine Fescue
Baron
Kentucky Bluegrass Cultivar Study
Perennial Ryegrass Cultivar Study
Endophyte Study
Tall Fescue Management Study
Tall Fescue
Buffalograss Management Study
Texoka
Common
Sharps
USGA US Regional
Alternative Grass Trials
S. D. Certified
Argyle
Ram I
Fairway Height Kentucky Bluegrass Study
Argyle
Low-Maintenance Kentucky Bluegrass
Argyle
Prograss Study
Tall Fescue Kentucky Bluegrass Seed Mixtures
Turfgrass Research
261,360 ft^2
6.0 Acres
Buffalo grass Trial
Drought Recovery Trial
S. D. Certified
Argyle
S. D. Certified
Fine Fescue Cultivar Study
Fairway Height Creeping Bentgrass Trial
Rebel II Study
Seed Priming Study
Sod Rooting Inihition Study
Premium Sod Blend
Green Height Creeping Bentgrass Trial
Emerald Fungicide Trials
Fertilizer Trial
Fertilizer Trial
Fertilizer Trial
Emerald
SR 1020
Penncross
Granular Fertilizer Study
Fertilizer-Cultivation Study
N
Building
Ornamental Grass Trial

1984 Expansion of the Turfgrass Research Area
108,900 ft^2 – 2.5 Acres

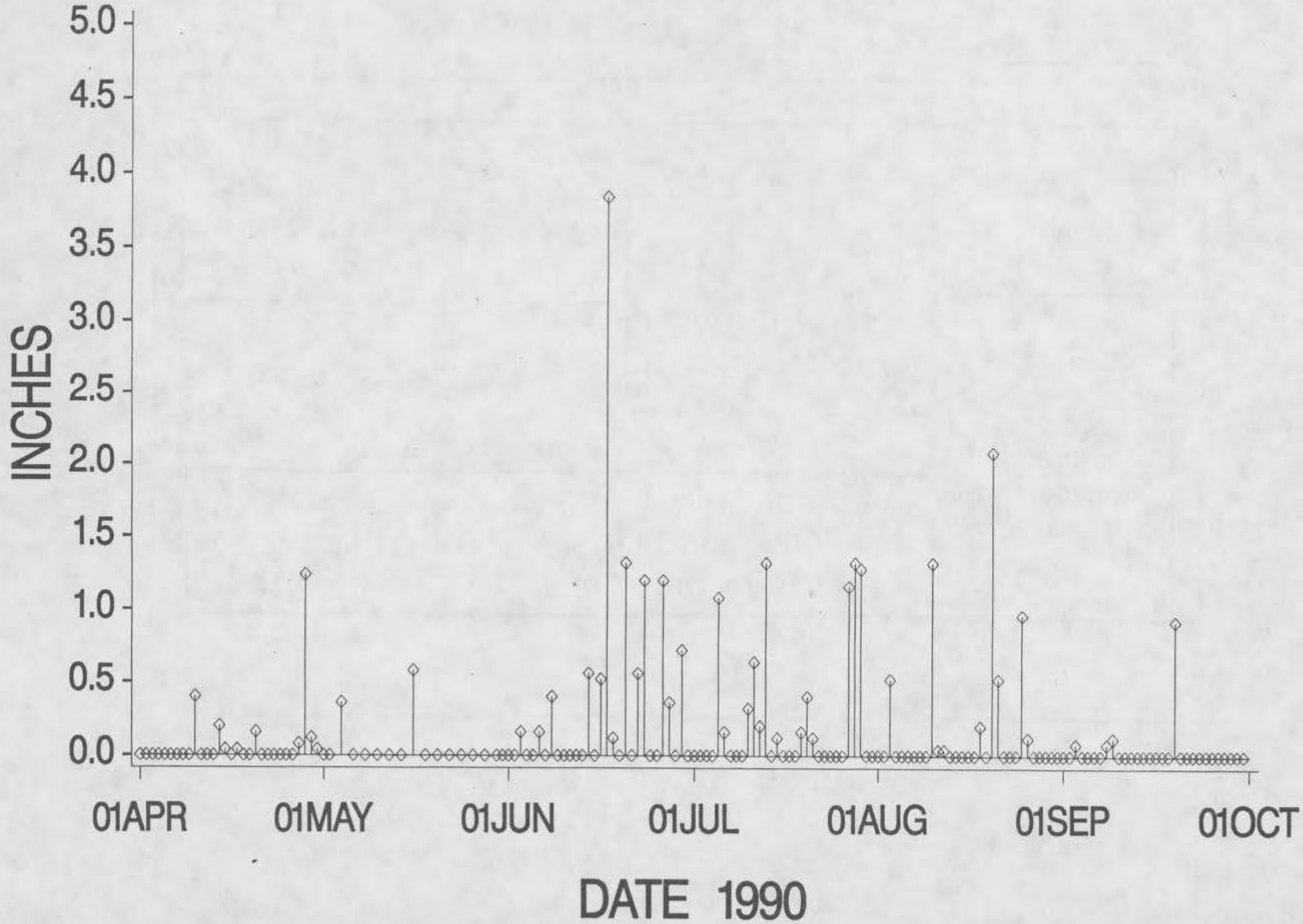


East Research Area



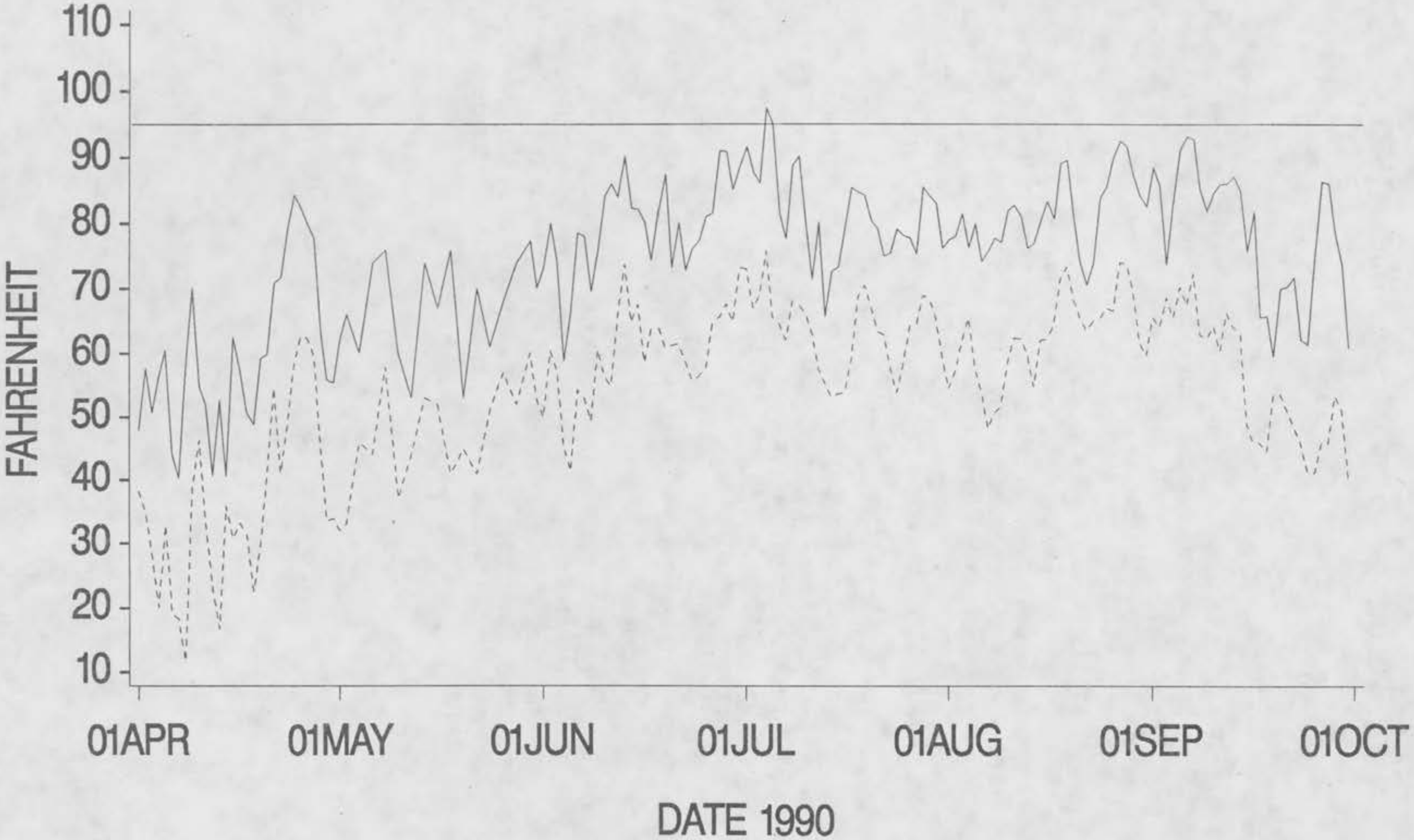
DAILY RAINFALL - AMES

Figure 2



DAILY TEMPERATURE – AMES

Figure 1



SOLID LINE = MAX DASHED LINE = MIN

Results of Kentucky

Bluegrass Regional Cultivar Trials - 1990

N.E. Christians

The United States Department of Agriculture (USDA) has initiated several regional Kentucky bluegrass cultivar trials that are currently being conducted at most of the northern agricultural experiment stations. The test consists of either 80 or 84 cultivars; the number depending on the year the trials were initiated, with each cultivar replicated three times.

Two trials were underway at Iowa State University during the 1990 season. The oldest is a high--maintenance study established in 1981 that receives 4 lb nitrogen (N)/1000 ft^2/yr and is irrigated as needed. The second trial was established in 1985 and receives 4 lb N/1000 ft^2/yr, but is not irrigated. The objective of the high-maintenance study is to investigate the performance of the 84 cultivars under a cultural regime similar to that used on irrigated home lawns in Iowa. The objective of the second study is to observe the response of 80 cultivars under conditions similar to those found in nonirrigated lawns that receive a receiving standard lawn care program.

The values listed under each month in Tables 1 and 2 are the averages of ratings made on three replicated plots for the two studies. Yearly means of data from each month were taken and are listed in the last column. The first cultivar received the highest average rating for the entire 1990 season. The cultivars are listed in descending order of average quality.

The high maintenance irrigated trial (Table 1) was terminated in July 1990 after 9 years. A new, larger USDA trial was seeded in the fall of 1990. 'Ram I' was the highest rated cultivar in 1990. Other well-known varieties that performed well in this extremely wet year were 'Welcome', 'Sydsport', 'Fylking' and 'Rugby'.

The nonirrigated, high-maintenance trial (Table 2) was much like an irrigated study because of the rainfall in 1990. Common varieties that performed well in the drought years of 1988 and 1989, such as 'Kenblue' and 'South Dakota Cert.', also received high ratings in 1990. This was probably due to the advantage these varieties maintained in the drought years and carried with them into the spring of 1990. The common varieties often decrease in quality in wet years due to disease development. This was not observed in 1990.

Table 1. The 1990 quality ratings for the high-maintenance regional Kentucky bluegrass test that was established in the fall of 1981.

	Cultivar	May	June	July	Mean
1.	RAM-1	7.7	8.0	8.0	7.9
2.	239	7.0	8.0	7.3	7.4
3.	MLM-18011	7.0	7.3	7.7	7.3
4.	WELCOME	7.0	7.3	7.7	7.3
5.	N535	7.3	7.0	7.7	7.3
6.	SYDSPORT	7.0	7.0	8.0	7.3
7.	ENOBLE	7.0	7.3	7.7	7.3
8.	GLADE	6.7	7.0	8.0	7.2
9.	FYLKING	7.0	7.3	7.3	7.2
10.	KIMONO	7.3	7.7	6.7	7.2
11.	RUGBY	7.0	7.3	7.3	7.2
12.	WW AG 480	6.7	7.7	7.3	7.2
13.	BONO	6.3	7.7	7.7	7.2
14.	SHASTA	7.0	7.3	7.3	7.2
15.	BRISTOL	7.0	7.3	7.3	7.2
16.	NUGGET	7.0	6.7	7.7	7.1
17.	PSU-190	7.0	7.3	7.0	7.1
18.	PSU-173	7.0	7.0	7.3	7.1
19.	PARADE	6.7	7.0	7.7	7.1
20.	WW AG 478	6.7	7.3	7.3	7.1
21.	I-13	7.7	6.7	7.0	7.1
22.	MER PP 300	7.0	7.7	6.7	7.1
23.	ESCORT	6.7	7.0	7.7	7.1
24.	BARON	7.0	7.0	7.0	7.0
25.	ENMUNDI	6.7	7.0	7.3	7.0
26.	SV-01617	6.7	7.0	7.3	7.0
27.	TOUCHDOWN	7.0	7.3	6.7	7.0
28.	VANESSA	7.0	6.7	7.3	7.0
29.	1528T	6.7	7.7	6.7	7.0
30.	ECLIPSE	6.3	7.0	7.7	7.0
31.	TRENTON	7.0	6.7	7.0	6.9
32.	WW AG 463	6.0	7.3	7.3	6.9
33.	MOSA	6.7	6.7	7.3	6.9
34.	MERIT	6.7	7.0	7.0	6.9
35.	COLUMBIA	7.0	6.7	7.0	6.9
36.	MONA	6.3	6.7	7.7	6.9
37.	VICTA	6.7	6.7	7.3	6.9
38.	S.D. COMMON	6.7	7.0	7.0	6.9
39.	BA-61-91	6.3	7.3	7.0	6.9
40.	BARBLUE	7.0	6.7	7.0	6.9
41.	243	6.3	7.0	7.0	6.8
42.	WABASH	6.3	7.3	6.7	6.8
43.	PSU-150	6.7	7.0	6.7	6.8
44.	PLUSH	6.3	6.3	7.7	6.8
45.	HARMONY	6.3	7.0	7.0	6.8
46.	MAJESTIC	6.0	7.3	7.0	6.8
47.	A20-6	7.3	7.0	6.0	6.8
48.	NJ 735	6.7	7.0	6.7	6.8
49.	225	7.0	6.0	7.3	6.8
50.	K3-179	7.0	6.7	6.7	6.8

Table 1. The 1990 quality ratings for the high-maintenance regional Kentucky bluegrass test that was established in the fall of 1981. (continued)

	Cultivar	May	June	July	Mean
51.	K3-178	6.7	7.0	6.7	6.8
52.	MONOPOLY	7.0	6.3	6.7	6.7
53.	BANFF	6.3	6.7	7.0	6.7
54.	DORMIE	6.7	6.7	6.7	6.7
55.	CEB VB 3965	6.3	7.0	6.7	6.7
56.	KENBLUE	6.0	6.3	7.7	6.7
57.	CELLO	7.3	6.7	6.0	6.7
58.	PIEDMONT	6.7	6.3	7.0	6.7
59.	A20	6.7	7.0	6.3	6.7
60.	A-34	7.0	6.7	6.3	6.7
61.	SH-2	6.7	6.3	7.0	6.7
62.	BIRKA	7.0	6.3	6.3	6.6
63.	CHERI	6.7	6.7	6.3	6.6
64.	S-21	7.0	6.0	6.7	6.6
65.	GERONIMO	6.7	6.7	6.3	6.6
66.	ASPEN	6.3	6.7	6.7	6.6
67.	CHARLOTTE	6.0	6.7	7.0	6.6
68.	A20-6A	6.3	7.0	6.3	6.6
69.	APART	6.0	6.3	7.3	6.6
70.	MER PP 43	5.7	7.0	7.0	6.6
71.	VANTAGE	6.7	6.0	6.7	6.4
72.	H-7	6.3	6.7	6.3	6.4
73.	LOVEGREEN	6.0	6.7	6.7	6.4
74.	P141 (MYSTIC)	6.3	6.7	6.3	6.4
75.	K3-152	5.7	7.0	6.7	6.4
76.	HOLIDAY	6.7	6.0	6.3	6.3
77.	BONNIEBLUE	6.0	6.3	6.7	6.3
78.	BAYSIDE	6.3	6.3	6.3	6.3
79.	ADMIRAL	6.0	6.3	6.7	6.3
80.	K3-162	6.0	6.3	6.7	6.3
81.	ADELPHI	6.7	5.3	6.7	6.2
82.	AMERICAN	5.7	6.3	6.3	6.1
83.	ARGYLE	6.0	5.7	6.7	6.1
84.	MERION	6.0	6.0	6.3	6.1

Table 2. The 1990 quality ratings for the high-maintenance regional Kentucky bluegrass test that was established in the fall of 1981.

Cultivar		May	June	July	Aug	Sept	Mean
1.	WABASH	7.3	7.0	7.3	8.0	6.0	7.1
2.	JOY	6.7	5.7	8.3	8.3	6.0	7.0
3.	GEORGETOWN	6.3	7.0	7.7	7.3	6.0	6.9
4.	MONOPOLY	6.5	6.0	8.0	7.5	6.0	6.8
5.	KENBLUE	6.3	6.7	7.7	7.0	6.3	6.8
6.	SOUTH DAKOTA CERT.	6.7	7.0	7.7	6.3	5.7	6.7
7.	PARK	6.3	6.7	8.0	6.3	6.3	6.7
8.	A-34	6.7	7.0	7.3	7.0	5.0	6.6
9.	SOMERSET	5.7	6.7	7.0	7.3	5.7	6.5
10.	NASSAU	6.0	6.7	7.3	7.0	5.3	6.5
11.	MYSTIC	4.7	5.7	7.7	7.0	6.3	6.3
12.	HUNTSVILLE	6.7	6.0	7.0	6.3	5.3	6.3
13.	TRENTON	5.7	6.7	7.3	7.0	5.0	6.3
14.	NE 80-30	5.7	6.7	7.3	7.0	5.0	6.3
15.	IKONE	5.7	6.0	7.3	6.3	5.7	6.2
16.	NE 80-14	6.3	5.3	6.0	7.3	6.0	6.2
17.	ABLE I	5.0	6.3	7.3	7.3	4.7	6.1
18.	NE 80-88	5.7	6.0	7.0	6.7	5.0	6.1
19.	LOFTS 1757	6.3	6.0	6.7	7.3	4.3	6.1
20.	JULIA	7.0	6.0	6.3	6.3	5.0	6.1
21.	F-1872	6.3	6.3	6.7	7.0	4.3	6.1
22.	BLACKSBURG	4.7	5.7	7.3	7.3	5.3	6.1
23.	WW AG 495	5.3	5.7	6.7	7.7	5.3	6.1
24.	RUGBY	5.3	6.3	6.7	6.7	5.0	6.0
25.	CLASSIC	6.3	6.7	6.7	6.0	4.0	5.9
26.	P-104	4.7	5.7	7.7	7.0	4.3	5.9
27.	BAR VB 534	4.3	6.7	7.3	6.3	4.7	5.9
28.	CYNTHIA	5.0	6.0	6.3	6.7	5.3	5.9
29.	PARADE	6.0	6.3	6.7	6.0	4.3	5.9
30.	DESTINY	5.3	5.3	6.7	6.7	5.3	5.9
31.	K3-178	5.0	6.0	6.3	6.3	5.7	5.9
32.	RAM-I	5.0	5.7	6.3	7.0	5.0	5.8
33.	BA 73-626	4.0	6.0	6.7	7.0	5.3	5.8
34.	ASSET	5.0	6.0	6.3	6.7	5.0	5.8
35.	ECLIPSE	4.7	6.3	6.3	6.7	5.0	5.8
36.	GLADE	4.3	6.0	6.7	7.0	5.0	5.8
37.	HARMONY	5.3	5.7	7.3	7.0	3.7	5.8
38.	NE 80-50	5.3	6.0	6.7	6.3	4.7	5.8
39.	TENDOS	4.7	4.7	7.0	6.7	5.7	5.7
40.	LIBERTY	4.7	5.7	6.3	7.3	4.3	5.7
41.	AMAZON	4.0	5.5	6.8	7.5	4.8	5.7
42.	239	5.7	5.7	6.7	6.3	4.3	5.7
43.	AQUILA	5.3	6.7	6.3	5.7	4.3	5.7
44.	K1-152	5.0	5.3	6.0	6.7	5.3	5.7
45.	WW AG 491	4.3	6.0	6.3	6.7	5.0	5.7
46.	NE 80-47	5.0	6.0	6.0	6.0	5.3	5.7
47.	AMERICA	4.3	5.0	7.7	6.0	5.0	5.6
48.	PST-CB1	5.3	5.7	6.0	6.3	4.7	5.6
49.	BARZAN	4.7	5.3	7.0	6.3	4.3	5.5
50.	HAGA	4.0	6.0	6.3	6.3	4.7	5.5
51.	BARON	5.0	6.0	6.3	5.7	4.7	5.5

Table 2. The 1990 quality ratings for the high-maintenance regional Kentucky bluegrass test that was established in the fall of 1981.(continued)

Cultivar		May	June	July	Aug	Sept	Mean
52.	CONNI	5.0	5.3	6.7	6.3	4.3	5.5
53.	BA 70-242	4.3	6.0	6.3	6.7	4.3	5.5
54.	BA 72-441	4.0	5.7	6.3	6.7	4.7	5.5
55.	BA 73-540	4.0	6.0	6.7	6.7	4.3	5.5
56.	NE 80-48	4.0	5.3	6.7	7.0	4.7	5.5
57.	BA 72-492	5.0	5.3	5.7	6.3	4.7	5.4
58.	SYDSPORT	4.0	5.3	6.0	6.0	5.0	5.3
59.	WW AG 468	3.7	5.0	6.7	6.3	5.0	5.3
60.	WW AG 496	4.0	6.0	6.7	6.0	4.0	5.3
61.	NE 80-55	5.3	5.3	5.7	5.7	4.3	5.3
62.	MERIT	5.0	5.0	6.0	6.0	4.0	5.2
63.	BA 70-139	4.0	5.3	5.7	6.3	4.7	5.2
64.	BA 69-82	4.0	5.3	6.0	6.0	4.7	5.2
65.	HV 97	3.3	5.7	6.0	6.7	4.3	5.2
66.	MIDNIGHT	3.3	5.3	6.3	6.0	5.0	5.2
67.	NE 80-110	5.0	5.7	5.7	5.3	4.3	5.2
68.	ANNIKA	4.0	5.3	6.0	6.0	4.3	5.1
69.	BRISTOL	4.3	5.0	6.0	6.3	3.7	5.1
70.	VICTA	4.0	5.3	6.0	6.3	3.7	5.1
71.	BA 72-500	4.0	5.0	5.3	6.3	5.0	5.1
72.	DAWN	5.3	5.7	5.7	5.3	3.7	5.1
73.	MERION	3.7	5.0	6.0	6.7	4.3	5.1
74.	WELCOME	4.3	5.7	5.7	5.3	4.3	5.1
75.	COMPACT	4.3	5.0	5.0	5.7	4.3	4.9
76.	CHERI	3.7	5.3	6.0	5.3	4.0	4.9
77.	ASPEN	3.3	5.0	6.3	5.7	4.0	4.9
78.	GNOME	4.3	4.7	5.3	5.3	4.3	4.8
79.	BAR VB 577	4.0	5.3	5.3	5.0	4.0	4.7
80.	CHALLENGER	4.3	4.7	5.3	5.7	3.3	4.7
	LSD 0.05	1.6	1.3	1.5	NS	1.5	3.0

Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Regional Perennial Ryegrass Cultivar Evaluation

R. W. Moore and N. E. Christians

This was the eighth and final year of data from this trial established in the fall of 1982. It was established in conjunction with several identical trials across the country coordinated by the USDA. The purpose of the trial was to identify regional adaptation of 48 perennial ryegrass cultivars. Cultivars were evaluated for turf quality each month of the growing season through August when the study was terminated.

The trial was maintained at a 2 in mowing height with 3 to 4 lb N/1000 ft^2 through the growing season and irrigated when needed to prevent drought. Preemergence herbicide is applied once in the spring and broadleaf herbicide was applied once in September to control weeds. This trial received record rainfall during the 1990 season.

There were no statistical differences among the first 16 cultivars in Table 3. Notice that several of the top performers in 1990 were experimental numbered cultivars. Several of these numbered cultivars have rated in the top 20 each of the past few years. A considerable amount of breeding and selection of perennial ryegrasses has been conducted in the past decade and a number of new releases of well-adapted cultivars can be expected in the future. Some of these numbered cultivars have been given names.

It is interesting to note that "Manhattan II" and "Manhattan", cultivars that performed well in this trial in past years, received low ratings in 1990. This was likely due to the very wet conditions.

Table 3. Turf quality of perennial ryegrass cultivars in 1990

	Cultivar	Ratings[a] April	May	June	July	Aug	Mean
1.	BIRDIE	6.3	7.3	6.7	7.3	7.7	7.1
2.	SWRC-1	5.7	6.7	7.0	7.3	7.7	6.9
3.	2EE (Cowboy)	5.7	6.7	6.7	7.3	7.7	6.8
4.	282 (Citation II)	5.7	6.7	7.0	7.0	7.7	6.8
5.	IA 728 (Allstar)	5.3	6.3	7.0	7.3	8.0	6.8
6.	PALMER	5.3	6.3	7.0	7.0	7.7	6.7
7.	LP 210	6.0	6.7	6.7	7.0	7.3	6.7
8.	ACCLAIM	5.7	6.7	6.3	7.0	7.7	6.7
9.	GT-II (Repell)	5.3	6.3	6.3	7.7	8.0	6.7
10.	ELKA	5.7	6.7	6.3	6.7	7.7	6.6
11.	PRELUDE	5.3	6.3	6.3	7.3	7.3	6.5
12.	LP 702 (Mondial)	5.0	6.0	6.7	7.3	7.7	6.5
13.	WWE 19	5.3	6.3	6.7	7.0	7.0	6.5
14.	HR-1	5.3	6.3	6.7	6.7	7.7	6.5
15.	DELRAY	5.0	6.0	6.3	7.0	7.7	6.4
16.	REGAL	5.0	6.0	6.3	7.0	7.7	6.4
17.	FIESTA	5.0	6.0	6.3	6.7	7.3	6.3
18.	NK 79309	5.3	6.0	6.0	6.7	7.3	6.3
19.	PENNANT	5.0	6.0	6.0	7.0	7.7	6.3
20.	BLAZER	5.0	5.7	6.3	6.7	7.3	6.2
21.	2ED (Birdie II)	5.0	5.7	6.3	6.7	7.3	6.2
22.	CROWN	5.3	6.3	6.0	6.0	6.7	6.1
23.	HE 178	5.0	6.0	6.0	6.3	7.0	6.1
24.	DASHER	4.7	5.7	5.7	7.0	7.3	6.1
25.	BT-I (Tara)	4.7	5.7	6.3	6.7	7.0	6.1
26.	HE 168	4.0	5.0	6.0	7.0	8.0	6.0
27.	CUPIDO	5.0	6.0	5.7	6.3	7.0	6.0
28.	DERBY	4.7	5.7	6.0	6.7	7.0	6.0
29.	DIPLOMAT	4.3	5.3	6.0	6.7	7.3	5.9
30.	RANGER	4.3	5.0	6.3	6.7	7.0	5.9
31.	COCKADE	5.0	5.7	5.7	6.3	7.0	5.9
32.	OMEGA	4.7	5.3	6.0	6.7	7.0	5.9
33.	NK 79307	4.3	5.0	6.3	6.7	7.3	5.9
34.	GATOR	5.0	6.0	6.0	6.3	6.3	5.9
35.	LP 736 (Ovation)	4.3	5.3	6.0	6.0	7.0	5.7
36.	LP 792	4.3	5.3	5.7	6.3	7.0	5.7
37.	PREMIER	4.0	5.0	6.0	6.3	7.0	5.7
38.	CIGIL	4.7	5.3	5.7	6.0	6.3	5.6
39.	MANHATTAN II	4.3	5.3	5.3	6.3	6.7	5.6
40.	NK 80389	4.7	5.0	5.3	6.0	6.7	5.5
41.	M382	4.3	5.0	5.7	6.3	6.3	5.5
42.	PENNFINE	4.0	4.7	6.0	6.0	6.7	5.5
43.	BARRY	4.3	4.7	5.3	6.0	6.7	5.4
44.	YORKTOWN II	4.3	4.7	5.3	5.3	6.7	5.3
45.	CITATION	4.3	4.3	5.3	6.0	6.7	5.3
46.	LINN	4.0	4.3	5.7	6.0	6.7	5.3
47.	MANHATTAN	4.3	5.0	5.0	5.7	6.0	5.2
48.	PIPPIN	4.3	5.3	5.0	5.3	5.7	5.1
	LSD 0.05	1.6	1.9	1.0	1.3	1.0	1.1

[a] Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Fine Fescue Management Study

N. E. Christians and R. W. Moore

The fine fescue management study includes the following cultivars:

1. Pennlawn Red Fescue
2. Scaldis Hard Fescue
3. Ruby Red Fescue
4. Atlanta Chewings Fescue
5. K5-29 Red Fescue
6. Dawson Red Fescue
7. Reliant Hard Fescue
8. Ensylva Red Fescue
9. Highlight Chewings Fescue
10. Jamestown Chewings Fescue

Each cultivar was maintained in full sun at two mowing heights: 1 and 2 in. Each plot was divided into two fertilizer treatments: 1 and 3 lb N/1000 ft^2 applied as IBDU. The area was irrigated as needed. The study was established on September 8, 1979, and was the oldest study in the turf research area before it was terminated in August 1990.

The quality ratings in Table 4 are the means of monthly ratings taken on replicated plots from May to August. 'Reliant' and 'Scaldis' hard fescue had the best overall quality in 1990 and through all of the years the study was conducted.

These cultivars performed satisfactorily even under the extreme conditions of a 1 in mowing height and 1 lb N/1000 ft^2/year. They have performed consistently well for the 12 years the trial has been in place. They also have shown excellent disease tolerance, whereas many of the other grasses have been observed to be quite susceptible to Dollar Spot.

'Jamestown' and 'Atlanta Chewings' fescue also performed well in 1990. 'Highlight' chewings fescue performed very poorly. Generally, the creeping red fescues did not perform well during the 12 years of the study.

Table 4. The effects of mowing height and nitrogen fertilizer on the quality of 10 fine fescues in 1990.

	Mowing Height				
	1 in		2 in		
	N Rate		N Rate		Overall
	1 lb[a]	3 lb	1 lb	3 lb	Mean
1. Pennlawn Red Fescue	5.4[b,c]	5.0	5.8	5.8	5.5
2. Scaldis Hard Fescue	6.6	6.7	6.8	7.0	6.8
3. Ruby Red Fescue	4.4	4.9	5.4	6.0	5.2
4. Atlanta Chewings Fescue	5.8	5.8	6.3	6.3	6.0
5. K5-29 Red Fescue	4.4	4.3	5.1	5.3	4.8
6. Dawson Red Fescue	5.0	5.0	5.7	6.2	5.5
7. Reliant Hard Fescue	6.4	6.6	6.7	6.8	6.6
8. Ensylva Red Fescue	5.4	4.8	6.5	5.9	5.7
9. Highlight Chewings Fescue	3.6	3.2	4.3	3.5	3.6
10. Jamestown Chewings Fescue	6.2	6.5	6.3	6.7	6.4

[a] N rates are in lb N/1000 ft^2/yr. The N source was IBDU.
[b] Values are the means of monthly observations from May to October.
[c] Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Tall Fescue Cultivar Trial

M. L. Agnew and N. E. Christians

The 65 tall fescue cultivars were established in the fall of 1987 at the Iowa State University Horticulture Research Station. The study was maintained at a 2-in mowing height and fertilized with 2 lb N/1000 ft^2/yr. The area was unirrigated and receives no fungicide or insecticide applications.

The data in Table 5 reflects the harsh summer of 1989. Rainfall was short and quality ratings were low. 'Normarc 25' and 'Shenandoah' were the only tall fescue cultivars to have a mean rating over 7. Most cultivars had a mean quality over the acceptable leval of 6.

Table 5. Quality data for tall fescue cultivar trial.

	Cultivar	Apr	May	June	July	Aug	Sept	Mean
1.	NORMARC 25	7.3	8.0	7.3	6.0	6.7	7.7	7.2
2.	PE-7E (Shenandoah)	7.3	7.3	7.0	6.7	5.3	8.3	7.0
3.	HUBBARD 87	7.0	8.0	7.0	5.3	6.3	7.7	6.9
4.	MESA	6.7	6.3	7.7	6.0	7.0	7.7	6.9
5.	FALCON	6.7	7.0	6.3	6.0	7.0	7.7	6.8
6.	JAGUAR II	6.3	7.0	7.0	5.7	6.3	8.3	6.8
7.	TRIBUTE	7.0	6.7	6.3	6.0	7.0	8.0	6.8
8.	CAREFREE	7.0	6.8	7.0	6.0	6.3	7.3	6.7
9.	FINELAWN I	7.3	6.7	6.3	6.0	6.0	8.0	6.7
10.	NORMARC 99	7.0	7.3	5.7	5.7	6.0	8.7	6.7
11.	PICK 845PN (Guardian)	6.7	7.3	6.7	4.7	6.3	8.3	6.7
12.	PST-5AP	7.3	7.3	6.0	5.3	6.7	7.7	6.7
13.	PST-DBC	6.7	7.3	6.3	5.3	6.7	8.0	6.7
14.	WILLAMETTE	7.0	7.0	6.3	6.0	6.3	7.7	6.7
15.	FATIMA	6.7	6.3	6.3	6.0	6.7	7.7	6.6
16.	FINELAWN 5GL	7.0	6.0	6.7	5.7	6.3	7.7	6.6
17.	JAGUAR	7.0	6.7	6.3	5.3	6.3	8.0	6.6
18.	PST-5DM	6.7	7.0	6.0	5.7	6.3	7.7	6.6
19.	KWS-DUR	6.0	7.0	6.3	5.3	6.3	8.0	6.5
20.	MONARCH	6.7	7.7	5.3	4.7	6.3	8.3	6.5
21.	APACHE	6.7	7.3	5.3	5.3	6.0	8.0	6.4
22.	BAR FA 7851 (Barnone)	6.3	6.7	6.3	5.0	6.0	8.0	6.4
23.	JB-2	6.7	6.7	6.0	6.0	6.0	7.3	6.4
24.	PST-5MW	6.7	8.0	6.0	5.0	5.7	7.3	6.4
25.	THOROUGHBRED	7.0	6.7	5.3	5.7	6.0	7.7	6.4
26.	TRAILBLAZER	6.7	6.7	6.7	4.7	6.7	7.0	6.4
27.	WRANGLER	6.7	7.0	6.3	4.7	6.0	8.0	6.4
28.	CIMMARON	6.3	6.7	5.3	5.3	6.3	7.7	6.3
29.	LEGEND	6.3	7.3	5.0	5.3	6.3	7.3	6.3
30.	OLYMPIC	6.7	6.3	6.0	5.0	6.3	7.7	6.3

Table 5. Quality data for tall fescue cultivar trial (continued).

	Cultivar	Apr	May	June	July	Aug	Sept	Mean
31.	TIP	6.7	6.0	6.3	5.3	6.0	7.7	6.3
32.	TITAN	7.0	7.0	5.0	5.0	6.0	8.0	6.3
33.	ADVENTURE	6.7	7.0	5.3	5.3	5.7	7.3	6.2
34.	ARID	6.7	6.0	6.3	5.0	5.7	7.3	6.2
35.	PE-7	7.0	7.7	5.3	4.3	5.7	7.0	6.2
36.	PICK DM (Avanti)	5.7	7.3	6.0	4.7	5.7	7.7	6.2
37.	PST-5D1 (Eldorado)	6.0	7.0	6.0	4.7	6.0	7.3	6.2
38.	PST-5EN	6.3	6.7	5.7	5.0	6.0	7.7	6.2
39.	REBEL	6.7	7.0	6.0	4.7	5.7	7.3	6.2
40.	REBEL II	6.0	6.7	6.3	5.0	6.0	7.0	6.2
41.	SYN GA	6.7	6.3	5.7	5.0	5.7	7.7	6.2
42.	TRIDENT	6.7	6.0	6.0	4.7	6.3	7.7	6.2
43.	KY-31	6.3	6.7	5.0	5.3	6.3	6.7	6.1
44.	PACER	6.3	6.0	6.0	5.3	6.0	7.0	6.1
45.	PICK GH6 (Maverick II)	6.3	7.0	5.3	4.3	5.7	8.0	6.1
46.	PST-5F2 (Winchester)	6.3	6.0	5.3	4.3	6.3	8.0	6.1
47.	RICHMOND	6.3	6.3	5.0	5.7	6.3	7.0	6.1
48.	TAURUS	6.3	7.3	5.7	4.3	5.7	7.3	6.1
49.	AZTEC	5.3	8.0	5.7	4.7	5.0	7.0	5.9
50.	BEL 86-1	6.3	7.0	4.7	4.7	5.3	7.3	5.9
51.	NORMARC 77	6.3	7.0	5.3	4.3	5.7	6.7	5.9
52.	PICK TF9 (Crossfire)	5.7	8.0	5.3	4.3	5.3	7.0	5.9
53.	PST-5HF (Amigo)	5.7	7.7	5.7	4.3	5.3	7.0	5.9
54.	SUNDANCE	5.7	6.3	5.0	5.0	6.0	7.7	5.9
55.	PICK 127 (Cochise)	6.0	7.3	4.7	4.0	5.7	7.3	5.8
56.	PST-5OL	6.0	6.3	5.7	4.3	6.0	6.7	5.8
57.	BEL 86-2	5.3	7.3	5.3	4.7	5.0	6.7	5.7
58.	BONANZA	5.3	7.0	5.0	4.3	5.7	6.7	5.7
59.	KWS-BG-6 (Twilight)	5.0	7.7	5.7	2.7	5.0	6.7	5.6
60.	PICK SLD (Emperor)	4.7	7.0	5.3	4.3	5.7	6.7	5.6
61.	PST-5D7 (Murietta)	3.3	7.3	6.0	4.3	5.0	7.3	5.6
62.	CHIEFTAIN	5.0	6.3	5.0	4.3	5.0	7.3	5.5
63.	PST-5BL (Silverado)	5.0	7.3	4.7	4.3	5.3	6.0	5.4
64.	PICK DDF (Shortstop)	4.0	6.7	4.7	4.0	5.7	7.0	5.3
65.	PST-5AG	4.7	6.3	4.3	4.0	4.7	6.3	5.1

Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Tall Fescue Management Study

R. W. Moore and N. E. Christians

This report contains the seventh year of data from this experiment. The experiment was designed to compare the response of 'Falcon', 'Houndog', 'Kentucky 31', 'Mustang', and 'Rebel' tall fescue at 0, 2, and 4 lb N/1000 ft^2/yr and cutting heights of 2 and 3 in. One pound of N was applied once during May and September for the 2 lb treatment and during April, May, August, and September for the 4 lb treatment. In the strip-split plot arrangement, all six combinations of the two management factors are placed in a 2 ft by 3 ft block within each cultivar with the five cultivars replicated three times.

There was little difference between the 3 in cut and the 2-in cut in overall turf quality for all cultivars (Table 6). Turf quality increased with each increment of N for all of the cultivars at both mowing heights. The cultivars responded in a very similar way to the variations in mowing height and fertility in 1990. In general, each of the cultivars performed well through the season. None of the new varieties were observed to be superior to the older Kentucky-31.

Table 6. Turf quality of tall fescue cultivars at two clipping heights and three fertility levels.

	Cultivar	Clip ht inch	lb N/ 1000 ft^2	Ratings[a] May	June	July	Aug	Sept	Mean
1.	REBEL	2	0	3.3	3.0	3.7	4.0	4.7	3.7
2.	REBEL	2	2	6.0	5.7	5.7	6.0	6.3	5.9
3.	REBEL	2	4	7.7	7.7	7.3	7.3	8.0	7.6
4.	REBEL	3	0	3.3	3.0	3.7	3.7	5.0	3.7
5.	REBEL	3	2	4.3	6.0	6.0	6.7	6.7	5.9
6.	REBEL	3	4	8.0	7.7	7.3	8.0	7.3	7.7
7.	MUSTANG	2	0	3.3	3.7	4.3	4.3	5.3	4.2
8.	MUSTANG	2	2	6.0	6.3	6.3	5.3	6.3	6.1
9.	MUSTANG	2	4	8.0	7.7	7.7	7.3	7.7	7.7
10.	MUSTANG	3	0	5.3	4.7	4.7	5.7	6.0	5.3
11.	MUSTANG	3	2	6.7	6.3	6.3	6.0	6.7	6.4
12.	MUSTANG	3	4	6.7	6.7	7.0	7.3	7.0	6.9
13.	KENTUCKY-31	2	0	3.3	3.3	3.7	3.7	5.0	3.8
14.	KENTUCKY-31	2	2	4.7	6.3	5.3	5.0	6.3	5.5
15.	KENTUCKY-31	2	4	6.7	7.7	7.3	7.3	7.7	7.3
16.	KENTUCKY-31	3	0	3.0	3.3	4.0	4.3	5.3	4.0
17.	KENTUCKY-31	3	2	5.0	6.0	5.7	5.7	6.3	5.7
18.	KENTUCKY-31	3	4	7.3	7.7	8.0	8.0	8.0	7.8
19.	HOUNDOG	2	0	3.3	3.3	3.7	4.0	5.0	3.9
20.	HOUNDOG	2	2	5.3	5.7	6.0	6.3	6.3	5.9
21.	HOUNDOG	2	4	7.0	7.7	7.7	7.7	8.0	7.6
22.	HOUNDOG	3	0	3.7	3.3	4.7	4.7	5.0	4.3
23.	HOUNDOG	3	2	6.0	6.0	6.0	6.7	6.3	6.2
24.	HOUNDOG	3	4	8.0	7.7	8.0	8.0	8.0	7.9
25.	FALCON	2	0	3.3	3.7	4.7	4.7	5.7	4.4
26.	FALCON	2	2	5.3	5.7	5.7	5.7	6.0	5.7
27.	FALCON	2	4	7.3	7.3	7.3	7.0	7.7	7.3
28.	FALCON	3	0	3.7	3.3	4.0	4.3	5.7	4.2
29.	FALCON	3	2	5.3	6.0	6.0	6.0	6.0	5.9
30.	FALCON	3	4	8.0	7.7	7.7	7.7	7.0	7.6
LSD cultivar averages				0.3	0.5	1.1	1.0	1.3	0.6
LSD fertilizer treatments				0.5	0.5	0.7	0.5	0.7	0.5

[a] Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Shade Adaptation Study

N. E. Christians

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

The area is located under the canopies of a mature stand of Siberian elm trees (*Ulmus pumila*) at the Iowa State University Horticulture Research Station. The grasses were mowed at a 2- in height and received 2 lb N/1000 ft^2/year. No weed control has been required on the area. The area was irrigated during extended droughts.

Monthly quality data was collected from May through September. Several of the hard fescues (H.F.) and 'Estica' creeping red fescue (C.R.F.) were the best performers in 1990 (Table 7). These were followed by the tall fescues, many of which maintained very good quality all season long. None of the Kentucky bluegrasses maintained an acceptable quality. In general, the Kentucky bluegrasses were the poorest quality grasses in this study.

Table 7. Turf quality ratings of shade trial in 1990 (seeded fall 1987).

	Cultivar	May	June	July	Aug	Sept	Mean
1.	ST-2 (SR-3000) (H.F.)	6.7	7.7	7.7	8.0	6.7	7.3
2.	SPARTAN (H.F.)	6.3	7.7	8.0	7.7	6.3	7.2
3.	BAR FO 81-225 (H.F.)	6.0	7.7	7.7	8.0	6.0	7.1
4.	BILJART (H.F.)	6.7	8.0	8.0	7.0	5.3	7.0
5.	ESTICA (C.R.F.)	6.3	7.7	7.3	8.0	5.7	7.0
6.	WALDINA (H.F.)	6.7	7.7	7.0	7.0	5.7	6.8
7.	REBEL II (T.F.)	6.0	7.0	7.0	7.0	7.0	6.8
8.	APACHE (T.F.)	6.3	6.3	7.0	7.7	6.7	6.8
9.	REBEL (T.F.)	6.3	6.3	7.0	7.0	6.3	6.6
10.	BONANZA (T.F.)	5.3	6.3	6.3	7.3	6.7	6.4
11.	MARY (C.F.)	6.5	7.0	7.0	6.0	5.0	6.3
12.	ARID (T.F.)	5.7	6.7	6.0	6.7	6.7	6.3
13.	FALCON (T.F.)	6.0	6.0	6.7	6.7	6.3	6.3
14.	WALDORF (C.F.)	6.0	6.7	6.3	6.7	5.3	6.2
15.	VICTOR (C.F.)	6.0	6.7	6.3	6.0	5.3	6.1
16.	JAMESTOWN (C.F.)	6.3	6.7	7.0	5.3	4.7	6.0
17.	BANNER (C.F.)	5.8	6.5	6.5	5.8	5.3	6.0
18.	SCALDIS (H.F.)	5.7	6.0	6.3	6.0	5.0	5.8
19.	ATLANTA (C.F.)	6.0	6.3	6.0	6.0	4.3	5.7
20.	PENNLAWN (C.R.F.)	6.0	6.0	6.0	6.0	4.0	5.6
21.	WINTERGREEN (C.F.)	5.0	5.7	6.3	6.0	4.3	5.5
22.	CHATEAU (K.B.)	4.3	5.7	6.3	6.3	4.7	5.5
23.	GLADE (K.B.)	4.0	5.3	6.3	7.0	4.3	5.4
24.	AGRAM (C.F.)	6.0	6.0	5.7	5.3	3.7	5.3
25.	COVENTRY (K.B.)	4.0	6.0	6.0	6.0	4.3	5.3
26.	SHADOW (C.F.)	5.7	6.3	5.0	4.7	4.3	5.2
27.	ENSYLVA (C.R.F.)	5.3	5.7	5.3	5.3	4.3	5.2
28.	RAM I (K.B.)	4.0	5.5	6.0	6.0	4.5	5.2
29.	SABRE (*Poa trivialis*)	3.7	5.0	6.3	6.0	4.0	5.0
30.	KOKET (C.F.)	5.0	5.7	4.7	5.0	4.0	4.9
31.	HIGHLIGHT (C.F.)	5.0	5.3	5.3	5.0	3.3	4.8
32.	MIDNIGHT (K.B.)	3.0	4.3	5.0	6.0	5.0	4.7
33.	BRISTOL (K.B.)	3.7	4.3	4.3	5.0	4.0	4.3
34.	RELIANT (H.F.)	3.3	4.0	4.3	4.3	3.7	3.9
35.	NASSAU (K.B.)	3.3	4.0	4.0	4.0	3.3	3.7
	LSD 0.05	1.5	1.4	1.8	1.5	1.7	1.3

Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

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

Fairway Height Bentgrass Study - 1990

N. E. Christians

The fairway height bentgrass study was established in the fall of 1988 to compare the response of several new cultivars of seeded bentgrasses with the older types. The grass was kept at an 0.5 in mowing height, the standard mowing height for creeping bentgrass fairways. The area received liquid applications of urea as needed during the season (0.2 lb N/1000 ft^2/application in 3 gal water/1000 ft^2). The total N application rate is approximately 3 lb/season. Fungicides and insecticides were used as needed. The area was irrigated as needed, but little irrigation was required until August because of the high rainfall in 1990.

The best cultivars in 1989 were 'SR 1020' and 'Penneagle' (see 1990 research report). In the extremely wet conditions of 1990, 'Penncross' was the best cultivar throughout the season. 'Penneagle', 'J. H. Bent', 'Pennlinks', and 'Putter' also performed very well (Table 8).

Table 8. The 1990 ratings for the fairway bentgrass study established in the fall of 1988.

	Cultivar	May	June	July	Aug.	Sept	Oct	Mean
1	PENNCROSS	7.0	8.0	8.0	6.7	7.0	6.7	7.2
2	PENNEAGLE	5.7	6.7	8.0	7.7	7.7	7.7	7.2
3	J. H. BENT	6.7	7.3	7.3	7.3	6.7	7.0	7.1
4	PENNLINKS	5.7	8.0	7.7	7.3	7.3	6.3	7.1
5	PUTTER	5.3	7.3	8.0	7.0	7.7	6.7	7.0
6	SOUTHSHORE	5.3	7.7	7.3	7.7	7.0	6.7	6.9
7	PROVIDENCE (SR 1019)	5.3	6.3	7.3	7.3	7.7	5.7	6.6
8	ISI 123	5.0	5.3	6.3	6.3	7.7	7.7	6.4
9	SR 1020	4.7	5.3	7.7	7.0	7.3	6.7	6.4
10	COBRA	5.7	5.7	6.7	6.0	7.3	6.3	6.3
11	ISI 124	5.3	6.3	7.0	6.0	7.7	5.7	6.3
12	EMERALD	6.0	5.0	7.0	6.3	6.3	6.3	6.2
13	CARMEN	5.3	6.3	6.3	6.7	6.3	5.0	6.0
14	NATIONAL	5.0	5.0	5.3	5.3	6.0	6.0	5.4
15	PROMINENT	5.3	5.3	5.0	5.0	5.0	6.3	5.3
16	EXETER (COLONIAL BENT)	4.3	5.0	5.3	5.0	5.0	5.0	4.9
	LSD 0.05	1.5	1.2	1.1	1.5	1.1	1.7	0.7

Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Fairway Height Kentucky Bluegrass Trial - 1990

N. E. Christians and R. W. Moore

The Kentucky bluegrass plots in this trial were established in 1979 and the study was maintained at lawn height for nine seasons. In the fall of 1988, the mowing height was slowly reduced to 1 inch to test the cultivars under conditions similar to a Kentucky bluegrass fairway.

The study was irrigated as needed and fertilized at a rate of 4 lb N/1000 ft^2/yr.

'Touchdown' performed best in 1990 (Table 9). The old standby of the 1970's, 'Merion', also performed surprisingly well. ('Merion' is no longer available.) 'Midnight' did very well, but it should be noted that this cultivar does not stand up well in dry years (see 1990 report) and develops severe powdery mildew if there is any shade in the area (the test area is in full sun).

'Majestic' and 'Adelphi' were the lowest rated cultivars. They are generally recognized as good performers at lower mowing heights. The wet season may have resulted in deterioration of quality for these cultivars.

Table 9. Quality ratings for the fairway height Kentucky bluegrass trial.

	Cultivar	May	June	July	Aug	Sept	Mean
1.	TOUCHDOWN	6.7	6.7	8.0	7.7	7.3	7.3
2.	MERION	7.7	6.3	7.0	7.0	8.0	7.2
3.	MIDNIGHT	7.3	7.7	7.3	8.0	7.2	
4.	A-20-6	5.3	7.7	7.3	7.3	7.7	7.1
5.	WABASH	6.3	6.3	7.7	7.3	7.7	7.1
6.	GLADE	6.3	6.7	8.0	7.7	6.3	7.0
7.	A-20	7.0	6.7	6.7	6.7	7.3	6.9
8.	ASPEN	7.0	6.7	7.0	6.7	7.0	6.9
9.	(WTN) H-7	6.3	6.7	7.3	6.7	7.7	6.9
10.	AMERICA	5.3	7.3	7.7	6.3	7.7	6.9
11.	FANFARE	8.0	6.7	7.3	6.3	6.0	6.9
12.	(WTN) I-13	6.0	7.3	7.0	7.3	7.0	6.9
13.	K76-86-4	6.3	6.7	7.3	7.0	7.3	6.9
14.	PARADE	7.0	6.3	6.7	7.0	7.0	6.8
15.	VICTA	6.0	6.7	7.3	6.3	7.7	6.8
16.	VANTAGE	6.3	6.3	7.0	7.3	7.0	6.8
17.	COMMON	6.0	6.3	7.0	6.3	7.7	6.7
18.	K3-160	6.7	6.3	7.3	6.3	6.7	6.7
19.	BFB-35	5.0	6.7	8.0	6.3	7.3	6.7
20.	PLUSH	5.7	6.0	7.7	6.7	7.7	6.7
21.	BRISTOL	5.3	6.0	6.3	7.7	8.0	6.7
22.	SV-01617	6.3	6.3	7.3	6.7	6.7	6.7
23.	ESCORT	5.3	6.7	7.7	6.3	7.3	6.7
24.	CHERI	6.0	6.7	7.0	5.7	7.7	6.6
25.	BARON	6.3	6.3	6.7	6.3	7.3	6.6
26.	PARK	6.7	6.0	6.7	6.7	6.3	6.5
27.	KIMONO	6.3	5.7	7.7	6.3	6.7	6.5
28.	N-535	5.3	6.7	7.0	6.3	7.0	6.5
29.	FYLKING	5.7	6.7	6.3	7.0	7.0	6.5
30.	BONNIEBLUE	5.7	6.3	7.0	6.0	7.7	6.5
31.	SYDSPORT	6.7	6.0	6.7	5.7	7.0	6.4
32.	COLUMBIA	6.0	6.3	6.3	6.3	7.0	6.4
33.	ENMUNDI	5.3	6.3	7.0	6.7	6.7	6.4
34.	P-164B	5.7	6.7	6.3	6.7	6.7	6.4
35.	A-34	5.0	6.3	7.3	6.3	7.0	6.4
36.	BARBIE	6.0	6.3	7.3	5.7	6.0	6.3
37.	TRENTON	5.7	6.7	6.3	6.3	6.7	6.3
38.	RUGBY	5.3	6.7	6.7	6.3	6.7	6.3
39.	MERIT	5.7	6.3	6.3	6.7	6.7	6.3
40.	SENIC	6.0	6.3	6.3	5.7	6.7	6.2
41.	RAM I	5.3	6.3	6.3	6.0	7.0	6.2
42.	AQUILLA	5.0	5.3	6.7	7.0	7.0	6.2
43.	SVING	4.3	6.0	6.7	6.7	6.3	6.0
44.	NUGGET	4.7	6.0	6.3	6.0	7.0	6.0
45.	ARISTA	5.3	5.3	6.3	6.0	6.3	5.9
46.	BIRKA	5.0	6.0	6.3	6.0	6.3	5.9
47.	PENNSTAR	5.7	5.7	6.3	6.0	6.0	5.9
48.	MAJESTIC	5.7	5.7	6.3	6.0	5.7	5.9
49.	ADELPHI	4.7	5.7	6.0	5.7	6.7	5.7
	LSD 0.05	NS	NS	1.3	1.4	NS	1.0

Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.

Preemergence Annual Weed Control Study - 1990

N. E. Christians and R. G. Roe

The 1990 preemergence annual weed control study was conducted at the turfgrass research area on a Nicolett (fine-loamy, mixed-mesic, Aquic Hapludoll) soil with a pH of 6.9 and 2.3% organic matter. The objective of the project was to evaluate the efficacy of several labeled and experimental preemergence herbicides applied to a 'Park' Kentucky bluegrass turf for the control of crabgrass. Plots measured 5 ft by 5 ft. They were arranged in a randomized, complete-block design with three replications.

The area was seeded in the third week of April with a combination of large hairy and smooth crabgrass harvested from the research area. Treatments were applied on April 26. Liquids were applied with a backpack carbon-dioxide sprayer equipped with 8006 nozzles. Granular materials were applied with a hand-held shaker. The study was irrigated following seeding and a heavy infestation of crabgrass developed in the control plots. Heavy rains in May, June, and July kept the area well watered and no additional irrigation was necessary following germination.

The study was observed weekly for signs of phytotoxicity. No damage was observed on any of the treated plots at any time during the summer of 1990. This was likely due to the very wet conditions and the lack of stress in the 2-month period following treatment. Estimates of the percentage reduction of crabgrass were made on July 10. Counts of crabgrass, spurge, and oxalis on the individual plots were made on August 10 (Table 10).

Ronstar 2G provided excellent crabgrass control at both the 2 and 4 lb ai/a rates as did Exp 03621B 2G (an experimental formulation of the same active ingredient). Ronstar at 4 lbs ai/a was the only material to provide 100% crabgrass control season-long during this wet season. Exp 03621C 2G was slightly less effective than Exp 03621B 2G numerically (the differences are not statistically significant). Exp 30509B 3EC did not provide satisfactory weed control unless repeat applications at the 3 lb ai/a level were applied at a 30 day interval.

Bensulide was effective, but Dacthal 6F was not. Team pendimethalin and Barricade were effective and provided similar results at the rates tested.

Gallery is not considered to be a crabgrass control. Its primary use is as a preemergence broadleaf control. Note that it was very effective on spurge and oxalis in this test. Dimension was quite effective at the 0.5 lb ai rate. The two Scotts fertilizer materials with pendimethalin were relatively effective. Both Spring Valley Team and ISU experimental were relatively ineffective in controlling crabgrass.

Table 10. Preemergence annual weed control study. Tested April 26, 1990.

			Control						
		lb/ai	Crabgrass			Spurge		Oxalis	
	Treatment	Acre	7/10	8/10	Ct	8/10	Ct	8/10	Ct
1	Control	-----	0**	0	750	0	2	0	5
2	Ronstar 2G	2.0	99	96	27	0	3	79	1
3	Ronstar 2G	4.0	100	100	2	50	1	93	0
4	Exp 03621B 2G	2.0	97	96	31	0	3	100	0
5	Exp 03621B 2G	4.0	98	98	14	83	0	100	0
6	Exp 03621C 2G	2.0	92	81	142	0	5	43	3
7	Exp 03621C 2G	4.0	99	99	5	100	0	100	0
8	Exp 30509B 3EC	4.0	53	35	485	0	4	100	0
9	Exp 30509B 3EC	6.0	91	82	136	0	7	93	0
10	Exp 30509B 3EC + Exp 30509B 3EC	3 + 2 (30 days)	98	90	77	0	2	100	0
11	Exp 30509B 3EC + Exp 30509B 3EC	3 + 3 (30 days)	100	98	15	50	1	93	0
12	Bensulide 4E	7.5	99	98	12	0	7	71	1
13	Dacthal 6F	10.5	29	52	362	50	1	29	3
14	Team	2.0	92	93	52	0	2	86	1
15	Pendimethalin 60DG	1.5	95	90	77	0	6	100	0
16	Barricade WG 65%	0.33	98	89	84	0	7	100	0
17	Barricade WG 65%	0.5	98	96	31	0	3	79	1
18	Barricade WG 65%	0.65	99	98	17	0	2	86	1
19	Barricade WG 65% + Gallery WG 75%	0.5 + 0.75	100	98	13	83	0	100	0
20	Gallery 75% DF	0.5	33	50	379	100	0	100	0
21	Gallery 75% DF	0.75	68	48	390	100	0	100	0
22	Gallery 75% DF	1.0	93	90	72	100	0	100	0
23	Dimension (Mon 15151 1EC)	0.38	97	94	49	0	5	100	0
24	Dimension (Mon 15151 1EC)	0.50	99	97	23	0	2	79	1
25	Spring Valley 10% Team	2.0	41	38	467	0	3	86	1
26	Spring Valley 10% Team	1.5 + 1.5 (10 wk)	8	52	360	0	4	86	1
27	Scotts 22-0-6	1.5	96	90	77	33	1	100	0
28	Scotts 30-3-10	1.5	94	87	100	50	1	86	1
29	ISU Exp	43.56*	22	26	558	77	1	0	6
30	ISU Exp	87.15*	56	40	453	0	2	57	2
	LSD 0.05		45	42	319	NS		63	3

* lbs material/Acre.
** % of the control.
Ct = plant count/25 ft^2 plot on August 10.

Postemergence Annual Grass Control Study - 1990

N. E. Christians and R. G. Roe

The objective of this study was to investigate the effectiveness of several postemergence annual grass herbicides for the control of crabgrass. Data was also collected on the control of broadleaf weeds. The study was conducted on an area adjacent to the Broadleaf and Postemergence Annual Weed Control Study. The protocols were very similar for the two test sites. The work was conducted on a Nicolett (fine-loamy, mixed-mesic, Aquic Hapludoll) soil with a pH of 6.9 and 2.3% organic matter. Individual plots measured 5 ft by 5 ft. They were arranged in a randomized, complete-block design with three replications. Due to very wet conditions during the study, no additional irrigation was necessary. The grass on the area was a common Kentucky bluegrass that had been in place approximately 20 years.

The study area was seeded in the first week of May, 1990, with a combination of large hairy and smooth crabgrass harvested at the research area and white clover (*Trifolium repens*). Due to the moist conditions, very high populations of both species developed by early June. There was also a native population of dandelion on the test area. Treatments were applied on June 20, 1990, at a time when the crabgrass plants were beginning to form their first tillers. All treatments were applied with a backpack carbgrass carbon-dioxide sprayer equipped with 8006 nozzles. The spray pressure was 20-25 psi. Treatments were applied with the equivalent of 4 gal water/1000 ft^2.

Ratings of phytotoxicity on the Kentucky bluegrass were made on July 13, July 20, and August 1 on a scale of 9 to 1. 9 = no damage and 1 = dead turf. Ratings of 6 and above were acceptable. Weed counts were made on August 17, 1990. White clover was rated on a percent cover basis. Table 11 lists the average number of other weeds in a 5 ft by 5 ft plot and the percentage reduction from the control.

The only material to seriously damage the Kentucky bluegrass turf was HOE 360-05H, an experimental material from American Hoechst (Table 11). This damage was quite severe, particularly at the 0.9 lb ai/a treatment level. It persisted throughout July and into early August. (Symptoms developed approximately two weeks after treatment.)

Crabgrass population was very high on the control plots. The 488 plants per plot represent more than 80% cover. Moisture stress before treatment can often reduce the effectiveness of postemergence annual grass controls. The plot area was very wet during the weeks before treatment and there was no moisture stress on the area at any time during June and July. Crabgrass control was very good for most of the materials studied (Table 11). Acclaim, which has provided somewhat inconsistent control in the last two years when extremely dry conditions existed at the research area, provided 98% crabgrass control in this study. BAS 514 (Impact) at rates of 0.75 lb ai/a and above was very effective on plots treated with single applications and plots that received repeat treatments 30 days after the initial treatment. This material was also quite effective where repeat applications of levels as low as 0.375 lb ai/a were applied. Scotts S-3061 is a granular fertilizer material that contains BAS 514 (Impact). This granular formulation was very effective as a crabgrass control. The Fermenta 2 + 2 was effective as a broadleaf control, but provided no reduction of crabgrass. MON 15104 (Dimension) was a very effective postemergence crabgrass control as it has been in studies conducted during the past few years.

BAS 514 (Impact) provided excellent broadleaf control in this study. The improved dandelion control compared to the adjacent study (Broadleaf and Postemergence Annual Weed Control Study) appears to be due to the repeat treatments in this study.

Table 11. Postemergence annual weed control study. Treated June 20, 1990.

	Treatment	lbs ai/ acre	Phytotoxicity 7/13	7/20	8/1	Control -- August 17, 1990: Crabgrass Pl #	Crabgrass % Ct	Clover % Cvr	Clover % Ct	Spurge Pl #	Spurge % Ct	Oxalis Pl #	Oxalis % Ct	Dandelion Pl #	Dandelion % Ct
1	Control	———	9	9	9	488	0	53	0	3	0	2	0	22	0
2	HOE 360-18H 28 g/l	0.045	9	9	9	44	91	27	41	2	40	0	100	23	0
3	HOE 360-18H 28 g/l	0.06	9	9	9	22	96	58	0	10	0	4	0	21	5
4	HOE 360-18H 28 g/l	0.075	9	9	9	14	97	60	0	4	0	1	60	28	0
5	HOE 360-18H 28 g/l	0.09	9	9	9	37	93	35	34	7	0	6	0	34	0
6	Acclaim	0.18	9	9	9	11	98	8	85	5	0	0	80	18	18
7	HOE 360-05H 80.5 g/l	0.6	4	6	8	28	94	50	6	8	0	2	0	34	0
8	HOE 360-05H 80.5 g/l	0.9	4	4	6	18	96	33	38	3	10	2	0	41	0
9	Sandoz Barricade 65% + Acclaim	0.5 + 0.12	9	9	9	5	99	43	19	1	60	0	100	34	0
10	Sandoz Barricade 65% + MSMA	0.5 + 2.0	9	9	9	28	94	25	55	2	50	0	100	16	27
11	BAS 514-34H + 090 02S	0.75 + 2.0 pt	9	9	9	53	89	0	100	1	70	3	0	1	96
12	BAS 514-34H + 090 02S	1.0 + 2.0 pt	8	8	8	14	97	0	100	1	70	8	0	7	68
13	BAS 514-34H + 090 02S + BCH 865 01S	0.75 + 2.0 pt + 3.0 pt	9	8	8	21	96	0	100	2	50	8	0	2	91
14	BAS 514-34H + 090 02S Repeat 30 days	0.375 + 2.0 pt Repeat 30 days	9	9	9	27	95	0	100	1	60	11	0	0	99
15	BAS 514-34H + 090 02S Repeat 30 days	0.5 + 2.0 pt Repeat 30 days	9	9	9	4	100	0	100	0	90	2	0	0	100
16	BAS 514-34H + 090 02S Repeat 30 days	0.75 + 2.0 pt / 0.25 + 2.0 pt	9	9	9	6	99	0	100	0	100	3	0	0	99
17	BAS 514-34H + 090 02S Repeat 30 days	0.75 + 2.0 pt / 0.375 + 2.0 pt	9	8	9	14	97	0	100	0	90	9	0	0	100
18	BAS 514-34H + 090 02S Repeat 30 days	0.75 + 2.0 pt / 0.5 + 2.0 pt	9	9	8	21	96	0	100	1	70	4	0	1	97
19	BAS 514-34H + 090 02S Repeat 30 days	0.75 + 2.0 pt Repeat 30 days	9	8	8	7	99	0	100	0	100	8	0	0	100
20	BAS 514-34H + 090 02S + BCH 865 01S Repeat 30 days	0.5 + 2.0 pt + 3.0 pt Repeat 30 days	9	9	8	2	100	0	100	1	70	3	0	0	100

Table 11 (Continued).

21	BAS 514-34H + 090 02S + BCH 865 01S Repeat 30 days	0.75 + 2.0 pt + 3.0 pt Repeat 30 days	9	9	9	1	100	0	100	0	100	3	0	0	100
22	Scotts S-3061	0.75	9	9	9	44	91	0	100	1	80	2	0	1	94
23	Scotts S-3061 Repeat 30 days	0.75 Repeat 30 days	9	9	9	8	99	0	100	0	100	1	20	0	100
24	Fermenta 2 + 2	1.0 oz/1000 ft^2	9	9	9	518	0	5	91	3	10	1	60	5	79
25	Fermenta 2 + 2	2.0 oz/1000 ft^2	9	9	9	518	0	2	98	2	30	0	100	0	99
26	MSMA	2.0 oz/1000 ft^2	9	9	9	67	86	6	89	3	20	0	100	5	76
27	MON 15104	0.38	9	9	9	27	95	37	32	4	0	0	100	15	33
28	MON 15104	0.50	9	9	9	13	97	15	72	2	40	2	0	36	0
	LSD 0.05		.7	1.3	NS	99	20	29	54		NS		NS	20	90

9 = no damage and 1 = dead turf
PL # = Plant count/25 sq ft plot.
% Ct = Percent of the control.
% Cvr = Percent cover.
Pt = Pints of product/Acre.

Broadleaf and Postemergence Annual Weed Control Study - 1990

N. E. Christians and R. G. Roe

The objective of this study was to investigate the efficacy of BAS 514 (Impact), an experimental herbicide currently being evaluated as a postemergence control of annual grasses and broadleaf weeds in turf areas. The material was applied alone and in tank-mix combinations with other herbicides (Table 12). The work was conducted on a Nicolett (fine-loamy, mixed-mesic, Aquic Hapludoll) soil with a pH of 6.9 and 2.3% organic matter. Individual plots measured 5 ft by 5 ft. They were arranged in a randomized, complete-block design with three replications. Due to very wet conditions during the study, no additional irrigation was necessary. The grass on the area was a common Kentucky bluegrass that had been in place approximately 20 years.

The study area was seeded with a combination of large hairy and smooth crabgrass harvested at the research area and white clover (*Trifolium repens*) in the first week of May 1990. Due to the moist conditions, very high populations of both species developed by early June. There was also a native population of dandelion on the test area. Treatments were applied on June 20, 1990, at a time when the crabgrass plants were beginning to form their first tillers. All treatments were applied with a backpack carbon dioxide sprayer equipped with 8006 nozzles. The spray pressure was 20-25 psi. Treatments were applied with the equivalent of 4 gal water/1000 ft^2.

Ratings of phytotoxicity on the Kentucky bluegrass were made on July 13, July 20, and August 1 on a scale of 9 to 1. 9 = no damage and 1 = dead turf. Ratings of 6 and above were acceptable. Weed counts were made on August 17, 1990. White clover was rated on a percent cover basis. Table 12 lists the average number of other weeds in a 5 ft by 5 ft plot and the percentage reduction from the control.

No damage occurred on the Kentucky bluegrass in any of the treated plots (Table 12). BAS 514 reduced crabgrass infestation at the 0.25 and 0.375 lb ai/a rates, but did not provide satisfactory control below rates of 0.5 and 0.75 lb ai. Tank-mix combinations with 2,4-D, 2,4DP-P, MCPP-P, and Trimec appeared to reduce crabgrass control to some degree, although the reductions were not statistically significant. Dimension and Confront slightly increased crabgrass control, although again the increase was only numerical and does not exceed the LSD value.

Clover control was excellent for all rates of BAS 514 at 0.5 lb ai/a and above and was not reduced significantly by any of the tank-mixes. Dandelion control was not satisfactory in any of the plots treated with BAS 514 alone and was less than would be desired with many of the tank-mix combinations. Trimec was required in this test for satisfactory dandelion control.

Spurge (*Euphorbia supina*) and oxalis (*Oxalis stricta*) germinated after treatment and there were no statistical differences among treatments.

Table 12. Broadleaf and postemergence annual weed control study. Treated June 20, 1990.

			Control -- August 17, 1990													
	Treatment	lbs ai/ acre	Phytotoxicity			Crabgrass		Clover		Spurge		Oxalis		Dandelion		
			7/13	7/20	8/1	Pl #	% Ct	% Cvr	% Ct	Pl #	% Ct	Pl #	% Ct	Pl #	% Ct
1	Control		9	9	9	490	0	50	0	4	0	5	0	17	0
2	BAS 514 34H	0.75	9	9	9	28	94	0	100	1	69	10	0	12	28
3	BAS 514 34H + 2,4-D Isooctyl Ester	0.75 + 0.75	9	8	9	170	65	0	100	1	69	4	27	2	86
4	BAS 514 34H + 2,4-DP-P	0.75 + 1.0	9	9	9	178	64	0	100	3	31	1	87	7	59
5	BAS 514 34H + MCPP-P	0.75 + 1.0	9	9	9	152	69	0	100	1	69	4	20	7	59
6	BAS 514 34H + Turflon II Amine	0.75 + 1.0	9	8	9	60	88	0	100	3	31	1	80	8	55
7	BAS 514 34H + Basagran	0.75 + 0.25	9	9	9	33	94	0	100	0	100	2	53	4	79
8	BAS 514 34H + Acclaim	0.625 + 0.2	9	8	8	23	95	0	100	3	23	10	0	21	0
9	BAS 514 34H + Dicamba	0.75 + 0.125	9	9	9	39	92	2	95	2	54	4	27	4	77
10	BAS 514 34H + Pendimethalin	0.625 + 1.5	9	9	9	15	97	0	100	0	92	1	73	13	24
11	BAS 514-34H + Balan	0.625 + 1.5	9	9	9	33	93	0	100	2	54	3	47	7	61
12	BAS 514-34H + Dimension 1EC	0.625 + 0.25	9	9	9	15	97	0	100	2	46	2	77	6	65
13	BAS 514-34H + Dimension 1EC	0.5 + 0.25	9	9	9	27	95	0	100	3	31	2	77	8	55
14	BAS 514-34H + Confront	0.75 + 0.56	9	9	9	20	96	0	100	1	77	4	23	3	80
15	BAS 514 34H + MSMA	0.65 + 1.0	9	8	9	70	86	0	100	4	15	2	60	7	59
16	Trimec	3.0 pt	9	9	9	485	1	0	100	1	85	0	100	2	88
17	BAS 514-34H + Trimec	0.75 + 3.0 pt	8	8	9	76	85	0	100	1	85	2	60	2	90
18	BAS 514-34H	0.25	9	9	9	283	42	6	89	3	39	0	93	21	0
19	BAS 514-34H	0.375	9	8	8	157	68	1	98	7	0	5	0	12	30
20	BAS 514-34H	0.5	9	9	9	56	89	0	100	5	0	5	0	11	33
	BAS 090 02S Added to all BAS 514 34H treatments at 2 pts/A														
	LSD 0.05		NS	NS	NS	174	35	7	14		NS		NS	11	67

On a scale of 9 to 1. 9 = no damage and 1 = dead turf.
Pl # = Plant count/25 sq ft plot.
% Ct = Percent of the control.
% Cvr = Percent cover.
Pt = Pints of product/Acre.

Broadleaf Weed Control Study - 1990

R. G. Roe and N. E. Christians

The objective of this study was to investigate the efficacy of ten herbicides currently being evaluated as postemergence controls of broadleaf weeds in turf areas. The study was conducted on a site in southeast Ames at the intersection of Highway 30 and Interstate 35. Individual plots measured 5 ft by 10 ft. They were arranged in a randomized, complete-block design with three replications. No irrigation was available at the site. However, due to very wet conditions throughout the duration of the study no drought stress was present. The grass on the area was a common Kentucky bluegrass of unknown age.

This site had a good population of the following broadleaf weeds: dandelion (*Taraxacum officianale*), white clover (*Trifolium repens*), and spurge (*Euphorbia supina*). Treatments were applied on August 2, 1990. All treatments were applied with a backpack carbon dioxide sprayer equipped with 8006 nozzles. The spray pressure was 20-25 psi. Treatments were applied with the equivalent of 3 gal water/1000 ft^2. A light rain occurred four hours after treatment.

No phytotoxicity was observed on the Kentucky bluegrass. Weed counts were made at 30 days. Table 13 lists the average number of weeds in a 5 ft by 10 ft plot. Turflon D and Super Trimec were the only products to provide satisfactory control of dandelions, clover, and spurge. Confront at the 2 pt ai/a rate showed a numerical reduction of dandelion.

Both Turflon D and Super Trimec were ester formulations that would be expected to penetrate the leaf surface quickly and provide better control in the very wet conditions present during the study period. The amine formulations, while not performing in this test, provide a greater degree of safety for surrounding landscape plants.

Table 13. Broadleaf weed control. Treated August 2, 1990.

	Treatment	lb ai/ acre	Dandelion	Clover	Spurge
1	Control	------	428	17	5
2	RD 392020	1.8 lb	425	2	31
3	RD 392020	2.5 lb	346	13	7
4	RD 104100	2.5 pt	310	11	15
5	RD 104100	3.5 pt	223	2	8
6	Triamine	3.0 pt	247	8	11
7	Triamine	4.0 pt	306	3	4
8	XRM 5202	2.0 pt	343	27	13
9	XRM 5202	3.0 pt	230	16	15
10	XRM 5202	4.0 pt	323	4	20
11	Turflon II Amine	3.0 pt	253	23	11
12	Turflon D	3.0 pt	16	0	2
13	Confront	1.0 pt	210	0	25
14	Confront	1.5 pt	256	0	21
15	Confront	2.0 pt	171	0	19
16	Trimec	4.0 pt	310	2	43
17	Super Trimec	2.5 pt	46	0	1
18	XRM 5290	1.38 lb	383	2	15
	LSD		174	NS	NS

Plots measure 5 ft by 10 ft.

Treated August 2, 1990.

Effects of Dithiopyr (Dimension) on the Rooting of Creeping Bentgrass

N. E. Christians and R. G. Roe

Dithiopyr (Dimension) is a new herbicide likely to be labeled for use on Kentucky bluegrass and other turf species in 1991. It functions both as a preemergence and early postemergence control of crabgrass. Trials with this compound on creeping bentgrass have been limited and little is known about the response of bentgrass to this compound at green-mowing height.

The objectives of this study were to observe rooting responses and foliar phytotoxicity to dithiopyr on creeping bentgrass mowed at 3/16-in and maintained under putting green conditions.

The turf was a 10-year-old stand of 'Penncross' creeping bentgrass established on a 1:1:1 (sand:soil:peat) soil mixture with a pH of 7.1. (Three plots of each replication extended into an adjacent area of 'Penneagle' creeping bentgrass. Observations during the study indicated no variation in response and these plots were included in the analysis.)

The area received 3-4 lb N/1000 ft^2 in 0.2 lb increments as needed. No P or K was applied. Standard fungicide and insecticide treatments were made uniformly on all plots. Each plot measured 5 ft by 5 ft and the study was replicated three times. Treatments were applied on May 9, 1990, with a carbon-dioxide backpack sprayer (Table 14).

The plots were observed for signs of visible treatment differences throughout the summer. At no time were there any signs of phytotoxicity. There was an initial positive response to the granular formulations of dithiopyr in some replications. This appeared to be due to a nutritional stimulation of the grass by the carrier. These responses were not consistent enough to be significant.

Root samples were collected on June 9 and August 5 to a depth of 20 cm. The diameter of the cores was 2.54 cm and six cores were collected per plot. The samples were divided into four subsamples: 0-5, 5-10, 10-15 and 15-20 cm. All soil was washed from the root samples. Samples were dried, weighed, and ashed at 500°C. Root weights were reported as the difference between ashed and dry weights.

Rooting varied by depth on June 9, but was not affected by herbicide treatment. Rooting on August 5 varied with depth, and all herbicide-treated bentgrass showed significantly reduced root weight from the control. There were no differences in rooting among herbicide treatments.

Bensulide is a labeled compound for use on bentgrass greens and was used as a standard in this trial. Root weights of dithiopyr treated bentgrass were generally equal to or greater than that of Bensulide-treated plots. This information combined with the lack of visible phytotoxicity would indicate that dithiopyr is probably as safe as Bensulide for use on these varieties of creeping bentgrass maintained at green height.

Table 14. Response of creeping bentgrass to dithiopyr and other preemergence herbicides.

			ROOTING									
			June 9, 1990					August 5, 1990				
		Rate	- g -					- g -				
	Treatment	lb ai/A	1*	2	3	4	Mean	1	2	3	4	Mean
1	Control	---	0.108	0.020	0.002	0.000	0.032	0.495	0.396	0.005	0.003	0.225
2	Dithiopyr 0.10G	0.125	0.662	0.026	0.002	0.000	0.172	0.120	0.014	0.006	0.002	0.035
3	Dithiopyr 0.10G	0.250	0.060	0.251	0.001	0.000	0.078	0.099	0.024	0.007	0.003	0.033
4	Dithiopyr 0.25G	0.380	0.106	0.018	0.001	0.000	0.031	0.106	0.014	0.005	0.002	0.032
5	Dithiopyr 0.25G	0.500	0.140	0.073	0.009	0.000	0.043	0.103	0.013	0.005	0.002	0.031
6	Dithiopyr 1EC	0.250	0.152	0.021	0.003	0.000	0.044	0.087	0.019	0.002	0.001	0.027
7	Dithiopyr 1EC	0.380	0.127	0.019	0.001	0.000	0.037	0.068	0.017	0.000	0.000	0.021
8	Dithiopyr 1EC	0.500	0.109	0.022	0.001	0.000	0.033	0.068	0.014	0.015	0.000	0.024
9	Dithiopyr 1EC	0.750	0.311	0.023	0.007	0.001	0.086	0.071	0.012	0.000	0.000	0.021
10	Bensulide 4E	10.0	0.102	0.025	0.001	0.000	0.032	0.046	0.017	0.001	0.000	0.016
11	DCPA (Dacthal) 75WP	10.0	0.091	0.020	0.004	0.000	0.029	0.058	0.010	0.005	0.001	0.018
	LSD 0.05						N.S.					0.170

Treatments were applied May 9, 1990, in the equivalent of 3 gal water/1000 ft^2.

* Rooting depths: 1 = 0-5 cm; 2 = 5-10 cm; 3 = 10-15 cm; and 4 = 15-20 cm.

1990 Sod Rooting Trial

R. G. Roe and N. E. Christians

The purpose of this study was to observe the effects of selected pesticides on establishment and rooting of sod. The test was conducted on a Nicollet (fine-loamy, mixed mesic, Aquic Hapludall) soil with a pH of 6.9 and 2.3% organic matter. Individual treatment cells measured 5 ft by 5 ft and were randomized in a complete block design with three replications. Water was applied as needed.

Treatments are listed in Table I5.

Table 15. Treatments included in the 1990 rooting trial.

	Treatment	lb ai/a	Product/ 5 x 5 ft plot	H_2O/ plot
1.	Control	----	----	----
2.	Banner 1.1E	2.0 oz/1000 ft^2	1.47 ml	380 ml
3.	Banner 1.1E [repeat 2 wk]*	2.0 oz/1000 ft^2	1.47 ml + 1.47 ml*	380 ml
4.	Super Trimec	3.0 pt / Acre	0.82 ml	380 ml
5.	Turflon D	3.0 pt / Acre	0.82 ml	380 ml
6.	Turflon II Amine	3.0 pt / Acre	0.82 ml	380 ml
7.	Confront	1.0 pt / Acre	0.27 ml	380 ml
8.	Confront	1.5 pt / Acre	0.40 ml	380 ml
9.	Confront	2.0 pt / Acre	0.54 ml	380 ml
10.	Dursban 4E	1.0 lb ai / Acre	0.54 ml	380 ml
11.	Triumph 4E	1.0 lb ai / Acre	0.54 ml	380 ml

* Repeat in 14 days.

Treatments were applied to the sod on September 19, 1990, with a backpack carbon-dioxide sprayer for the liquid materials, and a shaker box for the granular materials (Table 15). The Kentucky bluegrass turf was cut at a 3/4-in depth and laid in the standard fashion. Sod pieces were transplanted into wooden frames, 3 frames per plot. The frames had 18-mesh fiberglass screen bottoms and were constructed of 1 x 2 in pine boards with inside dimensions of 12 x 12 in. Screw hooks were placed at each of the four corners for use as the point of attachment for the hydraulic lift apparatus.

Rooting was measured with a technique modified from King (King & Beard, 1969). The frames were lifted vertically with a hydraulic pump apparatus. Woven steel cords were attached to each of the four-hook screws on the frame and drawn to an apex over the center of the frame. The lifting apparatus was raised by mounting it on a wooden crate 1 ft above the level of the turf, centered carefully over the frame to assure that the lifting force was vertical. The force at the point of root breakage from the soil was measured by use of a hydraulic pressure gauge. Rooting measurements were used as an indication of sod establishment. The frames were lifted 20 and 30 days following treatment. Visual quality ratings were recorded at 20 and 30 days. Quality was rated on a scale of 1 to 9, 9 = best, 5 = acceptable, and 1 = dead turf. An analysis of variance was performed on all data.

There were no significant differences in sod pulling pressure at either the 20 or 30 day testing time (Table 16). By the 20th day following treatment, the fungicide Banner 1.1E at the 2 oz/1000 ft^2 single application rate showed the greatest numerical pulling pressure. All other treatments reduced root development at 20 days compared to Banner 1.1E. Super Trimec at 3 pt/a and Banner 1.1E at the 2 oz/1000 ft^2 with a repeat application at two weeks showed the greatest reduction.

By the 30th day, the grass on plots treated with Banner 1.1E at the 2 oz/1000 ft^2 with a repeat treatment and Dursban 4E at 1 lb ai/a had numerically greater pulling pressure than the other treatments. Turflon D and Turflon II Amine showed the greatest reduction in rooting.

No noticeable differences in turf quality were visible after treatment.

King, J. W. and J. B. Beard. 1969. Measuring rooting of sodded turf. Agronomy Journal 61:497-498.

Table 16. Pulling pressures measured on treated sod at 20 and 30 days after treatment.

			Pulling Pressure PSI	
	Treatment	Rate	20 days Wood	30 days Wood
1.	Control	---	143.3	230.0
2.	Banner 1.1E	2.0 oz/1000 ft^2	203.3	231.6
3.	Banner 1.1E repeat 2 wk*	2.0 oz/1000 ft^2	156.6	346.6
4.	Super Trimec	3.0 pt/Acre	147.5	271.6
5.	Turflon D	3.0 pt/Acre	180.0	160.0
6.	Turflon II Amine	3.0 pt/Acre	166.6	203.3
7.	Confront	1.0 pt/Acre	176.6	210.0
8.	Confront	1.5 pt/Acre	171.6	306.6
9.	Confront	2.0 pt/Acre	182.5	240.0
10.	Dursban 4E	1.0 lb ai/Acre	193.3	316.6
11.	Triumph 4E	1.0 lb ai/Acre	200.00	256.6

* Repeat in 14 days.

The Effect of Prograss on the Establishment of Cool-Season Grasses

N. E. Christians

Prograss (ethofumesate) is marketed as a postemergence control of annual bluegrass *Poa annua* established in perennial ryegrass, creeping bentgrass (fairway height only), and Kentucky bluegrass turf on golf courses. The objective of this study was to observe the effects of prograss on establishment of five cool season-grasses from seed.

Prograss was applied to freshly tilled soil on Aug 30, 1990, to 10 ft by 5 ft plots at rates of 0 (control), 0.5, and 0.75 lbs. ai/a. Shortly after treatment the plots were split into 5, 2 ft by 5 ft sub-plots and seeded with the following grasses:

Grass	Rate (lbs/1000 ft.^{2})
1. 'Ram 1' Kentucky bluegrass	1.5
2. 'Manhattan II' Perennial Ryegrass	6.0
3. 'Arid' Tall Fescue	8.0
4. 'Penncross' Creeping Bentgrass	1.0

A fifth grass, 'Reliant' hard fescue, was seeded 30 days later on Sept 30 at a rate of 3 lbs/1000 ft.^{2}. Follow-up treatments of Prograss were made on Sept 30 and Oct 30 at the same rates applied on the Aug 30 treatment date.

Observations of percent cover were made at 14 days, 60 days, 75 days (end of the season), and in the spring of 1991 (Table 17). Perennial ryegrass and tall fescue were unaffected by Prograss at either rate. Kentucky bluegrass stand was reduced by two thirds by Prograss at the 0.5 lb ai/a rate and by 98% at the 0.75 lb ai/a rate. 'Penncross' creeping bentgrass was reduced by 52% at the 0.5 lb ai rate and by 87% at the 0.75 lb ai rate. 'Reliant' hard fescue was severely reduced at both rates of prograss.

In an earlier study (1990 Iowa Turfgrass Research Report, p 57-60) 'Shade Master' creeping red fescue showed greater tolerance to Prograss than did the closely related 'Reliant' hard fescue in this study. The earlier study involved delayed seeding dates. More work will be required to determine if these differences in response of the fine fescues are due to seeding date or variety/species differences.

Table 17. The percent cover of 5 cool-season grasses treated with prograss

	14 days	60 days	75 days	Spring
	% cover			
Control				
Kentucky Bluegrass	38	87	70	92
Perennial Ryegrass	73	100	100	100
Hard Fescue*	--	47	30	47
Tall Fescue	60	100	100	100
Creeping Bentgrass	68	100	100	100
Prograss 0.5 lbs ai				
Kentucky Bluegrass	8	33	27	32
Perennial Ryegrass	76	100	100	100
Hard Fescue	--	8	4	3
Tall Fescue	53	100	100	100
Creeping Bentgrass	15	37	25	48
Prograss 0.75 lbs ai				
Kentucky Bluegrass	3	6	3	2
Perennial Ryegrass	70	100	100	100
Hard Fescue	--	6	3	0
Tall Fescue	52	100	97	100
Creeping Bentgrass	7	13	12	13

*Hard fescue was not seeded until 30 days after the other 4 grasses.

Poa annua Control with Ethofumesate on Veenker Golf Course

N. E. Christians, B. Peterson and J. Newton

A demonstration on the use of Ethofumesate (prograss) was established at Veenker Memorial Golf Course in Ames in the fall of 1990. The objective was to evaluate the effectiveness of this material for the control of *Poa annua* on greens, tees, and fairways.

On September 14, 1990, we applied the first application of Ethofumesate to the No. 14 fairway and green and to the No. 15 women's tee. On the fairway and tee, we used a rate of 0 (control), 0.50, and 0.75 pounds active ingredient per acre. Each test strip was 15 ft wide. The length of the fairway strips was approximately 50 yds. The strips on greens and tees were the length of those areas, respectively. Two additional applications were made to the same areas on October 22 and November 16.

Loss of *Poa annua* was observed on the fairway and tee in the spring of 1991. The *Poa annua* on the green, however, was killed at all rates of Ethofumesate and remained healthy in the control strip. By late May, the percentage of bentgrass had increased greatly in the treated plots on the green, whereas the *Poa annua* was the predominate species in the control strip. No damage was observed on the bentgrass at any time during the fall or spring.

The lack of *Poa annua* control on the fairway and tee is still a mystery. The areas were treated at the same time with the same sprayer, yet only the *Poa annua* on the greens was killed. The differences may be due to variations in biotype of the *Poa* on the areas, or there may have been some unobserved differences in environmental conditions among the areas. More work is planned for this fall to determine the reasons for the differences in control observed in the spring of 1991.

Fairway Height Bentgrass Response to Fenoxaprop

N. E. Christians and R. W. Moore

Fenoxaprop (Acclaim) is a postemergence herbicide used for the control of crabgrass in Kentucky bluegrass lawns and other turf areas. Its use on bentgrass is currently not recommended because of concerns over phytotoxicity. Bentgrass cultivars are known to vary in response to herbicides and if there are bentgrasses that can tolerate fenoxaprop, this information would be of use to golf course superintendents.

The objective of this study was to observe the response of 15 creeping bentgrass cultivars and one colonial bentgrass cultivar maintained at fairway height (0.5 in) to fenoxaprop at 0.032 and 0.064 lb ai/a.

The two-year-old stand of creeping bentgrass is located at the Iowa State University Horticulture Research Station on Section 4 of the turfgrass research area. The soil is a Nicolett (fine-loamy, mixed-mesic, Aquic Hapludoll) with a pH of 6.8, 2.3% organic matter and 208 lb K/a. The area received 3 lb N/1000 ft^2 in 1990 in the form of urea. It was mowed at 0.5 in twice weekly during the season. The bentgrass variety trial on which this study was conducted was replicated four times. The fenoxaprop treatments were stripped across the replications. Treatment strips were randomized within replications.

Fenoxaprop treatments were made during the late afternoon of June 20, 1990. The area was not watered for 24 hours following treatment. On June 22, 1 in of rain was recorded. Another 1.5 in fell on June 24, and 1 in was recorded on June 28. The area was not under moisture stress during the study.

The first signs of phytotoxicity were observed on June 25, five days after treatment (Tables 18 & 19).

'Southshore', 'Penncross', and 'SR 1020' were the most tolerant cultivars and were not rated as unsatisfactory at any time following treatment at the 0.064 lb ai/a rate of fenoxaprop. 'Cobra', 'ISI 123', 'Emerald', 'Prominent', 'Carmen', and 'National' were most damaged by the fenoxaprop treatment. Nearly all of the damaged turf had recovered by July 9.

The results of this study indicate that bentgrass cultivar can play an important role in how fairway height bentgrass will respond to fenoxaprop treatments. 'Penncross', 'Penneagle', and 'Pennlinks', all cultivars that are commonly used in the midwest, showed only minor damage at the 0.032 lb ai/a level of fenoxaprop. Penncross appeared to be the best cultivar at the 0.064 lb ai/a rate.

Table 18. Response of 15 creeping bentgrass cultivars and one colonial bentgrass cultivar maintained at fairway height to fenoxaprop at 0.032 and 0.064 lb ai/a. Treatments were applied on June 20.

		June 25			June 28			July 1			July 3			July 6			July 9			July 12		
	Bentgrass Cultivar	0*	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1	Cobra	9	7	5	9	6	4	9	7	5	9	7	6	9	8	0	9	9	9	9	9	9
2	J. H. Bent	9	8	7	9	6	6	9	7	5	9	8	6	9	9	8	9	9	8	9	9	9
3	ISI 123	9	6	5	9	6	3	9	7	5	9	7	5	9	8	7	9	9	9	9	9	9
4	ISI 124	9	7	6	9	6	5	9	7	5	9	7	6	9	9	8	9	9	9	9	9	9
5	Emerald	9	7	5	9	6	4	9	6	5	9	7	5	9	8	7	9	9	9	9	9	9
6	Southshore	9	9	7	9	8	6	9	8	6	9	8	7	9	8	8	9	9	9	9	9	9
7	Penncross	9	8	8	9	7	6	9	8	7	9	9	8	9	9	9	9	9	9	9	9	9
8	Penneagle	9	9	7	9	7	5	9	7	5	9	8	7	9	9	8	9	9	9	9	9	9
9	Pennlinks	9	9	8	9	8	5	9	8	5	9	9	6	9	9	8	9	9	9	9	9	9
10	Prominent	9	7	5	9	6	4	9	7	4	9	7	6	9	8	8	9	9	8	9	9	9
11	SR 1020	9	8	7	9	8	6	9	9	6	9	8	7	9	9	8	9	9	9	9	9	9
12	Providence (SR 1019)	9	9	8	9	8	5	9	9	6	9	9	7	9	9	8	9	9	9	9	9	9
13	Putter	9	9	8	9	8	5	9	8	6	9	8	8	9	9	8	9	9	9	9	9	9
14	Carmen	9	8	7	9	6	4	9	7	6	9	8	7	9	9	8	9	9	9	9	9	9
15	National	9	8	7	9	5	4	9	7	5	9	8	6	9	9	8	9	9	9	9	9	9
16	Exeter (Colonial Bent)	9	7	6	9	8	5	9	8	6	9	8	7	9	9	8	9	9	9	9	9	9
	LSD 0.05**	1.7			1.6			1.3			1.4			0.7			0.4			NS		

* 0, 1, and 2 represent the control (0), fenoxaprop at 0.032 lb ai/a (1), and fenoxaprop at 0.064 lb ai/a (2).

** LSD values are for the separation of fenoxaprop means within a cultivar.

NS = not significant at the 0.05 level.

Data are phytotoxicity ratings where 9 = no damage, 1 - dead and 6 = acceptable.

Table 19. Average phytotoxicity rating for each of the 16 bentgrass cultivars. Treatments were applied on June 20.

	Bentgrass cultivar	June 25	June 28	July 1	July 3	July 6	July 9	July 12
1	Cobra	7	6	7	7	8	9	9
2	J. H. Bent	8	7	7	8	8	9	9
3	ISI 123	7	6	7	7	8	9	9
4	ISI 124	7	7	7	7	9	9	9
5	Emerald	7	6	7	7	8	9	9
6	Southshore	8	8	8	8	8	9	9
7	Penncross	8	7	8	8	9	9	9
8	Penneagle	8	7	7	8	9	9	9
9	Pennlinks	9	7	8	8	9	9	9
10	Prominent	7	6	7	7	8	9	9
11	SR 1020	8	7	8	8	9	9	9
12	Providence (SR 1019)	9	7	8	8	9	9	9
13	Putter	8	7	8	8	9	9	9
14	Carmen	8	7	7	7	9	9	9
15	National	8	6	7	7	9	9	9
16	Exeter (Colonial Bent)	8	7	7	8	9	9	9
	LSD 0.05	0.9	1.0	0.8	0.7	0.4	NS	NS

The Response of Kentucky Bluegrass Turf to Mefluidide Applied in Combination with Fungicides and Other Compounds

N. E. Christians and S. Luke

Mefluidide (Embark) is a growth-regulating compound labeled for use on Kentucky bluegrass turf. Under some conditions, its use can result in turf discoloration. In this study, two fungicides propicanazole (Banner) and triadimefon (Bayleton), Ferromec (an iron source), and BA (benzyladenine, a synthetic cytokinin plant hormone) were applied in combination with mefluidide.

The objectives of the study were to determine if the additives would reduce turf discoloration and to observe any effects the chemicals may have had on turf growth response to mefluidide.

The study was conducted on a 5-year-old mixed stand of 'Parade', 'Glade', 'Rugby', and 'Adelphi' Kentucky bluegrass established on a Nicolett (fine-loamy, mixed-mesic, Aquic Hapludoll) soil with a pH of 6.9 and 2.3% organic matter. The turf was mowed at 2 in and had received 1 lb N/1000 ft^2 before treatment. Treatments were applied on May 2 in three replications to 5 ft by 5 ft plots (Table 20).

All of the treated plots were observed to have significantly lower turf quality than the control on May 16, June 1, and June 8 (Table 20). Ferromec AC provided an initial response over mefluidide alone at the first rating date, but no significant effects were observed after that time (Table 20). No significant response was observed on plots treated with propicanazole. BA and triadimefon did not significantly alter turf quality on any of the treated areas beyond those effects observed with mefluidide alone.

All treated plots had significantly reduced leaf height from the control and all displayed greatly reduced seedhead formation.

At the highest rate, propicanazole and triadimefon appeared to improve growth suppression over plots treated with mefluidide alone, although these variations were not significantly different at the 0.05 level.

There were no differences in seedhead suppression among any of the treated plots.

The spring and summer of 1990 were extremely wet. Through much of the test period, the plot area was saturated. In spite of the excessive moisture, mefluidide was effective in suppressing growth and seedhead formation. The effects of the additives may have been affected by the moisture, however, and further work should be conducted with these materials under more normal conditions.

Table 20. Turf response to mefluidide and additives.

	Treatment	Rate-oz /1000 ft^2	Quality*					Leaf Spot** 5/26	Leaf Height (cm) 6/1	Seedhead+ suppression
			5/16	5/26	6/1	6/8	6/18			
1	Mefluidide	0.4	5.5	6.0	5.0	5.5	7.5	8.0	8.5	99
2	Mefluidide + Ferromec AC	0.4/0.6	6.5	6.5	6.5	6.5	7.5	7.5	8.7	91
3	Mefluidide + Propicanazole	0.4/0.046	5.5	5.5	5.5	6.5	8.0	5.5	7.0	99
4	Mefluidide + Propicanazole	0.4/0.092	6.0	5.5	5.5	5.5	7.0	6.5	7.0	97
5	Mefluidide + Triadimefon	0.4/0.184	5.5	6.5	5.5	5.5	8.0	8.0	8.5	94
6	Mefluidide + Triadimefon	0.4/0.26	6.0	6.5	6.0	6.5	8.0	8.0	7.3	96
7	Mefluidide + BA	0.4/0.6	5.5	5.5	6.0	6.5	8.0	6.5	8.5	99
8	Mefluidide + BA	0.4/1.2	6.0	6.0	5.3	6.5	7.5	7.0	8.0	97
9	Untreated Control	----	7.0	6.5	8.0	8.0	8.0	8.0	12.0	00
	LSD 0.05		0.9	NS	1.2	1.3	NS	NS	1.6	10

* Quality was rated on a scale of 9 to 1: 9 = best, 6 = acceptable, 1 = worst.
** Leaf spot disease ratings were based on a scale of 9 to 1; 9 = no disease, 1 = severe disease.
\+ Seedhead suppression is listed as percentage inhibition of seedhead formation.

Evaluation of Fungicides for Control of Leaf Spot on Park Kentucky Bluegrass - 1990

M. L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to Kentucky bluegrass (cultivar: 'Park'), maintained at a 2 1/2 in cutting height, with 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 plan with four replications. All plots measured 4 ft by 5 ft. Fungicides were applied on a 14, 21, or 28 day schedule (Table 22). Applications began on June 5 and continued through July 16. Plots were evaluated for severity of leaf spot symptoms on July 11 and August 10.

Leaf spot was present at trace to low levels on all rating dates. ASC-66608 at 5 oz (July 11), ASC-66518 at 3.8 oz (July 31), and ASC-66608 at 7.5 oz (July 31) had leaf spot levels significantly below the check. No phytotoxicity symptoms were noted on any rating date.

Table 22. Evaluation of fungicides for control of leaf spot in Park Kentucky bluegrass, 1990.

Company	Treatment	Rate per 1000 ft^2	Timing (days)	Disease Rating[a] June 28	July 11	Jul 31
-----	Check	-----	---	1.75 a	2.00 a	2.25 a
Grace-Sierra	Vorlan-Fungo Premix	2 oz	14	1.75 a	1.25 ab	2.00 ab
	Vorlan-Fungo Premix	4 oz	14	1.50 a	1.25 ab	1.25 ab
	Vorlan Flo	2 oz	14	1.50 a	1.88 a	1.75 ab
Rhone-Poulenc	Chipco 26019 Flo	4 oz	21	2.25 a	1.25 ab	1.50 ab
Fermenta	Daconil 2787	6 oz	14	1.25 a	1.00 ab	1.00 ab
	ASC-66518-X-'d' 82	3.8 oz	14	1.25 a	1.00 ab	0.75 b
	ASC-66608	5 oz	14	1.50 a	0.75 b	1.25 ab
	ASC-66608	7.5 oz	14	1.50 a	1.13 ab	0.75 b

[a] Means of ratings from four replicate plots. Ratings were based on the following scale: 0 - no trace; 1 - trace; 2 - slight damage; 3 - moderate damage; 4 - severe damage (melting out).

Means followed by the same letter are not significantly different (DMRT, P - 0.05).

Evaluation of Fungicides for Control of Snow Molds on Creeping Bentgrass, 1990-1991

M. L. Gleason

The trial was conducted on a creeping bentgrass green (Hole #4) at the Waverly Municipal Golf Course, Waverly, Iowa. This green had a history of outbreaks of gray and pink snow molds in most of the last 10 years. The experimental design was a randomized, complete-block with 4 replications. All plots measured 5 ft by 5 ft Fungicides were applied on November 13, 1990, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2.

Immediately after application of fungicides, the entire plot was covered with two layers of Curlex High-Velocity excelsior mats (American Excelsior Co., St. Paul, MN). The mats were fixed in place with wire stakes. The purpose of the mats was to simulate snow cover and provide favorable conditions for the development of snow mold even in the absence of snow cover (W. Stienstra, Department of Plant Pathology, University of Minnesota, personal communication).

Snow cover persisted on the green from December 5, 1990, until March 1, 1991. Mats were removed on March 6. On that date, symptoms of gray and pink snow mold were abundant at many sites on the golf course.

Snow-mold development on untreated check plots was moderate (Table 23). Symptoms of both gray and pink snow mold were evident in these plots. All fungicide treatments were free of snow mold damage. None of the fungicide treatments were significantly different from the others in disease suppression. Treatments that incorporated green paint were perceptibly greener in color than other treatments. No phytotoxicity symptoms were observed.

Because snow-mold occurred naturally at Waverly Municipal Golf Course in 1990-91, no conclusion could be drawn about the effect of excelsior mats on disease development. However, in winters with less than 3 months of snow cover (a common occurrence in Iowa), the mats may provide temperature and moisture conditions favorable for snow mold development.

Table 23. Evaluation of fungicides for control of snow mold in creeping bentgrass at Waverly Municipal Golf Course, Waverly, IA, 1990-91.

Company	Treatment	Rate/1000 ft^2 with symptoms[a]	Percentage of Plot
------- Check	-------	17.5 a	
ISK Biotech	Daconil 2787	16 oz	0 b
ISK Biotech	Daconil 2787	16 oz	0 b
	+ green latex paint(67019)	1 gal/40 gal H_2O	
ISK Biotech	ASC 66791	8 oz	0 b
ISK Biotech	ASC 66791	8 oz	0 b
	+ green latex paint(67019)	1 gal/40 gal H_2O	
DowElanco	Rubigan 1AS	8 oz	0.5 b
Nor-AM	NA249 70 WDG	1.25 oz ai	0 b
	(coformulation)		
Terra	Banner 1.1 EC	4 oz	0 b
Terra	Banner 1.1 EC		
	+ Plex	0.25%	0 b
Terra	Rubigan 1AS	8 oz	0.5 b
	+ Plex	0.25%	
Grace-Sierra	Calo-Gran	8 lb	0 b
O. M. Scott	S-2621	2.6 kg	0 b

[a] Means of 4 replications. Means followed by the same letter are not significantly different (DMRT, P=0.05).

Evaluation of Fungicides for Control of Dollar Spot on Emerald Bentgrass - 1990

M. L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to 'Emerald' bentgrass maintained at a 5/32-in cutting height with 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 three replications. Treated plots were alternated with untreated plots so treated plots did not adjoin each other. All plots measured 4 ft by 5 ft. Fungicides were applied on a 14, 21, or 28-day schedule (Table 24). Applications began on June 5 and continued through July 17. Plots were evaluated for severity of leaf spot symptoms on June 28, July 11, July 27, and August 10.

The entire plot was inoculated with rye grains infested with the dollar spot pathogen on May 31, 5 days before fungicide applications were begun.

As noted in Table 24, the August 10 rating was taken approximately 3 weeks after the final spraying. On this date, the rating was intended to be a measure of residual activity for 14-day-interval treatments, because ratings were made 3 rather than 2 weeks after spraying.

Disease ratings for dollar spot were made by counting the number of dollar spot infection centers per plot. Disease began to appear on June 21. Disease pressure was moderate to severe on June 28 and July 11 and very severe on July 27 and August 10.

Almost all treatments suppressed dollar spot significantly better than the check (unsprayed) treatment. The only exceptions were Banner at 1 oz, Banner at 0.5 oz plus Plex at 0.37 oz, and Chipco 26019 Flo at 4 oz on June 28. All the curative treatments had significantly fewer dollar spot infection centers per plot than the check on July 13 and July 26. No phytotoxicity symptoms were noted on any rating dates.

Table 24. Evaluation of fungicides for control of dollar spot in Emerald bentgrass

Company	Treatment	Rate per 1000 ft^2	Timing (days)	Disease Rating[a] Jun 28	Jul 11	Jul 27	Aug 10[b]
-----	Check	-----	---	52.67 bc	88.33 a	178.33 a	350.00 a
Ciba-Geigy	Banner	.5 oz	21	9.33 d	0.00 b	0.33 b	19.00 ef
	Banner	1 oz	21	23.67 cd	0.67 b	0.00 b	0.33 f
Terra/ Ciba-Geigy	Banner/Plex	.5 oz/.37 oz	21	67.00 ab	1.67 b	0.33 b	53.00 def
	Banner/Plex	1 oz/.37 oz	21	17.33 d	0.00 b	0.00 b	1.67 f
Mobay	Lynx 25 DF/ X-77	1.5 oz a i / 0.5 oz	28	0.00 d	0.00 b	0.00 b	7.67 f
	Bayleton	2 oz a i	28	0.00 d	0.00 b	0.00 b	5.33 f
Grace-Sierra	Vorlan-Fungo Premix	2 oz	14	0.33 d	0.00 b	0.00 b	20.67 ef
	Vorlan-Fungo Premix	4 oz	14	0.00 d	0.00 b	0.00 b	42.33 ef
	Vorlan Flo	2 oz	14	0.00 d	0.00 b	0.00 b	66.33 cdef
	Fungo Flo	2 oz	14	0.00 d	0.00 b	0.00 b	6.00 f
Dow Elanco	Rubigan 1 AS	1.5 oz	14	0.00 d	0.00 b	0.00 b	11.67 f
Nor-Am	SN 84364 70 WDG (NA 249)	1.25 oz a i	21	18.00 d	0.00 b	0.00 b	0.33 f
Rhone-Poulenc	Chipco 26019 Flo	4 oz	21	95.00 a	3.67 b	0.00 b	124.33 bcdef
Sandoz	Cyproconazole 40 WG	0.17 oz	28	14.00 d	3.00 b	6.67 b	66.00 cdef
	Cyproconazole 40 WG	0.25 oz	28	0.00 d	0.00 b	0.00 b	2.67 f
Fermenta	Daconil 2787	6 oz	14	0.33 d	1.33 b	11.67 b	123.33 bcdef
	ASC-66518-X-'a' 75 FG	4.2 oz	14	0.00 d	4.67 b	65.33 b	130.67 bcdef
	ASC-66518-X-'6' 75 FG	4.2 oz	14	0.00 d	1.33 b	13.00 b	174.67 bcd
	ASC-66518-X-'6' 82.5 FG	3.8 oz	14	1.00 d	22.33 b	49.67 b	177.00 bcd
	ASC-66518-X-'d' 82 FG	3.8 oz	14	1.00 d	3.00 b	44.67 b	206.67 b
	ASC-66608	5 oz	14	5.00 d	7.00 b	44.33 b	149.67 bcde
	ASC-66608	7.5 oz	14	0.00 d	0.00 b	26.00 b	186.67 bc
	ASC-66811 10 EC	.015 oz a i	14	0.33 d	0.00 b	0.00 b	0.00 f
	ASC-66811 10 EC	.03 oz a i	21	15.00 d	0.00 b	0.00 b	1.67 f
	ASC-66900	4 oz	14	0.33 d	0.00 b	25.67 b	143.67 bcde
	Bravo 90 DG	3.5 oz	14	4.67 d	5.33 b	32.67 b	183.33 bcd

[a] Means of counts of number of infection centers per plot from three replicate plots.
[b] Aug. 10 ratings were made 3 weeks after final sprays were applied.
Means followed by the same letter are not significantly different (DMRT, P = 0.05).

Report of Insecticide Evaluation

D. R. Lewis, N. E. Christians

Damage to turfgrass by annual white grubs (*Cyclocephala* spp.) is a common, but spotty and locally severe problem in Iowa. Amount of damage varies greatly from place to place and year to year, depending on several factors such as grass variety, cultural maintenance practices, irrigation, and weather. Root feeding by these masked chafer larvae characteristically causes grass to wilt, turn tan, and finally die, usually in late August or early September. Several granular and sprayable insecticide products are registered for white grub control. Timing of insecticide application is very important in achieving effective control of white grubs before damage becomes severe.

The objective of this study was to evaluate and compare the efficacy of several registered and experimental insecticides against annual white grubs infesting turfgrass.

The study was conducted on a rough area of the Hyperion Field Club located in Johnston, Iowa (Polk County). The soil at the club is a Waukegan loam (fine silt over sandy, mixed, mesic typic Hapludoll) with 148 lb/a P, 480 lb/a K, and 5% organic matter. The plots were on an east-facing slope. The grass species in the plots were Kentucky bluegrass and a small amount of crabgrass. The rough was receiving low maintenance but regular mowing (at approximately 3 in) and irrigation as necessary. There was between 1/4 and 1/2 in of thatch at the test site.

Grubs were present in the plot area at the time of insecticide application. Grass was very healthy and lush as a result of unprecedented rainfall during the first 8 months of 1990. The insecticide treatments were applied on August 16, 1990 except for the low rate of Gamma-Mean 400 (0.7 lb ai/a) which was applied on August 21, 1990. Grub population counts were made September 27, 1990.

The experimental design consisted of 12 treatment plots and one untreated check plot, randomly assigned in each of three replications. Each plot consisted of a 5 ft^2 area (25 ft^2). All insecticides were applied at the rate specified on the manufacturer's label or product guidelines. Liquid and dry flowable insecticides were diluted with water. The Gamma-Mean 400 product was tank-mixed with a penetrant supplied by the manufacturer. Sprays were applied with a compressed gas, backpack sprayer connected to a hand-held, three-nozzle boom. The boom covered a 5 ft wide area, and diluted insecticide spray was applied to the test plots with alternating perpendicular passes over the treatment area. The amount of spray solution applied to each plot was the equivalent of 131 gal or 3 gal per 1000 ft^2. Granular insecticides were premeasured into round, cardboard containers and applied uniformly over the plot by shaking through a perforated lid. The insecticides were watered into the turfgrass with approximately 1/2 in of irrigation.

Annual white grub population counts were made five weeks after treatment by randomly selecting four sample sites within each plot and cutting an 8 in circular plug with a "large cup" cutter. The sod was removed from the cut area and the root mass carefully parted and examined for living grubs. The soil beneath the cut sod was scratched loose to a depth of 2 in and similarly examined. The total number of white grubs found in each sample was recorded. Population counts in the samples were converted to number of white grubs per square foot for analysis and reporting.

The insecticides used in this project, formulation, rate of application, and mean number of white grubs per square foot are given in Table 25. Significant differences among treatments and between treatments and the untreated check were difficult to determine because of very low numbers of white grubs in the untreated checks and variation in population density among replications. However, a nonrestricted least significant difference (LSD) test was done to examine for significant differences in the treatment plots.

The average population density in the untreated check plots was only 1.9 white grubs per square foot. This is less than the population density threshold considered sufficient to cause damage in irrigated, healthy turfgrass. Indeed, the grass in the plots looked very good at the time of grub counting and root damage was very slight as evidenced by the strong root system connecting the cut plugs to the soil.

In spite of the low white grub numbers, differences in product performance can be detected. The high rate of Triumph 4E, Chipco Mocap 5G, and the Oftanol 2E provided significant control. Population reduction just outside the significant range was achieved with Triumph 1G (both rates) and Pageant DF chlorpyrifos. The chlorpyrifos observation is interesting in light of poor performance of Dursban products in earlier trials at this golf course and frequent complaints about Dursban performance within the turfgrass industry.

Products providing little or no control of white grubs included the low rate of Triumph 4E, Chipco Sevimol 4E, Gamma-Mean 400 (both rates), and Dylox SP.

Table 25. Effects of commercially available insecticides on annual white grubs infesting turfgrass, Polk County, Iowa, 1990.

Insecticide / Formulation	Rate lb ai/A	Mean number white grubs per square foot
Control		1.9
Triumph 4E	1.0	0.7
Triumph 4E	2.0	0.0
Triumph 1G	1.0	0.3
Triumph 1G	2.0	0.3
Chipco Sevimol 4E	8.0	1.0
Chipco Mocap 5G	5.0	0.0
Gamma-Mean 400	0.7	1.6
Gamma-Mean 400	1.0	1.2
Oftanol 2E	2.0	0.0
Dylox 80 SP	8.2	1.2
Turcam 2.5G	2.0	0.0
Pageant DF (chlorpyrifos)	1.0	0.3
LSD ($p>F = 0.14$)		1.7

Population count date - September 27, 1990

Controlling Adult Bluegrass Billbugs in Kentucky Bluegrass - 1990

S. M. Kassmeyer, D. R. Lewis, M. L. Agnew, and N. E. Christians

Damage resulting from the bluegrass billbug *Sphenophorus parvulus* Gyll. is generally not observed until late summer when it is too late to chemically treat the billbugs. A more effective means of controlling the bluegrass billbug is to kill the adult billbug before egg laying in April or early May.

The objective of this field test was to study the effectiveness of 12 insecticide treatments in controlling adult bluegrass billbugs in the spring as they emerge.

This study was conducted on a home lawn in Fort Dodge, Iowa, with the help of Myron Groat, owner ABC Lawn Care. The testing area consisted of Kentucky bluegrass, *Poa pratensis* L. and red fescue, *Festuca rubra* L. An apparent thatch layer was present. The area consisted of 12 insecticide treatment plots and one untreated check plot, randomly assigned, and replicated three times (Table 26). Each plot consisted of a 5 ft by 5 ft^2 area. The testing area was partially shaded during late afternoon. The plot area was mowed at 2 1/2 inc and received record rainfalls in May, June, and July.

Larvae damage from the previous year was apparent and adult bluegrass billbugs were found before treatments were applied. The insecticide treatments were applied on April 20, 199,0 with a carbon-dioxide backpack sprayer attached to a Chemlawn gun.

The plots were evaluated for billbug damage on July 7, 1990 (Table 26.). Very few larvae were observed in the test area. Each plot was rated on a scale of 0 to 10, with 0 equalling no injury and 10 equalling 100% injury. Very little visual damage was observed in the test area. No significant differences were observed in the July 7th rating.

The lack of billbug activity on this particular site was unexpected. This lawn had billbug damage the previous three years. The only difference was that climatic conditions of 1987 through 1989 were dry. In 1988, which was the hottest and driest on record, billbug damage to this lawn was extensive. In 1990, the rainfall in Fort Dodge hit an all-time high. Over 35 in of rainfall were registered by August 1. The excessive rains either masked billbug injury or prevented a viable hatching in 1990.

Table 26. Effects of different insecticide formulations on adult bluegrass billbugs infesting turfgrass, Fort Dodge, Iowa.

Treatment Number	Insecticide Formulation	Rate (ai/A)	Damage Rating
1.	Dursban Turf Insecticide	1 lb	2.0
2.	Dursban Turf Insecticide	0.5 lb	1.0
3.	XRM-5184	1 lb	1.3
4.	XRM-5184	0.5 lb	1.3
5.	Empire *20	1 lb	2.0
6.	Empire *20	0.5 lb	2.0
7.	Pageant DF	1 lb	2.7
8.	Pageant DF	0.5 lb	1.0
9.	Triumph 4E	2 lb	1.3
10.	Turcam	(1 oz/1000 ft^2)	1.7
11.	Tempo	(6 oz/1000 ft^2)	1.0
12.	Gamma-Mean 400 plus Penetrator	(.8oz/1000 ft^2)	0.7
13.	Control	-----	1.7

All treatments were applied with 380 ml H_2O/plot, equivalent to 4 gal/1000 ft^2.

CORON Research at Iowa State University

M. L. Agnew and S. M. Kassmeyer

CORON Burn Study: A foliar burn study was designed to compare the effects of two fertilizer sources, two nitrogen rates, and three water dilution rates on the burn potential of Kentucky bluegrass, *Poa pratensis L.* The two fertilizer sources were CORON (28-0-0) and urea (46-0-0). The intended nitrogen rates were 1 and 2 lb N/1000 ft^2 for both N sources. However, due to a calculation error, the nitrogen rate for CORON on the first treatment date was 2 and 4 lb N/1000 ft^2. Each fertilizer source and nitrogen rate was diluted into 1-, 3-, and 5-gal of water/1000 ft^2. A list of treatments is included on Tables 27, 28 and 29. Each plot measured 5 ft by 5 ft and was replicated 3 times in a randomized, complete-block design. Irrigation was provided to the plots to prevent drought stress. All plots were maintained at a cutting height of 2 in prior to treatments. Plots were left unmowed for 2 weeks following the initial treatment. Treatments were applied on the following cultivars of Kentucky bluegrass:

June 28	'Glade'
July 16	'Park'
September 5	'Glade'

Burn ratings and recovery quality data were recorded after each treatment. Burn rating was a visual rating of each plot. All ratings were made on a scale of 1 to 9, with 1 = dead turf and 9 = no burn. Recovery quality was a visual rating of each plot. This rating was also based on a scale of 1 to 9, with 1 = straw brown turf, 9 = green turf and 6.0 a minimum acceptable level.

The first burn treatment was made in late spring. As stated above, N rates for CORON on the first treatment date were 2 and 4 lb N/1000 ft^2. The data shows that 4 lb of N applied as CORON can cause a great deal of burn (Table 27). The CORON treatment at the 2 lb N rate showed less burn than the urea treatment at a 2 lb N rate. The water rate had no effect on burn potential for this application. The recovery rate of the burn plots was exceptional. The CORON treatments containing 4 lb N rates produced a very dark green turf by mid-August.

The second burn treatment was made in midsummer. Urea caused immediate burn. The plants quickly outgrew the foliar burn. The common bluegrass cultivars coupled with excessive rains probably helped decrease the burn effect. CORON caused very little burn after this treatment (Table 28). Regardless of N source, the 2 lb N rate caused greater burn, but it had a better recovery rate than the 1 lb N rate. CORON-treated plots generally recovered better than urea treated plots. While water rate did not affect initial burn, it did affect the recovery rate. Plots treated with the 3 to 5 gal water rate recovered better than plots treated with the 1 gal water rate.

The last treatment date was intended for cooler fall weather. However, September was the hottest, driest month in during 1990. Urea-treated plots had a greater burn rate than CORON treatments (Table 29). In addition, urea at the 2 lb N rate had the most severe burn, while CORON at the 2 lb N rate had the best overall rating on the second and third rating date. The 2 lb N rate recovered better from the burn and the water rates of 3 and 5 gal had better recovery rates.

In summary, CORON can cause severe burn if applied at excessively high N rates (4 lb N). However, even at these high rates, the recovery of plants treated by CORON was excellent. In contrast, urea caused severe burn but didn't recover as well as CORON. In addition, it is best to use a 3 or 5 gal water rate when using urea.

CORON Response Study: This study was designed to compare the length of response of 2 N sources (CORON 28-0-0 and Nutriculture 28-8-18) and 3 N rates (0.1, 0.2, 0.3 lb N) on a high sand content green. This study was conducted on a USGA green with a rootzone mixture of 80% sand, 10% peat, and 10% silt. The pH of the green was 8.3; P and K levels were low. Two lbs K_2O were applied to the entire green on June 10, 1990. The turfgrass species was *(Creeping Bentgrass) Agrostis palustris L.* Fertilizer applications were made on June 17, July 27, and August 8. Each fertilizer was applied with 3 gal water/1000 ft^2. Each plot measured 5 ft by 5 ft and was replicated 3 times in a randomized, complete-block design. The plots were maintained at a 1/4 in mowing height and irrigated as needed.

Visual quality ratings were taken after each treatment application until there were no visible treatment effects. Ratings were made on a scale of 1 to 9 with 1 = to dead, straw brown turf and 9 = dark green dense turf.

Figures 3, 4, and 5 show that CORON applied at 0.3 and 0.2 lb N rates produced the best quality turf in this study. While CORON treatments produced higher ratings than the Nutriculture treatments, all treatments will produce an acceptable quality turf. The 0.1lb N rate of Nutriculture showed less then unacceptable quality rating only twice in this study.

In summary, CORON provided a better quality turf than Nutriculture. The CORON provided better efficacy because it is most likely not as mobile as the Nutriculture.

Table 27. Effects of fertilizer source, fertilizer, rate and water rate on leaf burn and recovery of fertilizer applied on September 5, 1990

			Visual Burn Rating[3]			Recovery Quality[4]
Fertilizer Source	Fertilizer Rate[1]	Water Rate[2]	6/30	7/3	7/6	8/14
CORAN	2	1	6.7	5.7	6.3	7.7
CORAN	2	3	7.0	5.3	6.7	8.3
CORAN	2	5	7.7	5.3	6.3	7.7
CORAN	4	1	5.3	3.0	4.0	8.7
CORAN	4	3	5.0	3.3	4.7	8.7
CORAN	4	5	4.3	2.7	3.7	9.0
Urea	1	1	6.7	6.7	7.3	6.0
Urea	1	3	6.0	6.7	8.0	5.7
Urea	1	5	7.0	7.3	7.7	6.3
Urea	2	1	4.3	4.7	6.0	6.0
Urea	2	3	4.3	4.0	4.7	7.0
Urea	2	5	4.7	4.3	5.0	7.0
LSD (0.05)			1.3	1.4	2.3	1.8

1. Fertilizer rate = pound N/1000 ft^2.
2. Water rate = gallon of water/1000 ft^2.
3. Burn rating = a visual rating of each plot. All ratings were made on a scale of 1 to 9, with 1 = dead turf and 9 = no burn.
4. Recovery quality is a visual rating of each plot. The rating is based on a scale of 1 to 9, with 1 = straw brown turf and 9 = green turf and 6.0 is a minimum acceptable level.

Table 28. Effects of fertilizer source, fertilizer rate, and water rate on leaf burn and recovery of fertilizer applied on September 5, 1990.

			Visual Burn Rating[3]			Recovery Quality[4]
Fertilizer Source	Fertilizer Rate[1]	Water Rate[2]	6/30	7/3	7/6	8/14
CORON	1	1	7.3	7.3	6.7	6.3
CORON	1	3	8.0	7.7	6.7	7.3
CORON	1	5	7.7	7.7	7.0	7.0
CORON	2	1	7.0	8.3	8.0	8.0
CORON	2	3	7.0	7.7	8.3	8.3
CORON	2	5	7.0	6.3	8.3	8.3
Urea	1	1	5.0	7.3	6.7	6.0
Urea	1	3	6.0	7.7	7.7	6.3
Urea	1	5	5.3	6.7	7.3	6.3
Urea	2	1	3.7	7.0	8.3	8.3
Urea	2	3	3.3	7.0	8.3	8.3
Urea	2	5	4.0	7.0	8.7	8.3
LSD (0.05) (F.S.)			0.9	NS	0.3	0.3
LSD(0.05) (F.R.)			0.9	NS	0.3	0.3
LSD (0.05) (W.R.)			NS	NS	0.4	0.4

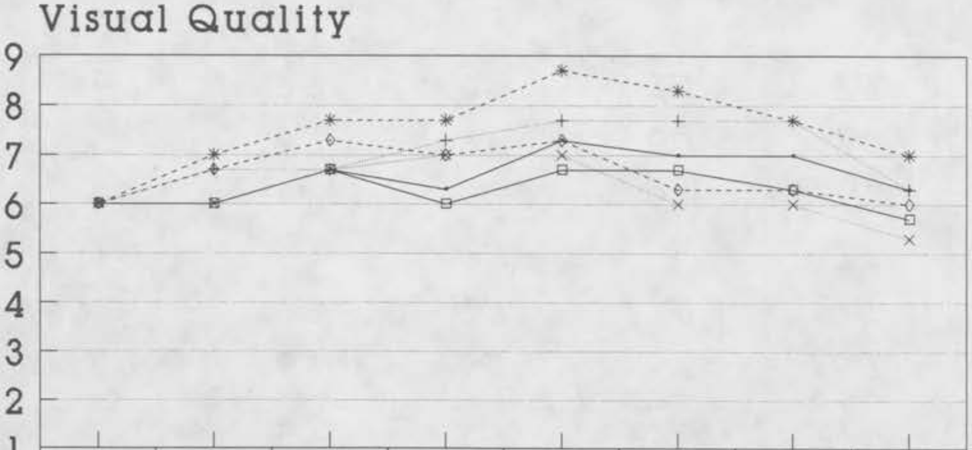
1. Fertilizer rate = pound N/1000 ft^2.
2. Water rate = gallon of water/1000 ft^2.
3. Burn rating = a visual rating of each plot. All ratings were made on a scale of 1 to 9, with 1 = dead turf and 9 = no burn.
4. Recovery quality = a visual rating of each plot. The rating is based on a scale of 1 to 9, with 1 = straw brown turf and 9 = green turf and 6.0 is a minimum acceptable level.

Table 29. Effects of fertilizer source, fertilizer rate, and water rate on leaf burn and recovery of fertilizer applied on September 5, 1990.

			Visual Burn Rating[3]			Recovery Quality[4]
Fertilizer Source	Fertilizer Rate[1]	Water Rate[2]	9/7	9/15	9/20	9/28
CORON	1	1	7.0	8.7	8.0	7.3
CORON	1	3	6.7	8.3	8.0	7.7
CORON	1	5	7.3	7.7	8.3	7.0
CORON	2	1	7.3	9.0	9.0	7.0
CORON	2	3	7.0	8.7	9.0	7.7
CORON	2	5	6.3	7.3	9.0	8.7
Urea	1	1	6.0	7.3	8.0	7.3
Urea	1	3	6.7	8.0	8.3	8.0
Urea	1	5	7.0	8.7	8.7	7.3
Urea	2	1	6.7	7.0	7.7	6.7
Urea	2	3	5.7	5.7	7.7	8.7
Urea	2	5	5.3	7.3	8.7	8.7
LSD (F.S.)			*[5]	**[6]	*	NS
LSD (F.R.)			NS	NS	NS	*
LSD (W.R.)			NS	NS	NS	**
LSD (F.S.XF.R.)			NS	*	**	NS

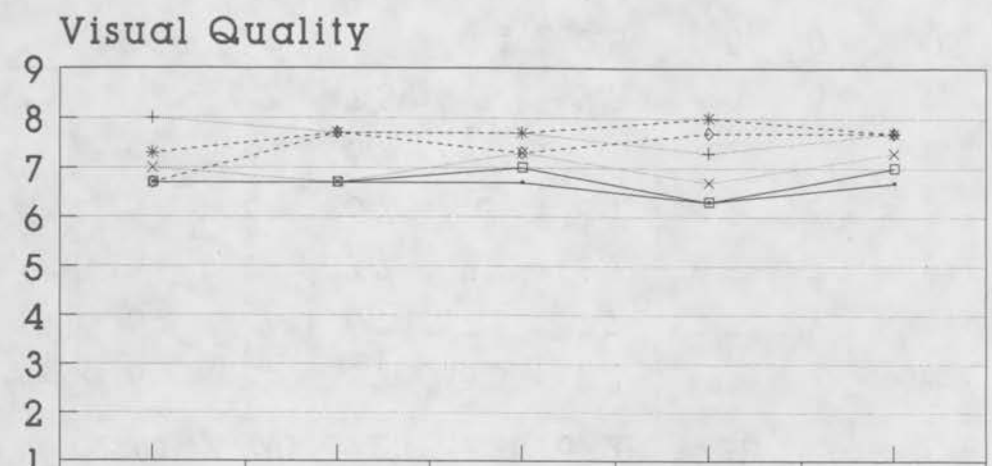
1. Fertilizer rate = pound N/1000 ft^2.
2. Water rate = gallon of water/1000 ft^2.
3. Burn rating = a visual rating of each plot. All ratings were made on a scale of 1 to 9, with 1 = dead turf and 9 = no burn.
4. Recovery quality = a visual rating of each plot. The rating is based on a scale of 1 to 9, with 1 = straw brown turf, and 9 = green turf, and 6.0 a minimum acceptable level.
5. * = significant at a 0.10 level.
6. ** = significant at a 0.05 level.

Figure 3. Effects of N source and N rate on visual quality of Creeping Bentgrass from 6-4 to 7-8.



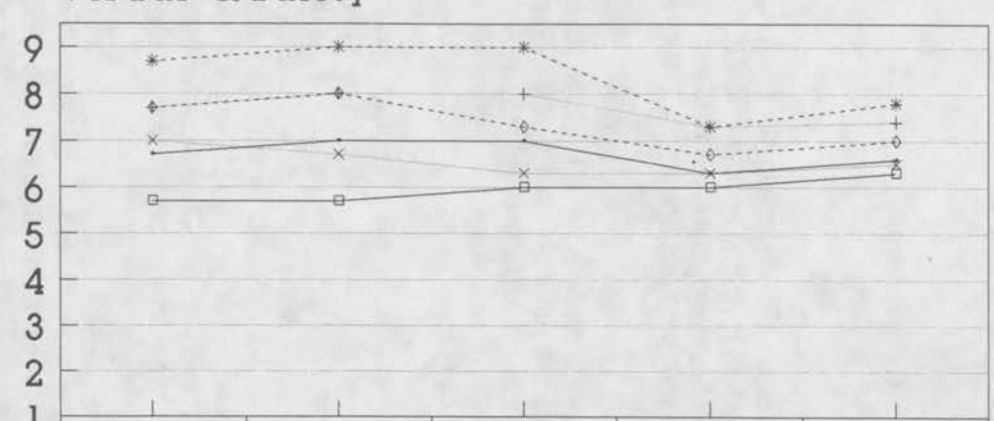
	6/4	6/20	6/23	6/25	6/28	6/30	7/2	7/8
.1 lb CORON	6	6	6.7	6.3	7.3	7	7	6.3
.2 lb CORON	6	6.7	6.7	7.3	7.7	7.7	7.7	6.3
.3 lb CORON	6	7	7.7	7.7	8.7	8.3	7.7	7
.1 lb Nutriculture	6	6	6.7	6	6.7	6.7	6.3	5.7
.2 lb Nutriculture	6	6	6.7	7	7	6	6	5.3
.3 lb Nutriculture	6	6.7	7.3	7	7.3	6.3	6.3	6
LSD (0.05) N-source		0.1		0.4	0.5	0.5	0.6	0.6
LSD (0.05) N-rate		0.4	0.3	0.5	0.6			

Figure 4. Effects of N source and N rate on visual quality of Creeping Bentgrass from 8-1 to 8-16.



	8/1	8/3	8/8	8/14	8/16
.1 lb CORON	6.7	6.7	6.7	6.3	6.7
.2 lb CORON	8	7.7	7.7	7.3	7.7
.3 lb CORON	7.3	7.7	7.7	8	7.7
.1 lb Nutriculture	6.7	6.7	7	6.3	7
.2 lb Nutriculture	7	6.7	7.3	6.7	7.3
.3 lb Nutriculture	6.7	7.7	7.3	7.7	7.7
LSD (0.05) N-source	0.5				
LSD (0.05) N-rate	0.6	0.7		0.5	0.7

Figure 5. Effects of N source and N rate on visual quality of Creeping Bentgrass from 9-10 to 9-28 and yearly average.



	9/10	9/13	9/20	9/28	Ave 90
.1 lb CORON	6.7	7	7	6.3	6.6
.2 lb CORON	7.7	8	8	7.3	7.4
.3 lb CORON	8.7	9	9	7.3	7.8
.1 lb Nutriculture	5.7	5.7	6	6	6.3
.2 lb Nutriculture	7	6.7	6.3	6.3	6.5
.3 lb Nutriculture	7.7	8	7.3	6.7	7
LSD (0.05) N-source	0.7	0.3	0.7		0.2
LSD (0.05) N-rate	0.8	0.3	0.8		0.3

Natural Organic Trial

M. L. Agnew and S. M. Kassmeyer

A natural organic nitrogen trial was established in 1989 on a four-year-old 'Park' Kentucky bluegrass (*Poa pratensis*) stand. The grass was mowed weekly with clippings removed, dried, and weights recorded. Irrigation was applied at a rate of 1 in of water/week. Rainfall was excessive from May through mid August. The area was subjected to high temperature stress only in the fall.

The purpose of this study was to compare nine natural organic fertilizers to urea. Treatments included Bioturf 10-4-4, Sustane medium grade 5-2-4, Sustane fine grade 5-2-4, ISU experimental (10% N), Milorganite 6-2-0, Natures Preference 5-3-5, Ringer 10-2-6, Ringer 6-1-3, Howe 5-2-5 (added in 1990), Urea 46-0-0, and a control. All fertilizers were applied at 1 lb N/1000 ft^2 on May 15, June 15, August 15, and September 15, 1989. This study was replicated three times in a randomized, complete-block design. Individual plot dimensions were 5 ft by 10 ft.

Data collected during the summer of 1990 included visual quality, clipping yield, and thatch development. All plots were rated weekly on a visual scale of 9 to 1. A rating of 9 is equal to a dark-green, dense turf, whereas a rating of 1 equals a straw-brown turfgrass stand. A rating of 6.0 was used as the minimum acceptable level of quality. Clipping yields were collected on a weekly basis or when enough grass was present to collect. Clippings were collected by removing all leaf tissue above 2 in within a 21 in by 10 ft area (17.5 ft^2) down the center of each plot. Clippings were placed in paper sacks and dried. Weights were recorded as grams/17.5 ft^2. Core samples were collected in July, 1990, and compressed thatch depth was measured in millimeters. The core samples were taken to the lab and percentage organic matter in the thatch layer was determined.

Clipping yield data is presented in Table 30. Plots fertilized with urea produced the most clippings. Unfertilized control and plots fertilized with Natures Preference produced the fewest clippings. For other fertilizers, Ringer products, Sustane fine, and ISU Experimental produced high quantities of clippings; Milorganite and Bioturf produced moderate amounts of clippings; Sustane medium and Howe 5-2-5 produced the smallest amount of clippings.

Visual quality ratings are presented in Table 31. Urea had the highest overall quality while the control and Nature's Preference had the lowest quality ratings. Milorganite, Bioturf, Ringer products, Sustane fine, and ISU Experimental had the best overall quality ratings.

The excessive rainfall in 1990 provided excellent growing conditions. Urea-treated plots grew excessively as indicated by the high level of clippings that were produced. This excessive growth led to a higher quality level, and the need to mow more frequently. All natural organic nitrogen sources reduced clipping yields significantly, and all but Natures Preference provided adequate quality for most of the growing season.

The performance of Howe 5-2-5 needs to be evaluated in proper context. This fertilizer source was not used in 1989. Therefore, this product is not discussed in this report because less nitrogen has been applied per plot.

Table 30. Natural Organic Trial - Clipping Yields, and Thatch.

	Clipping Yield[a] (Dates)																		Thatch[c]	
Fertilizer Source	5/26	5/31	6/05	6/14	6/20	6/27	7/05	7/13	7/20	7/27	8/06	8/13	8/22	8/29	9/12	9/19	10/10	CYT[b]	DEPTH (mm)	O.M. %
Milorganite	7.1	7.5	6.0	10.7	10.2	11.1	9.0	31.5	20.0	12.3	12.0	7.1	54.5	34.1	42.2	24.7	22.1	331.1	1.37	87.3
Bio Turf	7.2	6.7	7.4	12.9	13.8	15.7	9.0	23.4	12.7	10.0	9.6	6.6	52.6	45.9	38.1	31.4	34.8	367.3	1.35	84.8
Natures Preference	4.5	2.8	2.9	5.3	5.1	5.2	5.0	13.9	7.6	6.1	5.6	3.6	25.1	8.8	16.3	9.1	9.3	141.0	1.11	80.1
ISU Exp	7.7	7.0	8.1	14.0	19.1	21.4	14.4	39.7	32.5	19.6	19.2	11.1	59.0	33.6	51.3	29.8	31.8	433.9	1.07	86.5
Sustane Fine	10.3	11.6	9.1	15.2	15.0	15.4	15.6	43.8	28.6	16.1	18.8	9.3	61.9	36.4	36.9	22.9	26.9	409.3	1.38	85.1
Sustane Medium	9.6	6.9	5.7	9.9	10.8	9.0	9.1	27.4	16.1	9.6	9.8	6.7	51.4	25.3	38.1	16.7	20.7	291.9	1.22	82.8
Restore 10-2-6	8.2	9.6	11.1	16.7	16.5	17.9	14.0	42.9	29.0	16.9	18.0	9.2	63.2	37.0	45.7	24.7	24.6	419.2	1.47	83.2
Restore 6-1-3	9.7	9.0	9.0	17.1	18.0	18.3	14.1	38.9	29.7	18.2	19.9	10.4	51.9	37.4	44.4	25.5	30.9	416.7	1.41	88.4
Howe 5-2-5	4.0	2.9	3.3	5.6	5.5	6.7	4.5	17.6	9.6	6.9	5.3	3.8	38.2	17.2	24.8	16.1	15.2	191.7	1.31	78.3
Urea	14.3	18.5	15.9	23.3	19.2	20.4	20.0	56.2	51.8	30.2	35.5	16.9	101.9	46.8	52.7	32.4	47.8	623.9	0.85	91.8
Control	2.9	1.7	2.1	4.4	3.2	3.2	3.3	10.4	6.3	4.2	2.7	2.5	22.7	6.6	13.5	10.3	7.8	111.2	1.42	84.8
LSD (0.05)	2.6	3.3	3.1	4.3	4.0	6.0	4.5	8.5	6.7	7.5	6.7	3.6	15.2	13.5	22.0	14.4	13.1	115.8	NS	NS

(a) Clipping Yields are reported as grams dry weight / 17.5 ft^2.
(b) CYT = Clipping Yield Totals for 1990.
(c) Thatch is recorded in millimeters (mm) and % organic matter in thatch.

Table 31. Natural Organic Trial - Visual Quality.

Fertilizer Source	Visual Quality [a] (Dates) 4/20	5/1	5/17	5/30	6/5	6/13	6/20	6/26	7/3	7/13	7/19	7/25	8/1	8/8	8/14	8/20	8/28	9/6	9/11	9/19	10/1	10/8	10/19	Avg[b]
Milorganite	4.7	6.3	7.3	7.7	7.0	6.7	7.0	7.3	7.7	7.3	6.7	6.7	6.0	5.0	6.7	7.0	7.3	6.7	7.7	6.7	6.7	7.0	7.0	6.8
Bio Turf	4.7	6.7	7.3	7.7	6.0	5.7	7.0	7.3	7.3	5.7	6.0	5.7	5.7	4.7	5.7	6.3	9.0	7.7	9.0	7.7	7.3	7.7	7.7	6.8
Natures Preference	3.3	4.3	5.3	6.3	6.0	5.7	5.7	5.7	5.7	5.7	4.7	5.0	3.7	4.0	4.7	5.0	4.3	4.0	5.0	5.0	4.7	5.3	5.3	4.8
ISU Exp	5.7	7.0	7.7	8.0	6.3	6.3	7.7	8.3	8.3	8.7	8.0	8.3	7.3	6.3	7.7	7.3	7.7	7.3	8.7	7.3	7.0	7.7	7.7	7.6
Sustane Fine	4.7	6.7	7.0	7.3	7.7	8.0	7.7	8.3	8.0	8.7	7.3	7.7	7.3	6.0	7.0	7.7	7.7	7.7	8.3	7.3	7.0	7.3	7.3	7.5
Sustane Medium	4.7	6.0	6.7	7.0	6.7	6.3	6.3	7.0	6.7	7.0	6.3	6.0	4.7	5.0	6.3	6.3	6.7	5.7	6.3	5.7	5.7	6.3	6.7	6.1
Restore 10-2-6	5.3	7.0	7.7	8.0	7.0	7.7	8.0	8.3	8.7	8.7	8.0	7.0	6.7	6.3	7.7	7.7	8.0	7.3	8.3	7.3	7.0	7.3	7.0	7.5
Restore 6-1-3	5.7	7.3	7.7	8.0	7.0	6.7	7.0	8.0	8.0	8.0	7.3	7.0	6.3	5.7	7.0	6.3	5.7	7.0	8.0	6.7	6.7	6.7	6.7	7.0
Howe 5-2-5	---	---	4.3	5.7	6.0	5.3	5.7	6.3	6.0	6.3	6.0	6.3	6.0	5.0	6.7	6.3	6.7	5.7	6.3	6.0	6.3	6.3	6.7	6.2
Urea	6.0	7.3	8.0	8.0	8.0	9.0	9.0	8.7	8.7	9.0	9.0	9.0	9.0	8.0	9.0	9.0	9.0	8.0	8.7	7.7	8.0	7.7	8.0	8.5
Control	3.0	3.3	5.3	6.3	5.0	4.3	4.3	4.0	4.0	4.3	4.0	4.0	3.7	3.7	4.0	4.3	4.0	4.7	5.7	5.0	5.0	5.3	5.0	4.5
LSD (0.05)	0.9	1.4	1.3	0.9	0.9	1.3	0.6	0.9	1.0	1.0	0.8	0.8	1.5	1.2	1.3	0.9	1.6	2.0	1.7	1.3	1.8	1.3	1.1	0.8

(a) Visual Quality is based on a scale of 1 to 9, 1 = straw brown turf, 6 = minimum acceptable quality, and 9 = dark green, dense turfgrass stand.
(b) Avg = average quality rating for 1990 excluding the 4/20 rating.

The Effects of 13 Granular Nitrogen Fertilizer Sources on the Growth and Quality of 'Park' Kentucky Bluegrass

M. L. Agnew and S. M. Kassmeyer

The purpose of this study was to evaluate the performance of 13 granular nitrogen fertilizer sources. The treatments included urea, ammonium sulfate, sulfur coated urea (CIL), sulfur coated urea (TVA), sulfur-coated urea (Scotts), Blue Chip, IBDU (fine), UFC ammonium sulfate, Nutralene, Scotts 41-0-0, Milorganite, Restore 10-2-6, ISU Experimental (natural organic), and a control with no fertilizer applied. All treatments were applied at 1 lb N/1000 ft^2 on May 15, June 15, August 15, and September 15, 1989, to a 'Park' Kentucky bluegrass. This study was replicated three times in a randomized, complete-block design. Individual plot sizes were 4 ft by 10 ft.

All plots were mowed at a 2 in height with all clippings removed. The plots were irrigated with a minimum of 1.5 in water/growing week when sufficient rains did not occur. In 1990, rainfall was excessive from May through mid August.

Data collected included visual quality and clipping yields. Visual quality is based on a scale of 1 to 9; with 9 equal to dark-green turfgrass, 6 equal to minimum quality, and 1 equal to straw-colored turf. Clipping yields were obtained at each mowing by collecting all leaf tissue over 2 in within a 1.75 ft by 10 ft (17.5 ft^2) area. Clippings were dried and weights recorded.

Visual quality data is included in Table 32. Average quality was determined as the means of all quality ratings less the March 29 and April 20 data. None of the fertilizer sources exhibited an average quality less than 7. Sulfur-coated urea (Scotts), sulfur-coated urea (TVA), and Restore 10-2-6 all had an average quality rating greater than 8. The March 26 and April 20 data reflect spring green-up. Sulfur-coated urea (Scotts), milorganite, and Restore 10-2-6 were the only treatments to provide quality ratings above 6 during the early spring.

Clipping yield data is included in Table 33. The methylene ureas (Blue Chip, Nutralene, and Scotts 41-0-0) exhibited the lowest clipping yields, while sulfur-coated urea (Scotts), and Restore 10-2-6 produced the greatest clipping yield. Urea-treated plots had low clipping yields when compared to other fertilizer trials.

To calculate the amount of dried clippings that would be removed for 1000 ft^2 in mowing, simply divide the total amount of clippings by 8. For example, Restore 10-2-6 produced 52.5 lb of dried plant tissue for 1000 ft^2 in one growing season, while Blue Chip produced 25.5 lb of dried plant tissue for 1000 ft^2

Table 32. Granular fertilizer trial - visual quality.

Fertilizer Source	Visual Quality [a] (Dates) 3/29	4/20	5/1	5/17	5/23	5/30	6/5	6/15	6/20	6/26	7/2	7/13	7/19	7/25	8/1	8/8	8/14	8/20	8/28	9/6	9/11	9/19	10/1	10/8	10/19	Avg[b]
Urea	4.3	5.3	6.7	7.0	7.3	7.7	8.7	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.3	7.7	7.7	7.7	8.0	7.3	7.0	7.0	7.3	7.3	7.0	7.5
Ammonium Sulfate	4.3	5.3	7.0	6.7	6.7	7.7	8.7	8.0	8.0	7.3	7.7	8.3	7.7	7.7	7.7	6.3	7.0	8.3	8.3	8.0	7.7	7.3	7.3	7.3	8.0	7.6
UFC Ammonium Sulfate	4.7	5.3	6.7	7.0	6.7	7.7	8.3	8.0	8.0	8.0	7.7	8.0	8.0	8.0	8.0	8.0	8.0	7.3	8.3	7.7	7.7	7.3	7.3	7.7	7.3	7.7
SCU CIL)	4.7	5.7	6.7	7.3	7.0	6.7	7.7	7.0	7.7	7.7	7.0	7.3	8.0	8.0	7.7	8.3	8.3	8.0	8.3	7.3	8.0	7.3	7.3	8.0	7.7	7.8
SCU (TVA)	5.7	6.7	6.7	7.3	7.0	7.0	7.7	8.0	8.0	8.0	7.7	8.3	8.3	8.3	8.0	8.3	8.7	8.3	8.7	7.7	8.3	8.0	8.0	8.0	8.0	8.2
SCU (Scotts)	6.3	7.3	6.7	7.7	7.3	7.7	8.7	8.0	9.0	8.0	8.0	8.7	8.7	9.0	8.3	9.0	8.7	8.3	9.0	8.3	9.0	8.0	8.0	9.0	9.0	8.6
IBDU	5.3	6.3	7.3	7.0	7.7	7.7	8.3	7.7	8.0	7.7	7.0	8.0	7.7	8.0	7.3	8.0	8.0	8.0	8.0	8.3	7.7	6.7	7.7	7.7	6.7	7.7
Blue Chip	4.7	5.3	6.7	6.0	6.7	5.7	6.3	6.7	6.7	7.3	6.7	7.3	7.0	7.3	6.3	7.7	7.7	7.3	7.7	6.7	7.7	7.3	7.3	7.0	7.0	7.2
Milorganite	6.0	5.7	7.3	6.7	6.7	7.0	7.7	7.3	7.7	7.7	7.7	8.7	8.0	8.0	7.3	8.0	8.0	7.7	7.7	7.7	7.7	7.0	7.7	7.3	7.3	7.7
Methylene Urea (NOR-AM)	3.7	5.0	7.3	7.0	7.3	8.0	8.3	8.0	9.0	8.0	7.7	7.3	8.3	8.7	8.0	8.3	8.3	8.3	8.0	8.3	7.7	7.3	7.3	7.3	7.7	7.9
Methylene Urea (Scotts)	4.7	5.7	7.0	7.0	7.3	7.7	8.3	7.7	8.0	8.0	8.0	7.7	8.3	8.3	7.3	7.7	8.0	8.0	8.0	7.7	7.7	7.3	7.7	8.0	7.7	7.8
Restore 10-2-6	6.0	6.3	7.0	7.3	6.7	7.3	8.0	7.3	8.3	8.0	8.0	9.0	8.7	8.0	8.0	8.3	7.3	8.0	8.0	8.3	8.3	7.0	7.7	8.0	8.3	8.1
ISU Exp	5.7	6.7	7.0	7.0	7.0	8.0	9.0	8.0	8.7	9.0	7.7	8.7	9.0	9.0	8.3	8.7	8.3	8.0	8.0	7.0	7.3	6.7	6.7	7.3	7.3	7.9
Control	3.0	3.0	4.0	5.0	4.0	5.0	4.7	4.0	5.3	3.0	4.3	4.3	4.0	4.7	5.0	4.0	4.7	5.7	4.7	4.7	5.3	5.0	5.3	5.0	5.0	4.8
LSD (0.05)	1.3	1.6	1.0	1.0	1.1	0.9	1.2	0.8	1.2	0.8	1.5	1.4	1.0	1.2	0.9	1.2	1.2	NS	1.0	0.9	1.4	1.1	1.0	1.1	1.4	0.6

(a) Visual Quality is based on a scale of 1 to 9, 1 = straw brown turf, 6 = minimum acceptable quality, and 9 = dark green, dense turfgrass stand.
(b) Avg = average quality rating for 1990 excluding 3/29 and 4/20 data.

Table 33. Granular fertilizer trial - clipping yields.

Fertilizer Source	Clipping Yield [a] (Dates)																			
	5/26	5/30	6/05	6/13	6/20	6/27	7/02	7/13	7/19	7/25	8/01	8/08	8/14	8/21	8/30	9/06	9/12	9/20	10/10	CYT[b]
Urea	16.8	6.0	13.2	14.7	11.4	9.0	6.2	27.3	13.5	11.1	11.0	7.3	4.4	45.5	30.5	23.6	18.2	15.6	10.1	291.1
Ammonium Sulfate	13.5	5.2	14.7	12.4	9.7	9.2	7.6	22.7	11.9	9.9	10.8	5.0	2.6	46.1	36.2	28.0	12.6	14.4	7.3	277.2
UFC Ammonium Sulfate	27.8	5.5	12.5	15.8	11.4	9.4	6.7	23.8	14.1	8.9	12.8	7.9	3.6	42.8	37.0	27.5	11.1	14.1	8.1	297.0
SCU CIL)	18.2	5.4	9.9	11.8	6.1	9.4	4.7	21.8	15.2	11.2	13.8	9.9	5.7	46.8	36.5	27.3	12.7	17.0	7.5	285.2
SCU (TVA)	24.7	6.5	14.6	16.6	11.9	13.5	9.4	34.8	18.9	15.0	18.7	11.8	6.8	54.9	44.8	29.6	16.8	18.0	8.0	368.7
SCU (Scotts)	35.4	10.5	20.7	23.1	15.6	15.2	10.3	36.8	19.2	15.9	18.9	14.5	7.5	66.9	54.1	42.3	16.7	20.6	15.6	452.2
IBDU	19.7	6.5	12.9	14.3	9.8	8.3	4.7	18.8	13.7	11.3	12.5	7.7	5.6	40.9	33.3	30.2	13.9	17.4	13.4	289.3
Blue Chip	13.0	2.8	6.4	7.2	5.7	6.5	4.2	15.0	8.4	8.2	9.5	6.0	3.5	34.9	23.8	20.9	12.0	13.7	6.2	204.2
Milorganite	20.3	7.8	15.2	17.8	13.4	16.2	11.9	37.8	21.2	14.8	17.4	10.8	4.5	53.7	37.7	34.0	12.3	18.3	8.7	369.4
Methylene Urea (NOR-AM)	17.9	2.8	9.9	11.6	7.9	8.4	3.8	19.3	15.5	11.4	12.7	8.3	5.2	37.8	26.7	22.5	8.5	16.9	7.7	249.7
Methylene Urea (Scotts)	19.4	3.7	11.4	13.0	8.4	10.9	5.6	18.1	13.7	8.9	11.2	6.4	4.3	42.8	31.2	21.8	9.6	16.2	7.2	259.5
Restore 10-2-6	25.9	9.2	22.3	20.7	14.4	15.4	11.2	46.5	24.9	18.4	17.5	12.3	6.9	56.3	47.5	38.8	13.7	19.5	5.8	420.2
ISU Exp	19.4	6.8	15.0	19.9	13.3	14.2	6.1	27.3	21.0	14.7	17.4	10.9	5.9	44.1	28.2	25.2	14.6	15.3	6.4	319.9
Control	4.3	0.7	2.0	1.7	1.9	2.1	1.1	3.8	4.4	3.0	3.8	2.3	1.5	16.1	5.5	8.0	6.7	5.6	2.0	75.1
LSD (0.05)	NS	NS	NS*	NS	NS	NS*	NS	21.5	9.6	7.1	7.6	NS*	NS	NS	22.8	16.0	NS	NS	NS	193.4

(a) Clipping Yields are reported as grams dry weight / 17.5 ft^2.
(b) CYT = Clipping Yield Total for 1990.
* = Significant at a 10 % level.

The Effects of Synthetic and Natural Organic Nitrogen Source and Core Cultivation on Turfgrass Growth Under Traffic Stress

M. L. Agnew

This study was initiated at the Iowa State University Horticulture Research Station in Ames, Iowa, during the spring of 1989. The objective of this study was to observe the effects of six fertilizer sources and core cultivation on turfgrass quality, clipping production, root density, and physical soil properties.

The six fertilizer sources include:

1. Urea 46-0-0	(Synthetic fast-release organic)
2. IBDU 31-0-0	(Synthetic slow-release organic)
3. Ringer Turf Restore 10-2-6	(Natural organic)
4. Ringer Green Restore 6-1-3	(Natural organic)
5. Milorganite 6-2-0	(Natural organic)
6. Ureaform (Blue Chip) 38-0-0	(Synthetic slow-release organic)

Urea was applied at 1 lb N/1000 ft^2 on May 15, June 15, August 15, and September 15, 1990. All other fertilizers were applied on May 15 and August 15 at 2 lb N/1000 ft^2.

Core cultivation treatments consisted of two passes with a Ryan Lawn-Aire 28 just before fertilization on May 15 and August 15. This resulted in approximately 20 holes/ft^2/treatment.

Traffic stress was initiated on May 15 and consisted of five passes each Friday with a water-filled smooth roller. Traffic stress resulted in a combination of wear and soil compaction. Due to the extremely wet summer of 1990, the predominant traffic stress was soil compaction.

One undisturbed soil sample was collected from each plot on October 15. Total porosity, air-filled porosity, bulk density, and soil strength were determined for each sample.

Fertilizer source had little effect on soil physical properties (Table 34). While there was a difference in bulk density at the 10% level of probability, the differences were minor. The effects of cultivation treatments were much more pronounced.

Core cultivation and traffic stress had a significant effect on soil physical properties. Plots that were core cultivated had a soil strength of 2.9 and an air-filled porosity of 20.2%, while plots that were not cultivated had a soil strength of 3.2 and an air-filled porosity of 18.9% This shows the ability of core cultivation to alleviate soil compaction. Soils receiving weekly traffic had greater soil strength (3.4 vs 2.8), increased bulk density (1.42 vs 1.31), and lower total pore space (38.6 vs 40.0) than soils that received no traffic. There were no interactions between variables.

Visual quality ratings and clipping yield samples were collected on a weekly basis. Shoot density, thatch, and root density samples were collected on June 30. Visual ratings were based on a visual scale of 9 to 1. A rating of 9 equals a dark green, dense turfgrass, whereas a rating of 1 equals a straw-brown turfgrass stand. A rating of 6 was used as the minimum acceptable level of quality. Clippings were collected by removing all leaf tissue over 2 in within a 21 in by 5 ft area (8.75 ft^2) down the center of each plot. Clippings were placed in paper bags and dried. Weights were recorded as grams/8.75 ft^2. Shoot density was determined by counting the number of tillers/15 in^2 at three locations for each plot. Thatch depths were measured by taking two 3-in diameter plugs from each plot. The thatch was compressed with a 2 kg weight and depth was measured as mm. No difference was found for either shoot density or thatch development. Hence, the data is not shown. Root density samples were collected by taking six cores from each plot with a 1-in diameter soil probe. Samples were divided into 5 cm segments. Soil was washed from the roots, which were dried and ashed. Data is reported as mg of organic matter/25 cm^3.

<u>Fertilizer Source</u>:

The effect of fertilizer source on visual quality is presented in Table 35. Urea had an overall quality of 7.8, followed by Restore 10-2-6 (7.2), Restore 6-1-3 (7.0), Milorganite (6.7), Blue Chip (6.5), and IBDU (6.4). Plots treated with urea, IBDU, and Restore 6-1-3 exhibited a quicker spring green-up. Following the first fertilizer application for 1990, all treatments provided acceptable quality. While there were treatment differences on each measurement date, no one fertilizer maintained consistently better quality over the others.

The effect of fertilizer source on clipping yields is presented in Table 36. Urea produced the greatest amount of clippings (181.1 g), followed by Restore 10-2-6 (172 g), Restore 6-1-3 (162 g), Milorganite (129 g), IBDU (98 g), and Blue Chip (93 g). Treatments with higher yields corresponded to the better quality ratings. Urea-treated plots demonstrated quicker growth in the spring. By early June, both Restore-treated plots produced the greatest amount of clippings. After mid-June, the urea-treated plots produced the most clippings.

There were no major effects of fertilizer on root density (Table 37). However, minor differences did occur at the 10% level in the 10 to 15 cm soil zone. Milorganite had the greatest root mass followed by Restore 10-2-6 and Blue Chip.

<u>Core cultivation</u>:

The effects of core cultivation were evident on several measurement dates (Table 35). Core cultivation improved quality on June 13, June 20, July 25, August 1, and August 14. Core cultivation adversely affected quality on September 19. The high temperatures in September coupled with a more open turf due to core cultivation may well have been responsible for the lower quality in September.

Core cultivation had very little effect on clipping yields (Table 36) and root density (Table 37).

<u>Traffic Stress</u>:

Overall, traffic decreased visual quality of Kentucky bluegrass (Table 35). Traffic reduced visual quality on March 29, April 20, June 20, June 26, August 1, August 8, August 14, September 11, and September 19. Interestingly, visual quality was greater for traffic plots on May 13, 2 days prior to the onset of traffic treatments.

Traffic had a minor effect on clipping yields (Table 36) and increased surface rooting (Table 37). An increase in surface rooting is common on sites that are heavily compacted. However, it is rare that these differences show up in field studies.

Table 34. The effects of fertilizer, core cultivation, and traffic on soil properties.

Fertilizer Source	Core	Traffic	Soil Strength	Bulk Density	Total Pore Space	Air-Filled Pores
Urea	Yes	Yes	3.1	1.42	36.9	20.0
Urea	Yes	No	2.9	1.27	41.4	20.4
Urea	No	Yes	3.7	1.47	38.4	19.6
Urea	No	No	2.5	1.23	38.8	18.6
IBDU	Yes	Yes	3.1	1.43	38.3	20.6
IBDU	Yes	No	2.8	1.33	39.6	18.9
IBDU	No	Yes	3.7	1.40	38.1	19.6
IBDU	No	No	3.3	1.38	38.7	17.5
Restore 10-2-6	Yes	Yes	3.4	1.41	39.9	20.6
Restore 10-2-6	Yes	No	2.7	1.34	40.5	21.8
Restore 10-2-6	No	Yes	3.9	1.46	40.3	18.4
Restore 10-2-6	No	No	2.6	1.33	38.1	18.3
Milorganite	Yes	Yes	3.3	1.50	38.1	21.2
Milorganite	Yes	No	2.8	1.41	42.2	19.9
Milorganite	No	Yes	3.3	1.38	37.5	19.5
Milorganite	No	No	2.1	1.25	39.0	17.8
Restore 6-1-3	Yes	Yes	3.3	1.45	39.5	20.2
Restore 6-1-3	Yes	No	2.3	1.24	43.3	20.1
Restore 6-1-3	No	Yes	3.3	1.37	38.0	20.9
Restore 6-1-3	No	No	3.4	1.27	41.4	18.3
Blue Chip	Yes	Yes	2.8	1.34	41.7	19.7
Blue Chip	Yes	No	2.6	1.29	37.4	18.4
Blue Chip	No	Yes	3.8	1.42	36.4	19.6
Blue Chip	No	No	3.1	1.36	38.9	19.0
LSD (FERT)			N.S.	N.S.*	N.S.	N.S.
LSD (CORE)			N.S.	N.S.	N.S.	N.S.
LSD (COMP)			0.2	0.03	1.3	N.S.*

* = significant at a 10% level.

Table 35. Effects of fertilizer, core cultivation, and traffic on plant quality.

Fertilizer Source	Core	Traffic	Visual Quality[a] (Dates) 3/29	4/20	5/1	5/13	5/17	6/5	6/13	6/20	6/26	7/3	7/13	7/19
Urea	Yes	Yes	5.7	6.7	7.7	8.0	7.7	8.7	8.0	7.7	6.7	7.3	8.7	8.3
Urea	Yes	No	6.0	7.0	7.7	7.7	7.7	8.3	8.7	8.0	7.3	7.3	8.7	8.7
Urea	No	Yes	5.3	6.0	8.0	7.7	8.0	8.7	8.0	6.3	6.7	7.3	8.0	8.3
Urea	No	No	5.7	6.7	7.6	7.0	7.3	8.3	7.7	7.3	7.0	6.7	8.3	8.7
IBDU	Yes	Yes	5.3	6.0	7.7	7.3	7.7	7.7	7.3	6.7	6.7	6.3	7.3	6.7
IBDU	Yes	No	6.0	6.7	7.0	6.7	7.3	7.7	7.3	7.3	7.3	6.0	7.0	7.0
IBDU	No	Yes	5.7	7.0	7.3	7.3	7.7	7.3	7.3	6.7	6.7	6.7	7.0	7.0
IBDU	No	No	6.3	7.0	7.3	7.3	8.0	7.7	7.3	7.0	6.7	6.0	6.7	6.3
Restore 10-2-6	Yes	Yes	5.0	5.7	7.0	7.0	7.0	8.7	8.7	8.7	8.0	7.3	8.0	7.7
Restore 10-2-6	Yes	No	5.3	6.3	7.0	7.0	6.7	8.7	9.0	9.0	9.0	7.0	8.3	7.0
Restore 10-2-6	No	Yes	5.3	6.3	7.0	7.7	7.3	9.0	8.0	8.3	7.7	7.3	8.3	7.3
Restore 10-2-6	No	No	6.0	6.7	7.0	7.3	7.3	9.0	8.3	8.7	8.3	7.3	8.3	7.3
Milorganite	Yes	Yes	5.0	6.0	7.0	7.7	7.0	8.3	7.7	8.0	7.0	7.0	7.3	7.3
Milorganite	Yes	No	5.3	6.7	7.0	7.7	7.0	8.3	7.7	8.0	7.0	7.0	7.7	7.0
Milorganite	No	Yes	5.0	5.7	7.0	7.3	7.0	8.3	8.0	7.3	6.7	7.3	7.3	7.3
Milorganite	No	No	5.0	6.0	7.0	7.0	7.3	8.3	8.0	7.3	7.0	7.3	7.7	7.0
Restore 6-1-3	Yes	Yes	5.3	6.3	7.3	7.0	7.0	8.0	8.3	7.7	7.3	8.0	7.7	7.3
Restore 6-1-3	Yes	No	5.7	6.7	7.3	6.7	7.0	8.0	8.7	8.3	8.7	7.3	8.0	8.0
Restore 6-1-3	No	Yes	5.0	6.7	7.3	7.3	7.3	8.0	8.0	8.0	7.7	7.7	7.7	7.7
Restore 6-1-3	No	No	5.3	7.0	7.3	7.0	7.0	7.7	7.7	8.0	8.3	7.3	7.7	7.3
Blue Chip	Yes	Yes	4.3	5.0	6.0	6.3	6.7	7.0	6.3	6.3	6.0	6.0	7.0	6.7
Blue Chip	Yes	No	4.3	5.3	6.0	6.0	6.3	6.7	7.0	6.3	6.3	6.0	7.0	7.0
Blue Chip	No	Yes	4.3	4.7	6.3	7.0	6.3	6.3	6.3	6.3	6.0	6.0	7.0	7.0
Blue Chip	No	No	4.3	5.3	6.7	6.0	6.7	5.7	6.3	5.7	6.0	6.0	6.7	6.7
LSD (FERT)			0.5	0.7	0.6	0.4	0.4	0.5	0.4	0.5	0.4	0.5	0.5	0.4
LSD (CORE)			NS	NS	NS	NS	NS	NS	0.2	0.3	NS*	NS	NS	NS
LSD (COMP)			0.3	0.4	NS	0.2	NS	NS	NS	0.3	0.2	NS*	NS	NS

[a] Visual Quality is based on a scale of 1 to 9, 1 = straw brown turf, 6 = minimum acceptable quality, and 9 = dark green, dense turfgrass stand.
* = significant at 10% level.

Table 35. (continued).

Fertilizer Source	Core	Traffic	Visual Quality[a] (Dates) 7/25	8/1	8/8	8/14	8/20	8/28	9/6	9/11	9/19	10/1	10/8	10/19	Avg[b]
Urea	Yes	Yes	8.7	8.3	8.0	7.0	7.7	8.0	7.3	7.3	6.7	7.0	7.3	7.7	7.5
Urea	Yes	No	8.7	8.0	8.0	8.0	8.0	8.3	7.7	8.0	7.7	7.7	7.7	8.0	8.0
Urea	No	Yes	7.7	6.7	7.3	7.0	8.7	9.0	7.7	7.7	7.7	7.7	8.0	8.0	7.8
Urea	No	No	8.3	7.0	8.0	7.7	8.7	9.0	8.0	8.0	8.0	8.0	8.0	8.0	8.1
IBDU	Yes	Yes	7.0	6.3	6.3	6.3	5.7	6.7	6.3	6.3	6.7	6.3	6.3	6.7	6.5
IBDU	Yes	No	6.7	6.3	6.7	6.7	6.3	6.3	6.0	6.3	6.0	5.7	6.0	6.3	6.4
IBDU	No	Yes	7.0	6.0	6.0	6.3	6.0	6.7	6.3	6.3	6.7	6.0	6.3	6.7	6.5
IBDU	No	No	6.7	6.0	6.3	6.7	6.0	6.0	5.7	6.3	6.7	6.0	6.3	6.7	6.4
Restore 10-2-6	Yes	Yes	8.0	6.7	6.7	6.7	7.0	7.3	6.7	6.7	7.0	6.3	6.7	7.0	7.0
Restore 10-2-6	Yes	No	8.0	8.0	7.0	7.7	7.3	7.7	6.7	7.3	7.7	7.3	6.7	6.3	7.4
Restore 10-2-6	No	Yes	7.3	7.0	7.0	6.7	6.7	7.7	6.7	7.3	7.7	6.7	6.7	6.3	7.1
Restore 10-2-6	No	No	7.7	6.7	7.3	7.0	7.3	8.0	7.0	7.3	7.7	6.7	6.7	6.7	7.3
Milorganite	Yes	Yes	7.7	7.0	6.7	7.0	6.3	6.7	6.3	6.0	6.3	6.7	6.7	6.7	6.8
Milorganite	Yes	No	7.3	7.0	6.7	7.0	7.0	6.7	6.3	6.3	6.7	6.0	6.0	6.0	6.7
Milorganite	No	Yes	7.0	6.3	6.3	6.7	6.7	6.3	6.0	5.7	6.3	6.3	6.0	6.0	6.5
Milorganite	No	No	7.0	6.3	7.0	7.3	7.0	6.7	6.0	6.7	7.0	6.0	6.0	6.0	6.7
Restore 6-1-3	Yes	Yes	7.7	7.0	7.0	6.7	6.7	7.3	6.3	6.7	6.3	6.0	6.3	6.3	6.8
Restore 6-1-3	Yes	No	8.0	7.0	7.0	7.7	7.0	7.7	6.0	7.0	7.3	7.0	6.3	6.3	7.2
Restore 6-1-3	No	Yes	7.3	7.0	6.7	6.3	7.0	8.0	6.3	7.0	7.0	6.0	6.3	6.3	6.9
Restore 6-1-3	No	No	7.3	7.3	7.0	6.7	7.0	8.0	6.3	7.3	7.0	6.0	6.3	6.3	7.0
Blue Chip	Yes	Yes	7.0	6.0	7.0	6.7	6.3	6.3	5.7	6.0	6.3	6.3	6.3	6.7	6.4
Blue Chip	Yes	No	7.3	6.3	7.0	7.3	7.3	6.3	6.3	6.3	6.7	6.7	6.3	6.3	6.7
Blue Chip	No	Yes	6.3	6.3	6.3	6.3	7.0	6.3	6.0	6.0	6.3	6.3	6.7	6.7	6.4
Blue Chip	No	No	6.7	6.3	6.7	6.3	7.3	6.3	5.7	6.3	7.0	6.7	6.7	6.7	6.5
LSD (FERT)			0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.2
LSD (CORE)			0.3	0.2	NS*	0.2	NS*	NS*	NS	NS	0.3	NS	NS	NS	NS
LSD (COMP)			NS	0.2	0.3	0.2	0.3	NS	NS	0.2	0.3	NS	NS	NS	0.1

[a] Visual Quality is based on a scale of 1 to 9, 1 = straw brown turf, 6 = minimum acceptable quality, and 9 = dark green, dense turfgrass stand.
[b] Avg = average quality rating for 1990 excluding the 3/29 and 4/20 ratings.
* = significant at 10% level.

Table 36. The effects of fertilizer, core cultivation, and traffic on clipping yield.

Fertilizer Source	Core	Traffic	Clipping Yield[a] (Dates) 5/27	5/31	6/5	6/13	6/21	6/27	7/5	7/13	7/20	7/27	8/6	8/13	8/22	8/30	9/10	9/19	10/10	CYT[b]
Urea	Yes	Yes	7.7	6.4	4.7	5.5	6.3	7.0	6.9	13.0	8.7	4.1	11.4	5.4	22.4	15.3	13.8	15.4	14.2	168.2
Urea	Yes	No	7.0	6.8	6.2	7.1	5.6	5.4	6.8	13.0	8.7	5.3	9.0	4.5	34.7	19.6	16.5	13.5	15.6	193.5
Urea	No	Yes	6.3	4.0	4.3	7.2	6.6	7.4	7.3	20.5	12.0	5.7	8.0	3.9	33.9	19.5	18.1	12.6	5.45	182.8
Urea	No	No	6.3	5.1	5.2	6.2	6.2	4.8	6.7	19.3	11.5	5.2	7.7	4.2	32.3	19.5	19.0	12.1	8.1	179.4
IBDU	Yes	Yes	5.4	3.3	3.2	3.5	4.7	4.6	3.9	8.7	4.4	2.3	3.8	1.8	13.6	7.1	9.3	5.5	4.0	89.1
IBDU	Yes	No	5.1	4.2	3.4	5.6	9.9	6.1	4.4	11.0	5.0	3.9	5.8	2.9	17.4	10.6	11.5	7.6	5.3	119.7
IBDU	No	Yes	4.1	2.8	2.3	4.5	4.4	5.0	3.1	9.2	4.2	2.7	3.6	2.1	14.5	8.0	11.7	6.8	5.2	94.2
IBDU	No	No	4.3	3.3	3.2	4.7	4.5	5.2	3.7	8.3	4.0	1.9	4.3	2.2	13.3	8.7	9.6	5.9	3.4	90.5
Restore 10-2-6	Yes	Yes	3.1	4.9	5.7	9.6	13.4	14.3	8.8	15.2	7.8	4.5	6.3	3.3	22.3	11.1	11.4	6.5	4.6	130.6
Restore 10-2-6	Yes	No	3.5	6.4	6.6	9.9	13.9	12.8	6.9	16.4	8.4	4.0	6.8	3.3	22.4	10.6	9.3	7.3	5.3	130.2
Restore 10-2-6	No	Yes	4.1	4.9	5.6	11.0	14.4	14.7	8.2	15.7	8.0	4.8	8.5	3.8	33.1	18.8	15.8	10.6	7.3	189.4
Restore 10-2-6	No	No	3.8	5.9	6.6	10.7	14.0	13.2	8.5	17.9	8.5	6.0	8.6	3.4	22.1	15.6	12.4	8.2	5.5	171.0
Milorganite	Yes	Yes	6.2	4.3	4.5	6.2	7.0	8.5	5.6	12.9	5.3	4.5	6.3	3.3	22.3	11.1	11.4	6.5	4.6	130.6
Milorganite	Yes	No	3.3	5.2	4.7	6.4	6.6	7.9	5.3	14.3	7.8	4.0	6.8	3.3	22.4	10.6	9.3	7.3	5.3	130.2
Milorganite	No	Yes	4.6	4.5	5.3	8.1	10.0	10.2	7.6	15.1	7.4	5.6	6.3	3.4	24.5	12.6	10.6	7.4	5.3	148.3
Milorganite	No	No	2.9	3.6	4.3	6.2	7.0	6.2	4.4	11.4	5.7	3.5	6.2	2.3	18.2	8.2	9.0	5.3	3.8	108.2
Restore 6-1-3	Yes	Yes	3.3	4.1	4.9	9.6	13.4	14.5	9.6	17.0	8.2	6.5	9.2	4.4	27.4	15.2	15.8	9.7	7.8	180.6
Restore 6-1-3	Yes	No	3.1	4.8	5.2	8.6	11.3	11.6	7.7	17.1	9.8	7.1	8.0	3.7	23.5	14.2	14.0	9.7	7.2	166.5
Restore 6-1-3	No	Yes	3.4	4.4	3.8	8.3	13.9	12.9	7.8	14.4	7.0	2.6	4.6	2.4	16.6	7.4	10.0	7.6	7.4	92.5
Restore 6-1-3	No	No	3.2	3.8	4.0	7.6	12.2	11.4	7.1	12.0	7.6	4.6	8.7	3.7	20.1	11.6	14.0	7.5	4.5	143.6
Blue Chip	Yes	Yes	3.7	2.1	2.3	4.5	4.2	4.1	3.2	11.4	5.7	2.9	4.7	2.6	22.2	9.7	10.9	8.8	3.0	106.0
Blue Chip	Yes	No	2.5	2.0	1.5	2.7	2.2	3.2	2.8	9.0	5.2	4.0	4.6	2.3	17.8	8.1	8.0	5.8	4.5	86.0
Blue Chip	No	Yes	3.1	2.3	1.6	4.1	2.7	4.2	3.1	9.5	3.6	2.6	4.6	2.4	16.6	7.4	10.0	7.6	7.4	92.5
Blue Chip	No	No	2.8	2.3	2.1	4.3	2.2	2.9	3.4	8.8	6.6	2.9	4.3	2.6	16.3	8.6	8.3	5.7	4.1	88.1
LSD (FERT)			1.4	1.2	1.1	2.0	2.6	1.6	1.4	2.8	1.9	1.4	1.3	0.9	5.7	3.6	3.4	2.5	2.5	26.4
LSD (CORE)			NS	NS*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.4	NS
LSD (COMP)			NS	NS	NS	NS	NS	0.9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Clipping Yields are reported as grams dry weight/8.75 ft^2.
[b] CYT = Clipping Yield Total for 1990.
* = Significant at a 10 % level.

Table 37. The effects of fertilizer, core cultivation, and traffic on rooting.

Fertilizer Source	Core	Traffic	Depth (cm) 0-5	5-10	10-15	15-20
Urea	Yes	Yes	105.0	33.4	23.3	7.3
Urea	Yes	No	121.3	27.5	22.9	6.6
Urea	No	Yes	143.0	51.0	23.7	3.5
Urea	No	No	124.4	43.6	16.7	1.2
IBDU	Yes	Yes	135.8	57.2	17.5	9.5
IBDU	Yes	No	115.0	36.5	20.3	5.8
IBDU	No	Yes	156.1	47.3	16.8	12.1
IBDU	No	No	107.3	30.9	15.9	11.8
Restore 10-2-6	Yes	Yes	136.8	65.5	22.5	10.2
Restore 10-2-6	Yes	No	117.0	39.8	22.0	5.6
Restore 10-2-6	No	Yes	174.1	63.0	36.5	12.1
Restore 10-2-6	No	No	133.8	52.5	20.8	15.4
Milorganite	Yes	Yes	115.7	56.6	30.0	12.3
Milorganite	Yes	No	169.7	40.0	35.5	7.5
Milorganite	No	Yes	129.0	71.3	32.6	7.3
Milorganite	No	No	119.7	44.3	12.9	10.7
Restore 6-1-3	Yes	Yes	124.3	50.9	24.8	4.9
Restore 6-1-3	Yes	No	103.0	44.0	13.0	9.4
Restore 6-1-3	No	Yes	117.8	46.7	12.5	8.6
Restore 6-1-3	No	No	110.6	45.7	11.1	5.3
Blue Chip	Yes	Yes	178.1	33.7	21.5	10.7
Blue Chip	Yes	No	114.8	40.8	23.2	8.4
Blue Chip	No	Yes	127.3	62.4	19.8	7.5
Blue Chip	No	No	116.5	45.9	26.4	6.2
LSD (FERT)			N.S.	N.S.	N.S.*	N.S.
LSD (CORE)			N.S.	N.S.*	N.S.	N.S.
LSD (COMP)			17.9	8.1	N.S.	N.S.

* = significant at the 15% level.

The Evaluation of 13 Granular Nitrogen Sources on the Quality of Bentgrass Greens

M.L. Agnew and S.M. Kassmeyer

The purpose of this study was to evaluate the performance of 13 granular nitrogen fertilizer sources. The treatments are listed in Table 38 and Table 39. The treatments were applied at a rate of 0.5 lb N/1000ft^2 on May 29, June 26, July 24, and August 20 to a creeping bentgrass 'Pencross'/*Poa annua* green. The testing area was located at the Hyperion Field Club, Johnston, Iowa. The plot consisted of a randomized, block-design replicated three times.

The plots were mowed daily and irrigated as needed.

Visual quality data was collected weekly. Visual quality ratings were based on a scale of 1 to 9, with one being equivalent to straw brown turf and 9 equal to dense dark green turf (Table 38 and Table 39).

The fertilizers containing higher soluble nitrogen, Country Club, (Country Club + NIAD, Scotts + Minors, and Scotts + Manganese) had consistent average visual quality ratings above 6.0, dipping below 6.0 one or two times. Scotts + Manganese had the highest overall ratings and remained deep green in color during the entire 1990 testing season. The second-most noticable dark green turf was obtained by using Scotts + Minors. Both fertilizers maintained a 7.0 or above rating for most of the 1990 testing season.

The rest of the fertilizers used were slow release nitrogen sources and showed ratings of 5.0 or 6.0 the first part of June. From mid-July through October the slow-release fertilizers showed turf with ratings of at least 6.0 or above.

Table 38. The comparison of fertilizer sources on visual quality of bentgrass from June 5 to July 31.

	Date							
	June			July				
Fertilizer	5	11	26	3	11	18	24	31
Country Club 18-4-10	6.3	7.3	6.0	6.0	6.0	5.7	6.7	6.7
Country Club + NAIAD	6.3	7.3	6.0	6.7	6.0	6.7	6.7	7.3
Scotts + Minors	7.3	8.3	7.3	7.3	6.7	7.3	7.0	8.7
Scotts + Manganese	8.3	9.0	8.7	8.7	9.0	7.3	7.0	8.7
Milorganite	5.3	5.7	5.7	6.3	6.3	6.0	6.7	6.3
Ringer Restore	5.3	5.7	5.7	6.3	5.3	7.0	7.0	6.3
Spring Valley	5.7	5.3	5.7	6.0	5.7	6.7	6.7	6.7
IBDU fine	4.7	5.0	6.3	5.3	5.7	7.0	7.0	7.0
Sustane fine	6.7	7.0	6.3	6.7	6.3	7.3	7.0	7.3
Nutralene	5.3	6.7	5.3	6.7	5.7	7.3	7.0	7.7
Blue Chip	5.3	6.3	5.7	5.7	6.0	6.3	6.7	6.7
Tee time	5.6	6.0	4.3	5.7	6.0	6.3	6.7	6.3
Control	4.7	4.0	4.3	4.0	6.7	6.0	5.7	5.3
LSD	.71	.92	1.4	1.4	2.1	1.6	.68	1.0

Table 39. The comparison of fertilizer sources on visual qaulity of bentgrass from August 7 to October 2.

	Date								
	August				September				October
Fertilizer	7	13	20	28	4	12	19	25	2
Country Club 18-4-10	7.3	7.0	7.0	7.3	8.0	7.0	7.3	6.7	7.0
Country Club + NAIAD	7.0	8.0	6.3	7.3	8.0	6.7	7.7	6.7	6.7
Scotts + Minors	7.7	7.7	7.3	8.3	8.7	7.7	8.0	7.7	7.3
Scotts + Manganese	9.0	8.3	8.0	9.0	9.0	8.7	9.0	8.7	8.7
Milorganite	6.7	5.7	7.3	7.0	7.0	7.0	7.3	6.3	7.0
Ringer Restore	7.0	7.7	6.3	8.0	7.3	6.0	7.7	6.7	7.0
Spring Valley	7.0	7.7	6.0	6.3	7.0	6.0	7.0	6.0	6.7
IBDU fine	7.0	7.7	7.0	7.7	8.0	7.0	8.7	7.0	7.3
Sustane fine	7.3	7.7	5.7	7.3	7.3	7.3	7.0	6.3	7.0
Nutralene	7.3	8.0	6.3	7.7	7.0	6.7	7.3	6.7	7.0
Blue Chip	7.0	7.3	6.3	7.3	7.0	7.0	7.3	6.0	7.3
Tee Time	6.7	7.3	6.3	7.0	6.3	6.3	6.7	5.7	6.7
Control	6.0	6.7	5.7	4.7	5.0	4.0	5.0	4.0	4.7
LSD	.67	1.3	.93	.94	.56	1.2	.75	.64	1.0

The Effects of Core Cultivation on the Performance of Four Nitrogen Fertilizers

M. L. Agnew and S. M. Kassmeyer

This study compares the effects of core cultivation on the performance of four granular nitrogen sources. The study was established of May 20, 1988, and terminated in the spring of 1991. The turf was 'Park' Kentucky bluegrass that was established in the fall of 1987. The grass was mowed weekly at 2 in and all clippings were removed. Irrigation was applied at a rate of 1.5 in/week.

Treatments included five nitrogen treatments and two cultivation treatments. The fertilizer included Milorganite, Blue Chip, Scott's methylene urea (41-0-0), ISU experimental (natural organic), and a non-fertilized control. Cultivation treatments included core cultivation and non cultivated control. Treatments were applied on May 22, June 27, and August 15, 1990. Fertilizer was applied immediately following each cultivation treatment.

This study was replicated three times in a randomized complete-block design with a two-way factorial. Individual plot sizes were 5 ft x 10 ft.

Data collected included visual quality and clipping yields. Visual quality is based on a scale of 1 to 9, with 1 equivalent to straw brown turfgrass and 9 equivalent to a dark green, dense turfgrass stand. A rating of 6.0 was the minimum acceptable quality level. Clipping yields were collected on a weekly basis by removing all leaf tissue above 2 in in a 21 in x 10 ft area (17.5 ft^2) down the center of each plot. Clippings were placed in paper sacks, dried, and weights recorded as grams/17.5 ft^2.

Visual quality data is presented in Table 40. There were no differences between cultivation treatments or fertilizer x cultivation interaction. All fertilizer sources consistently had better quality than the untreated control. Scott's 41-0-0 fertilizer greened up quickest in spring and maintained acceptable quality throughout the growing season. ISU Experimental Fertilizer performed very similarly to the Scotts product. Milorganite and Blue Chip had a consistently lower quality during the spring and summer. Milorganite quality was equivalent to the ISU Experimental product in the fall.

Clipping yield data is presented in Table 41. ISU Experimental had the greatest total clipping production, followed by Scotts 41-0-0, Milorganite, and Blue Chip. All fertilizers had greater clipping production when compared to the non-fertilized control. Core cultivation had a negative effect on May 22 and June 20. While this effect was noted on those days, it does indicate that cultivation prior to dry weather does have an effect on clipping production.

Table 40. Fertilizer Coring Study - Visual Quality.

		Visual Quality[a] Dates																						
Fertilizer	Core	5/1	5/17	5/23	5/30	6/5	6/13	6/20	6/26	7/2	7/13	7/19	7/25	8/1	8/8	8/14	8/20	8/28	9/6	9/11	9/19	10/1	10/8	10/19	AVG[b]
Control	No	4.0	5.7	4.0	4.7	4.7	3.7	3.7	3.3	4.3	4.0	4.3	4.0	4.7	3.7	4.0	4.7	4.0	4.0	4.0	4.7	5.0	5.0	5.0	4.2
Control	Yes	4.3	5.7	4.3	5.3	4.7	4.3	3.7	3.7	3.3	3.3	4.0	3.7	3.7	3.7	4.3	4.3	4.0	4.0	4.0	4.3	5.0	5.0	5.0	4.1
Milorganite	No	7.0	7.3	7.0	7.3	7.3	7.7	7.0	7.7	7.0	8.0	6.7	7.0	6.7	6.7	7.0	8.3	8.7	8.3	8.7	7.7	7.7	7.7	7.7	7.4
Milorganite	Yes	7.0	7.0	7.3	7.7	8.7	8.3	7.7	8.3	7.3	8.3	8.0	7.3	7.0	6.7	7.7	8.3	9.0	8.6	8.7	7.7	7.7	7.7	7.7	7.7
Blue Chip	No	6.3	7.7	8.0	7.0	7.7	7.3	7.3	8.0	7.0	7.7	7.0	7.0	7.3	7.0	7.7	8.7	7.3	7.0	7.3	7.0	7.0	8.0	8.0	7.2
Blue Chip	Yes	6.3	7.7	8.0	7.0	7.7	7.7	7.7	7.7	7.0	7.7	7.0	7.0	7.0	6.7	7.3	7.7	7.3	7.7	7.7	7.0	7.3	7.3	7.0	7.1
MU 41-0-0	No	6.3	7.7	8.3	7.7	8.7	8.3	8.6	8.7	7.0	7.7	8.0	7.3	7.3	8.0	7.7	8.3	8.3	7.7	7.7	7.3	7.3	7.3	7.3	7.6
MU 41-0-0	Yes	6.3	7.7	8.7	7.3	8.7	8.3	8.6	8.3	7.3	8.0	8.0	7.7	7.7	8.3	8.7	8.3	8.3	8.0	8.0	7.7	7.7	8.0	8.0	7.8
ISU Exp.	No	7.3	7.3	7.7	7.7	8.7	8.3	9.0	8.7	7.3	8.7	8.7	7.7	8.0	8.3	8.3	8.7	8.7	8.3	8.3	7.3	7.7	8.0	7.7	7.9
ISU Exp.	Yes	7.3	7.3	6.7	8.0	9.0	9.0	9.0	9.0	8.0	9.0	9.0	8.3	8.0	9.0	9.0	8.3	9.0	9.0	9.0	8.0	8.0	8.0	8.3	8.2
$LSD_{fert\ (0.05)}$		0.8	0.7	0.6	0.9	0.7	0.8	0.7	0.7	0.7	0.8	0.8	0.7	0.9	1.1	0.8	0.9	0.6	0.9	0.8	0.7	0.6	0.8	0.9	0.4
$LSD_{core\ (0.05)}$		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 41. Fertilizer Coring Study - Clipping Yields.

		Clipping Yield[a] Dates																			
Fertilizer	Core	5/26	5/30	6/5	6/13	6/20	6/27	7/2	7/13	7/19	7/25	8/1	8/8	8/14	8/21	8/30	9/6	9/12	9/20	10/14	CYT[b]
Control	No	4.6	1.3	3.3	2.1	1.9	3.0	1.1	3.7	3.0	3.0	2.3	2.3	2.3	10.9	9.7	8.7	5.7	5.8	2.4	77.0
Control	Yes	3.9	0.9	2.0	2.4	1.5	2.6	1.1	2.5	2.3	2.3	2.9	1.9	1.8	11.8	4.8	8.1	4.4	4.6	3.4	65.2
Milorganite	No	23.5	9.3	13.5	13.5	10.4	10.9	6.2	20.1	13.3	10.5	13.1	8.2	5.2	46.0	45.1	33.2	21.6	18.2	9.3	331.1
Milorganite	Yes	20.4	10.7	16.5	17.4	12.1	15.9	7.8	26.9	16.7	11.7	12.2	9.8	7.3	40.3	46.3	31.9	18.7	18.0	9.5	350.1
Blue Chip	No	16.9	4.1	10.7	11.0	6.8	13.8	7.4	20.3	12.2	11.0	9.9	7.8	6.4	39.0	31.0	22.3	13.1	14.4	9.4	267.4
Blue Chip	Yes	13.4	3.8	6.9	8.1	6.7	10.4	5.8	17.7	11.5	8.9	8.8	6.7	6.2	33.7	23.9	20.5	13.3	12.1	7.8	226.2
MU 41-0-0	No	22.7	7.3	13.7	16.6	11.7	13.7	6.6	24.7	16.3	13.1	12.3	9.1	5.9	53.5	36.3	26.8	17.9	20.0	9.8	337.9
MU 41-0-0	Yes	23.5	7.1	15.4	16.2	12.3	15.5	7.4	24.2	18.1	13.4	13.4	10.3	5.9	41.7	31.2	25.6	13.3	15.8	7.0	317.1
ISU Exp.	No	23.0	9.8	22.2	26.9	18.4	20.1	8.6	26.9	19.6	15.5	16.4	14.2	7.0	51.0	49.4	39.5	20.3	21.2	10.4	420.4
ISU Exp.	Yes	17.2	8.1	20.8	29.7	20.9	20.2	7.0	28.6	22.0	19.4	18.1	12.9	8.4	43.6	44.9	38.1	22.9	20.0	11.7	414.6
$LSD_{fert\ (0.05)}$		8.0	4.4	6.1	6.3	4.3	5.4	3.2	8.3	5.6	4.3	4.1	2.5	2.6	13.8	10.0	9.2	4.2	5.7	3.0	84.5
$LSD_{core\ (0.05)}$		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Comparison of Kentucky Bluegrass Response to Agriform, IBDU, Sulfur Coated Urea, and Urea

R. W. Moore and N. E. Christians

Four nitrogen sources were evaluated for maintenance fertilization of Kentucky bluegrass. This evaluation included one quick-release source, urea, and three slow-release materials, IBDU (fine), sulfur-coated urea (CIL), and Agriform. Urea, IBDU, and sulfur coated urea are commonly used turf fertilizers. Agriform (34-0-7) is a blend of 70% coated and 15% uncoated urea. The coated fraction is further divided into 3 to 4 month resin-coated urea and 8 to 9 month resin-coated urea. The balance of this fertilizer is an uncoated potassium sulfate.

The turfgrass used in this study was 'Park' Kentucky bluegrass, which was maintained at a cutting height of 2 in. The plots were irrigated regularly at 1 in of moisture/week when needed. A randomized, complete-block design with three replications was used. Each plot measured 4 ft by 8 ft, and each replication was separated by a 2 ft border.

Each product was applied with two application schedules (Table 42). The Agriform (34-0-7), IBDU, and sulfur-coated urea were applied at 4 lb N/1000 ft^2 in one application on April 15, 1989, and at 4 lb N in three split applications of 1.3 lb each. The split applications were made on April 15, June 15, and August 15. Urea was applied on a balanced schedule at 1.3 lb/1000 ft^2 on the same dates and on a standard four application schedule of 0.75 lb of N on April 15 and May 15, 1 lb of N on August 15, and 1.5 lb on September 15. Potassium sulfate was applied to all treatments not containing potassium, at a rate equivalent to that provided by Agriform.

Data taken included visual quality and clipping yields. The visual quality rating was based on a 9 to 1 scale; 9 = best quality, 6 = acceptable quality, and 1 = no live grass. Clipping yields were obtained by using a 21 in push mower and making one swath through the 8 ft length of each plot. This resulted in a 14 ft^2 area in which clippings were sampled.

The grass that received the Agriform product at 4 lb/1000 ft^2 in mid-April (Graph 6, Table 42 & 43) showed lowerer overall quality ratings than SCU but maintained better quality ratings than IBDU. This treatment also had better quality in May, June and July, but not August or September. The grass which received three equal applications of Agriform, in mid-April, mid-June and in mid-August, had a slower spring start but more acceptable or near acceptable quality ratings in July, August and September.

The IBDU-treated grass(Fig 6, Tables 42 & 43) at 4 pounds of N per 1000 ft^2 in a mid-April application demonstrated acceptable quality ratings in late May and through June only. The IBDU-treated grass, at three equal application rates in mid-April, mid-June, and mid-August, demonstrated acceptable quality ratings in early April, but not again until late July and in August and September.

The grass treated with SCU (Figure 6, Tables 42 & 43) at 4 lb of N per 1000 ft^2 in mid-April had the most consistent acceptable quality ratings. Only in early April, late August, and in September did quality ratings fall below an acceptable level. The grass treated with three equal applications, had accceptable quality ratings in early April, late July, and again in August and September.

The balanced-urea-treated grass, (Fig 6, Tables 42 & 43) demonstrated acceptable quality in late April and May, and again in late August and September. The standard-urea-treated grass responded similarly to the balanced program with slightly higher quality ratings.

The LSD readings (Table 43) suggest there are significant differences in quality ratings among the eight treatments.

Overall clipping yields were not significantly different. The Agriform-treated grass at the 4 lb in one application rate demonstrated slightly higher yields on the late fall collection dates. The SCU at the split rate demonstrated slightly higher yields throughout the season. Again, these differences were not significant.

Agriform at the 4 lb one application rate, (Figure 6, Table 43) had lower overall quality ratings than SCU but maintained better quality ratings than IBDU. This is probably due to the combination of quick and resin-coated ureas used. This also suggests the reason for a higher midsummer quality rating. This rate was significantly greater than all of the split applications at the midsummer June 26 collection date (Table 43). Agriform applied at the split rate (Table 42) had somewhat higher quality ratings in the last three data collection dates (Table 43). This is probably due to the slower-release resin-coated ureas in the Agriform blend that released at the end of the season.

The addition of more water-insoluble nitrogen to the formula would possibly increase the early season response of the grass.

Very little difference was demonstrated in clipping yield. In fact, the data suggests no significant differences (Fig 7, Table 44). The large increase on the August 22 collection date was likely due to a lower than normal mower height setting at the time of collection.

Table 42. Treatments for the Sierra Corporation Agriform study.

Treatments		Total lb N/ 1000 ft^2/yr	Rates applied	Dates applied	g/plot/ appl	g of K/ appl/plot
			- lbs N -			
1. Agriform (TM)	34-0-7	4	4.0	April	175.0 g	
2. Agriform (TM)	34-0-7	4	1.3	April	58.3 g	
			1.3	June		
			1.3	August		
3. IBDU	31-0-0	4	4.0	April	189.0 g	25.0 g
4. IBDU	31-0-0	4	1.3	April	63.0 g	8.33g
			1.3	June		
			1.3	August		
5. SCU	32-0-0	4	4.0	April	182.0 g	25.0 g
6. SCU	32-0-0	4	1.3	April	60.7 g	8.33g
			1.3	June		
			1.3	August		
7. Urea (balanced)[1]	46-0-0	4	1.3	April	43.6 g	8.33g
			1.3	June		
			1.3	August		
8. Urea (standard)[2]	46-0-0	4				6.25 g
			.75	April	24.0 g	April & May
			.75	May	24.0 g	August
			1.0	August	32.0 g	September
			1.5	September	48.0 g	

1 Balanced urea program matches split applications of Agriform.

2 Standard urea program for midwest conditions.

Potassium sulfate applied to Treatments 3 to 8 at a rate equivalent to that provided by Agriformin plots 1 and 2.

Table 43.

SIERRA TRIAL 1990

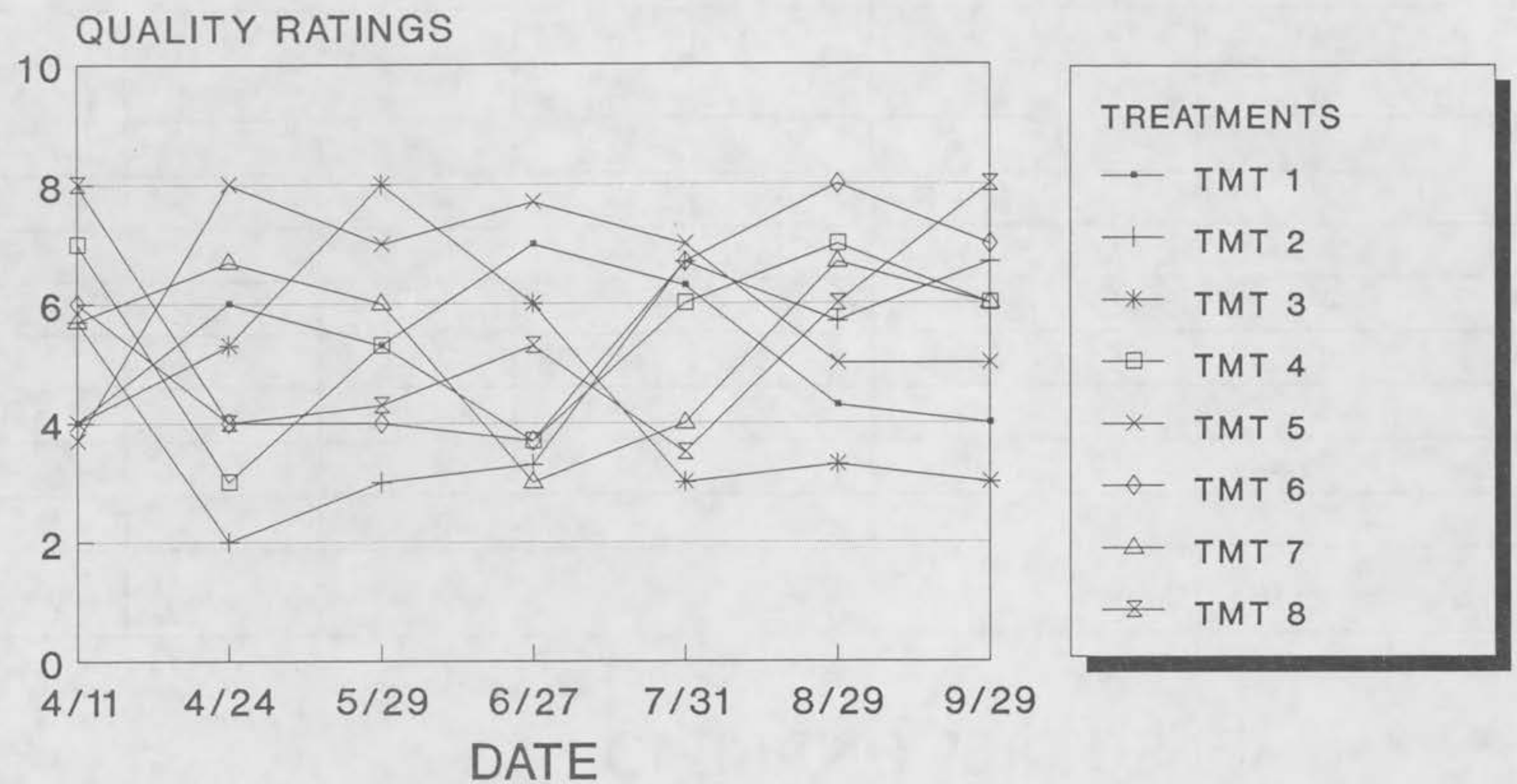
QUALITY RATINGS

	AGRIFORM 1	AGRIFORM 3	IBDU 1	IBDU 3	SCU 1	SCU 3	UREA-BALANCED	UREA-STANDARD	LSD=.05
4/11	4.0	5.7	4.0	7.0	3.7	6.0	5.7	8.0	1.12
4/24	6.0	2.0	5.3	3.0	8.0	4.0	6.7	4.0	0.85
5/29	5.3	3.0	8.0	5.3	7.0	4.0	6.0	4.3	0.66
6/27	7.0	3.3	6.0	3.7	7.7	3.7	3.0	5.3	0.84
7/31	6.3	6.7	3.0	6.0	7.0	6.7	4.0	3.5	1.85
8/29	4.3	5.7	3.3	7.0	5.0	8.0	6.7	6.0	0.80
9/29	4.0	6.7	3.0	6.0	5.0	7.0	6.0	8.0	0.36

RATINGS BASED ON 9-1 RATING.
9=BEST QUALITY, 6=ACCEPTABLE QUALITY AND
1=NO LIVE GRASS.
HEADINGS-- 1= 0NE APPLICATION RATE & 3= SPLIT RATE

SIERRA TRIAL 1990
QUALITY RATINGS

Figure 6



RATINGS BASED ON 9-1 RATING.
9=BEST QUALITY, 6=ACCEPTABLE QUALITY AND
1=NO LIVE GRASS

Table 44.

SIERRA TRIAL 1990

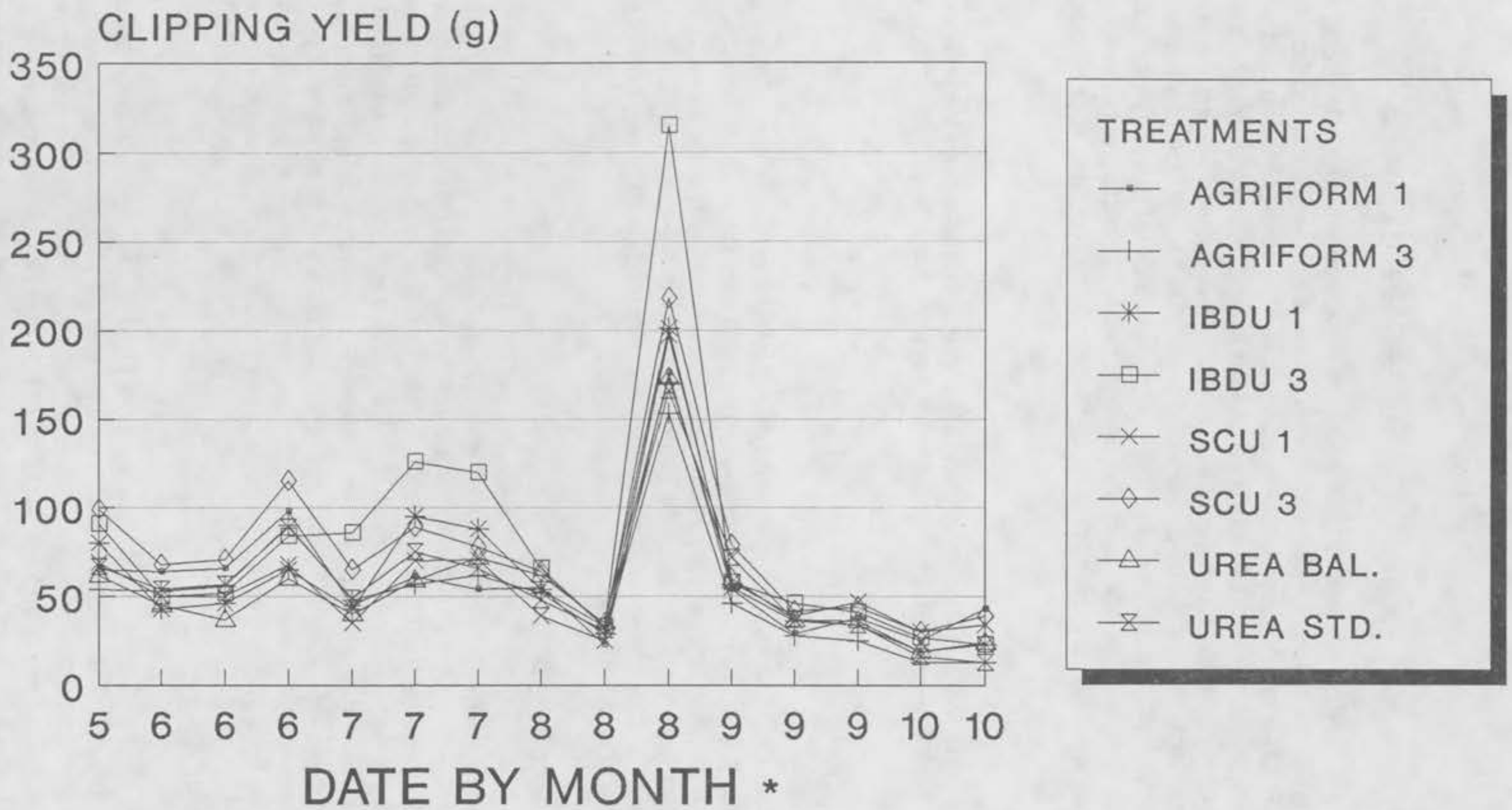
CLIPPING YIELDS (g)

	AGRIFORM 1	AGRIFORM 3	IBDU 1	IBDU 3	SCU 1	SCU 3	UREA-BALANCED	UREA-STANDARD	LSD=.05
5/26	65	54	80	91	69	99	62	67	NS
6/6	64	53	43	50	50	68	45	54	NS
6/13	66	56	46	52	50	71	37	57	NS
6/24	98	90	65	84	68	115	60	89	NS
7/2	45	48	43	86	35	65	40	49	NS
7/13	61	57	95	126	70	89	59	75	NS
7/20	54	62	88	120	71	78	72	66	NS
8/6	55	52	54	66	39	64	62	48	NS
8/13	23	29	33	33	25	33	35	31	NS
8/22	176	153	201	315	197	218	173	166	NS
9/5	54	46	55	58	58	79	60	72	NS
9/12	29	28	36	46	39	42	37	37	NS
9/19	38	25	34	41	47	44	36	34	NS
10/1	25	13	19	27	30	30	19	16	NS
10/10	43	13	23	23	34	39	24	13	NS

CLIPPING YIELDS ARE IN GRAMS
PER 14 sq. ft. OF PLOT
HEADINGS -- 1= 0NE APPLICATION RATE & 3= SPLIT RATE

SIERRA TRIAL 1990
CLIPPING YIELDS (g)

Figure 7



CLIPPING YIELDS ARE IN GRAMS
PER 14 sq.ft. OF PLOT.
* DATA TAKEN EVERY 7-10 DAYS

MURP Studies

M. L. Agnew and S. M. Kassmeyer

Tolerance Study

In the spring of 1990 a study was established in cooperation with O. M. Scott & Sons Company to compare the effects of four nitrogen formulations on a four-year-old stand of 'Ram I' Kentucky bluegrass. Prior to any fertilizer treatments, the site was core cultivated and power raked to provide a uniform testing area. Individual plots measured 3 ft X 10 ft and the treatments were replicated 3 times in a randomized complete block design. The plots were mowed weekly with one mower pass and all leaf tissue above 1 1/2 in collected. Irrigation was added to reduce plant stress. However, 1990 was an extremely wet year and these conditions may have placed plants under waterlogged conditions for short periods of time. The effects of the waterlogged soil conditions became evident in September. Temperatures were hot and plant growth declined due to probable root dieback caused by wet soils.

Treatments

Nitrogen fertilizers used in this study include: three methylene urea formulations (39-0-0, 41-0-0, and 42-0-0) and urea (46-0-0). The fertilizers were applied at a rate of 1 lb N/1000 ft^2 on May 23, June 29, and August 14.

Data Collected

Data collected included fresh clipping weight and visual quality rating. Clippings were collected each week or when growth warranted clipping removal. Clippings were collected with a Toro rotary mower and placed in bags. Fresh weights were recorded immediately after mowing. Visual quality ratings were collected weekly prior to clipping removal. Ratings are based on a scale of 9 to 1. A rating of 9 is equivalent to a dark-green turfgrass stand, 1 is equal to dead, straw-brown turf and 6 is equivalent to a minimum acceptable level.

Results - Quality Ratings

Visual quality ratings are shown in Tables 45, 46, and 47. Table 45 contains the data from the first fertilizer application. Table 46 contains data from the second fertilizer application and Table 47 contains data from the third fertilizer application. Fertilizer carryover from the previous dry seasons was quite noticeable. This was reflected in the consistently higher quality ratings for control plots before August 28. Only slight differences appeared when comparing urea (46-0-0) and the two methylene ureas (42-0-0 and 41-0-0). However, the quality of methylene urea (39-0-0) was consistently lower than urea. Except for the September 19 rating all fertilizer treatments rated above an acceptable level. During this time period, plots were heavily stressed due to high temperatures.

Results - Fresh Weights

Fresh weight data is shown in Fig 8, 9, 10, and 11. Fig. 8 shows the data collected after the first fertilizer application. There were few differences between the methylene ureas and urea. Fig. 9 shows the data collected after the second fertilizer application. Fresh clipping weights were statistically the same for urea (46-0-0) and methylene ureas (42-0-0 and 41-0-0). However, the urea treatment consistently had the highest value. The fresh clipping weights of methylene urea (39-0-0) were statistically less than urea for this period. Fig. 10 shows the data collected after the third fertilizer application. Due to hot, dry weather in the fall growth slowed, causing a decrease in mowing frequency. (The low mowing height and dry, hot conditions stressed the turf.) Dollar spot infested the testing area in mid-August which also slowed growth. Fig. 11 shows the total fresh clipping weights for 1990. Urea (46-0-0) and methylene urea (42-0-0) produced the greatest amount of vegetative growth, while methylene urea (39-0-0) produced the least amount of growth.

Summary

The weather in 1990 was very wet. This provided excellent conditions for utilization of nitrogen applied as urea. The probable loss of nitrogen due to volatilization or leaching was low since fertilizers received water after application and the soils were silty clay loams that are not prone to leaching. The overall green color for urea-treated plots was good throughout the season. The addition of urea increased clipping yields by 128% over the non-fertilized control, while the addition of 39-0-0 methylene urea increased clipping yields only by 32% over the non-fertilized control.

It is important that this study be duplicated in a year when weather conditions are "more normal" (i.e. hot and dry in summer and best growing conditions in spring and fall). Plans are to repeat this study in 1991 on the same site .

Burn Study

Using the same fertilizers (42-0-0, 41-0-0, 39-0-0, and 46-0-0) a study was conducted to examine the burn potential of different nitrogen formulations using 3 and 6 lb N rates.

Figs. 12 and 13 show burn ratings as they appeared 7 and 10 days after the application. Burn ratings were taken on a scale of 9 to 1, with 9 equivalent to dark-green dense turf and 1 equal to a straw-brown dead turf. Using this scale, 6 is equivalent to a minimum acceptable level.

Methylene urea (42-0-0) produced a high amount of burn when applied at 6 lb N/1000 ft^2. The burn was immediate, showing a rating of 4.3. Methylene urea (42-0-0) applied at 3 lb N/1000 ft^2 showed very little burn, while the 3 and 6 lb N rates of the 41-0-0 and 39-0-0 showed no burn. Urea (46-0-0) applied at the 3 lb and 6 lb N rates showed severe burn immediately after application. The 3 lb N rate burn did not appear as severe but was still very evident.

Table 45. Visual Quality Ratings from May 30 to June 26, 1990.

Fertilizer	5/30	6/4	6/13	6/20	6/26	7/3	7/13	7/19	7/25
Control	6.7	5.0	6.0	6.7	7.7	6.3	7.0	6.7	7.0
39-0-0	7.0	6.3	6.0	7.3	8.0	6.7	7.0	7.7	8.0
41-0-0	7.0	6.7	7.0	8.3	7.3	7.7	8.0	8.7	8.7
42-0-0	7.0	7.3	7.0	7.7	7.3	9.0	8.7	9.0	8.7
46-0-0	7.0	7.7	8.3	8.7	9.0	9.0	9.0	9.0	8.7
LSD	1.5	1.0	2.4	1.5	1.4	0.9	1.6	0.6	0.9

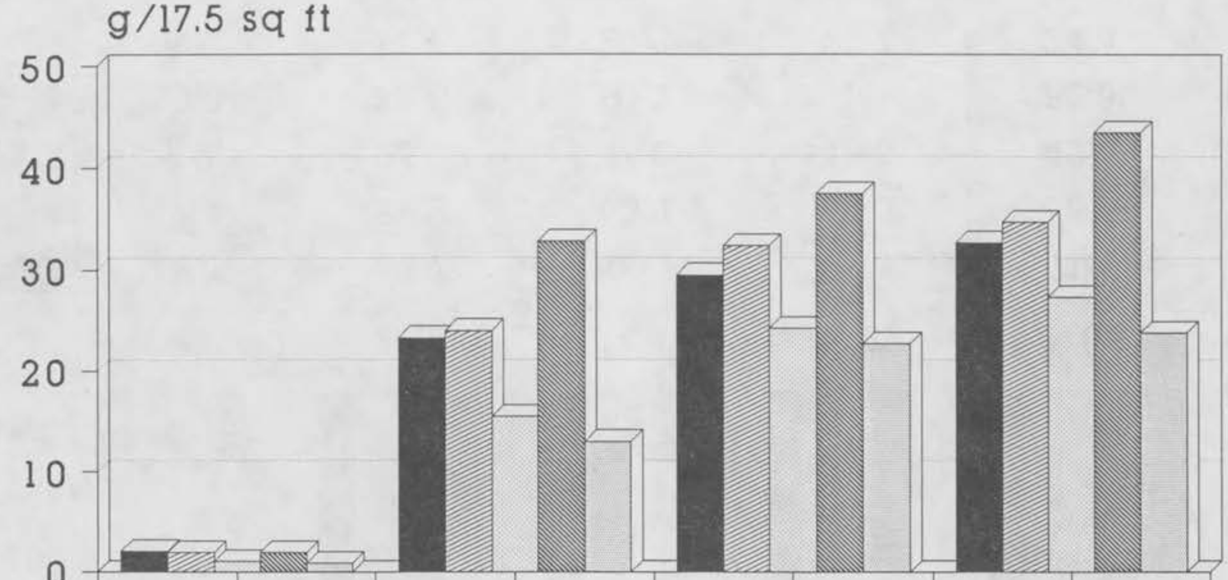
Table 46. Visual Quality Ratings from July 3 to August 14, 1990.

Fertilizer	8/1	8/8	8/14	8/20	8/28
Control	6.3	7.0	7.7	6.7	5.3
39-0-0	7.3	7.7	7.0	7.3	6.7
41-0-0	8.3	8.3	8.0	8.0	7.7
42-0-0	8.7	8.7	8.7	9.0	9.0
46-0-0	8.7	9.0	9.0	9.0	9.0
LSD	1.0	0.9	1.2	0.6	0.7

Table 47. Visual Quality Ratings from August 20 to October 19, 1990.

Fertilizer	9/6	9/11	9/19	10/1	10/8	10/19
Control	5.3	6.0	5.0	5.0	5.7	5.7
39-0-0	6.3	7.7	5.7	6.0	7.0	7.0
41-0-0	6.7	8.0	5.7	6.3	7.0	7.0
42-0-0	7.7	9.0	6.7	6.7	7.0	7.7
46-0-0	7.7	8.3	6.3	7.3	7.7	8.0
LSD	0.8	1.4	1.4	0.9	0.7	0.7

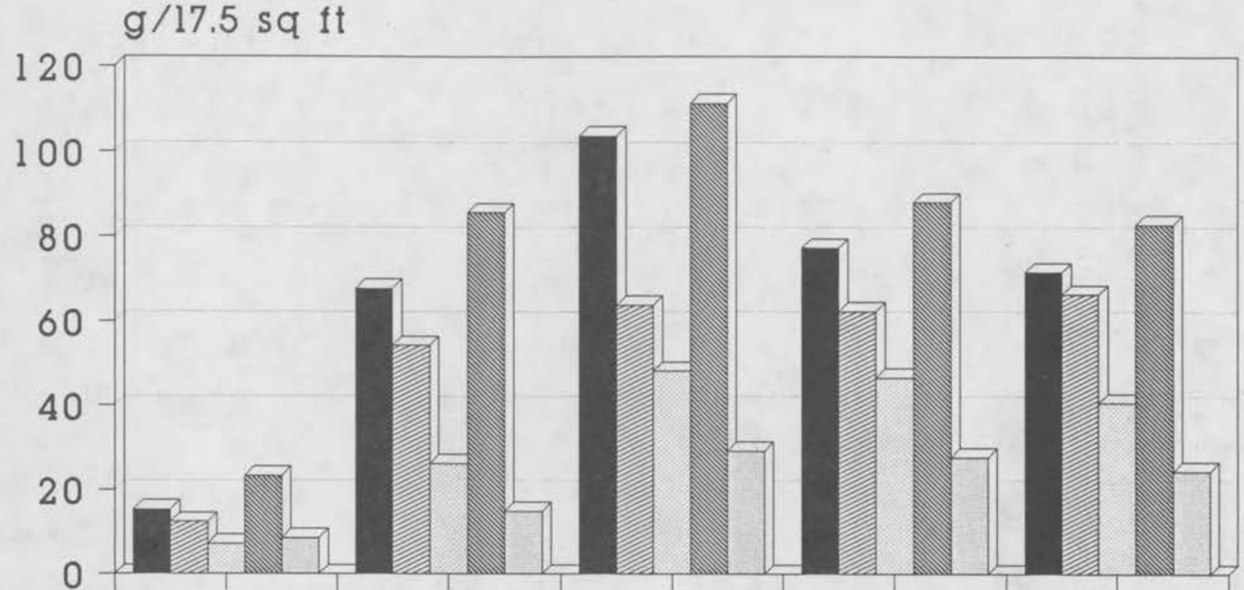
Figure 8. Clipping yields from June 4 to June 27.



	6/04	6-13	6/20	6/27
'42-0-0'	2.1	23.3	29.5	32.7
'41-0-0'	2	24	32.4	34.7
'39-0-0'	1.1	15.5	24.2	27.3
'46-0-0'	2	32.8	37.5	43.5
CONTROL	0.9	13	22.7	23.8
LSD (0.05)	N.S.	N.S.	N.S.	0 *

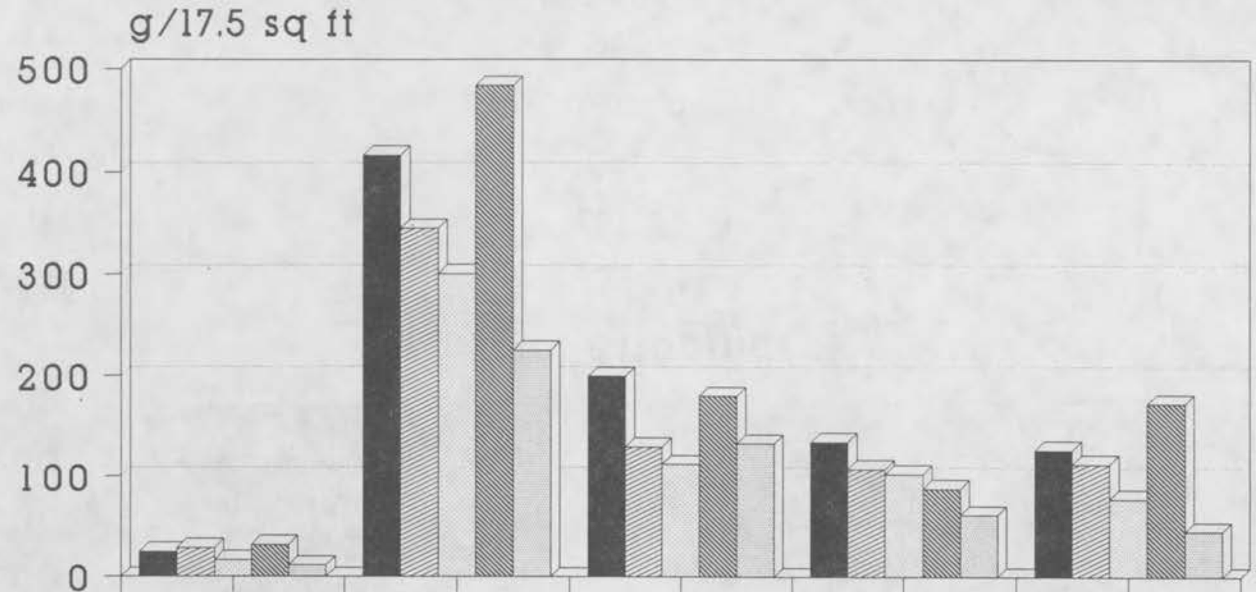
* significant at α 0.10 level.

Figure 9. Clipping yields from July 5 to August 6.



	7/05	7-13	7/20	7/27	8/06
'42-0-0'	15.3	67.7	103.7	77.3	71.6
'41-0-0'	12.4	54.2	63.8	62.3	66.3
'39-0-0'	7.2	26.2	48.2	46.6	40.6
'46-0-0'	23.3	85.6	111.2	88	82.8
CONTROL	8.5	14.9	29.2	27.7	24.4
LSD (0.05)	11.2	38.1	47.6	30.9	33.1

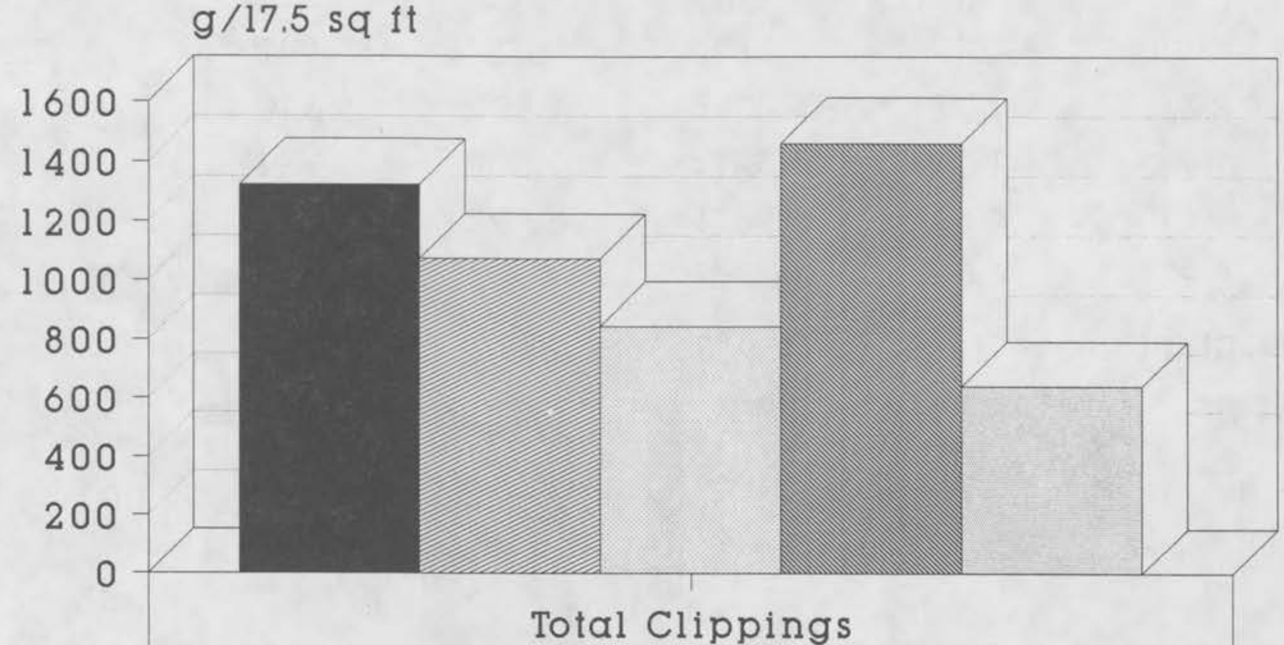
Figure 10. Clipping yields from August 13 to October 10.



	8/13	8/22	8/29	9/11	10/10
'42-0-0'	24.8	416.3	199.5	134.2	126.3
'41-0-0'	28.8	344.9	129.2	107.3	112.4
'39-0-0'	16.6	300.4	112	102.1	77.6
'46-0-0'	31.9	483.8	180.1	87.9	172.3
CONTROL	11.4	225	132.8	61.7	45.2
LSD (0.05)	NS	92.9	NS *	NS	29.6

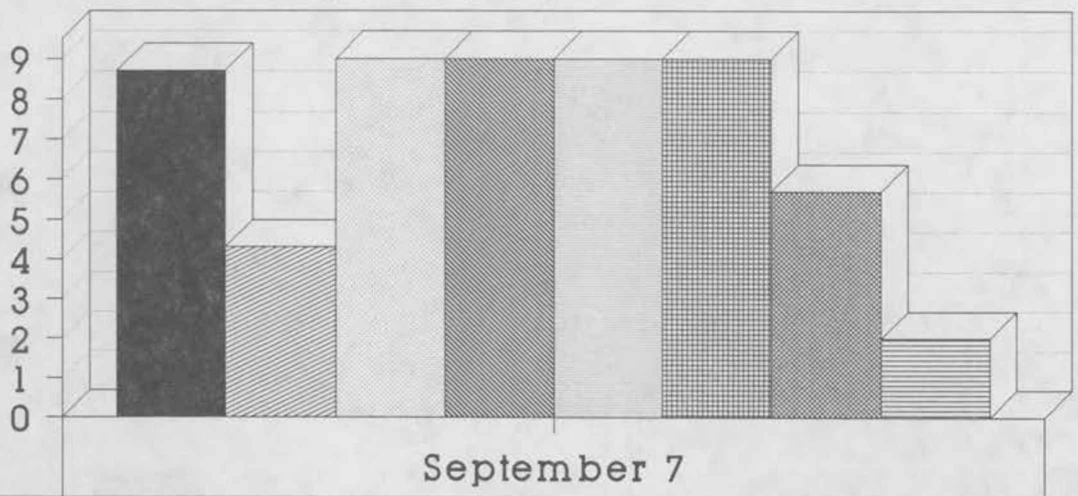
* significant at a 0.10 level.

Figure 11. Total Clipping Yields for 1990.



	Total Clippings
'42-0-0'	1324.3
'41-0-0'	1074.7
'39-0-0'	845.7
'46-0-0'	1462.6
CONTROL	641.3
LSD (0.05)	365.2

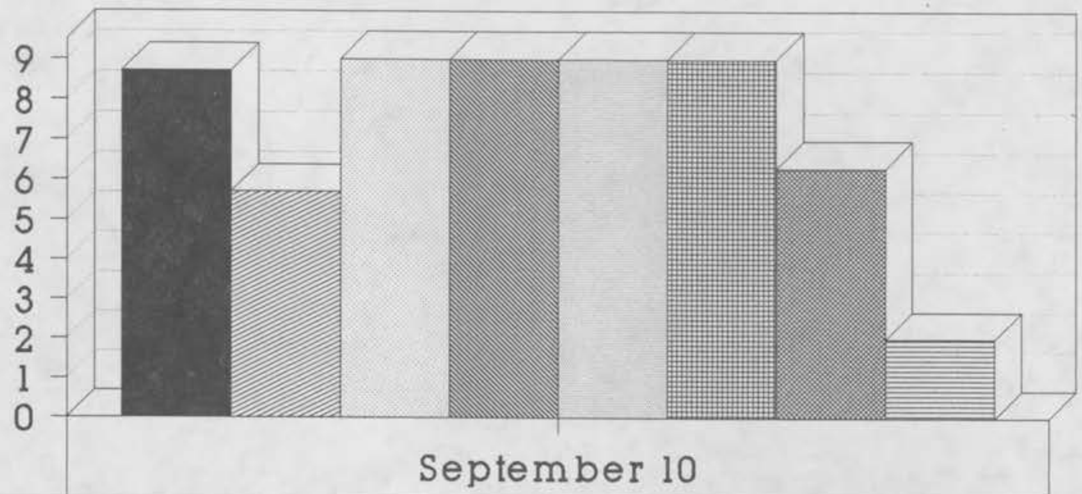
Figure 12. Burn rating 7 days after application.



	September 7
42-0-0 / 3 lb N	8.7
42-0-0 / 6 lb N	4.3
41-0-0 / 3 lb N	9
41-0-0 / 6 lb N	9
39-0-0 / 3 lb N	9
39-0-0 / 6 lb N	9
46-0-0 / 3 lb N	5.7
46-0-0 / 6 lb N	2
LSD (0.05)	1.3

1 = dead turf, 9 = no injury.

Figure 13. Burn rating 10 days after application.



	September 10
42-0-0 / 3 lb N	8.7
42-0-0 / 6 lb N	5.7
41-0-0 / 3 lb N	9
41-0-0 / 6 lb N	9
39-0-0 / 3 lb N	9
39-0-0 / 6 lb N	9
46-0-0 / 3 lb N	6.3
46-0-0 / 6 lb N	2
LSD (0.05)	1.5

1 = dead turf, 9 = no injury.

Crabapples

J. K. Iles

crab apple (krab'ap l) **n. 1.** any of several species of terrible little trees well known for their propensity to litter the ground with rotting fruit and defoliate in July. **2.** so-called ornamental trees sold by dishonest nurseries and garden centers. **3.** a homeowner's worst nightmare.

Unfortunately, many homeowners might not see the humor in this tongue-in-cheek definition of crabapples. Thanks to cultivars such as 'Dolgo', 'Hopa', 'Radiant', and 'Royalty', which were planted heavily over the last 20 to 30 years, the public has had ample opportunity to see trees without leaves in August and experience messy fruit drop. It's a wonder that nurseries are able to sell crabapples at all with cultivars such as 'Radiant' serving as goodwill ambassadors. Today, most nursery operators are aware that superior cultivars of the genus Malus exist. These trees produce small, persistent fruit and show excellent disease resistance. Nurseries and garden centers are obliged to sell these preferred cultivars and varieties and phase out more troublesome species. Only when this is done will the general public begin to regain faith in a truly remarkable group of small ornamental trees.

Iowa State University is one of 23 cooperators taking part in the **National Crabapple Evaluation Program (NCEP)**. Each trial site is currently evaluating over 50 crabapple varieties and cultivars for disease resistance and outstanding ornamental features. ISU is also participating in the **National Crabapple Introduction Program (NCIP)**, established to evaluate new taxa. Cultivars and varieties demonstrating superior qualities at the Ames, Iowa, trial site are described below.

'Adams' - Originated in the late 1940s at the West Springfield residence of the late Walter Adams, former president of Adams Nursery, Westfield, Massachusetts. Trees are rounded and dense, growing about 20 ft tall with an equal spread. In spring, deep carmine buds open to single reddish-pink flowers. The light-green foliage exhibits a reddish tinge on new growth and is only slightly susceptible to powdery mildew. The 5/8 in fruit of 'Adams' colors a dark red by the middle of July, but will persist until the following spring. Use the tree in mass plantings or as a single specimen.

'Candied Apple' - A popular weeping form growing 10 to 15 ft tall developed at Lake County Nursery Exchange, Perry, Ohio. Dark red buds open to single, pink flowers in spring and leaves are dark green with just a hint of brownish-red. The bright cherry red fruit are 5/8 in in diameter and may persist until late winter. 'Candied Apple' reportedly has slight to moderate scab susceptibility; however, this disease has not affected trees in Ames. Use it in place of the disease-prone weeper 'Red Jade'.

'David' - Named in 1957 by Arie F. denBoer after a grandson, this round and compact tree will grow to a height of approximately 20 ft. Flowers are light pink in bud, opening to moderately fragrant single white blooms. Fruit are 1/2 in in diameter, scarlet red, and very persistent. Unfortunately, the dense, dark green foliage of 'David' tends to conceal the attractive flowers and fruit. This cultivar is only slightly susceptible to scab and fireblight.

'Donald Wyman' - Given the name of the famous horticulturist in the late 1940s, this cultivar remains a standout among the hundreds of available crabapples. Dark-green foliage is dense on this tree's rounded, 15 to 20 ft tall frame. Pink buds open to mildly fragrant single white flowers and an abundant crop of bright red 3/8 in fruit is produced annually. The persistent fruit are a welcome addition to bleak winter landscapes. 'Donald Wyman' is only slightly susceptible to powdery mildew.

'Harvest Gold' - This vigorous cultivar grows 15 to 20 ft tall and maintains a neat, upright habit, perfect for narrow boulevards or other sites where space is limited. Single white flowers are followed by 3/5 in golden-yellow fruit that remain effective well into December. 'Harvest Gold' is highly resistant to all major crabapple diseases.

'Professor Sprenger' - This wonderful cultivar, introduced in 1950 by Mr. S. G. A. Doorenbos of the Hague, Netherlands, is still struggling for acceptance in this country. The tree grows to heights of 20 to 25 ft and develops a spreading, global shape with maturity. Abundant, showy white flowers are produced in spring followed by eye-catching 1/2 to 5/8 in orange-red fruit in late summer. Because birds shun the fruit, these colorful ornaments are allowed to remain on trees until midwinter. Some have found the dried fruit make interesting additions to floral displays. 'Professor Sprenger' is highly disease resistant.

There is no shortage of desirable crabapples for midwestern landscapes. Some like 'Bob White', 'Indian Magic', 'Profusion', 'Sentinel', and 'Snowdrift' have been around for years, while newcomers 'Adirondack', 'Doubloons', and 'Louisa' show promise for the future. It is time for responsible growers and retailers to introduce superior cultivars and varieties to homeowners, landscape architects and designers, and other grounds maintenance personnel throughout our region.

The **International Ornamental Crabapple Society** has been formed to bring together breeders, wholesalers, retailers, horticulturists, scientists, and hobbyists who are interested in crabapples with the intent to educate the public and eliminate substandard plant material from the market place. Persons wishing to join IOCS may contact Dr. Thomas Green, Research Plant Pathologist, The Morton Arboretum, Lisle, Illinois 60532.

Table 48.

National Crabapple Evaluation Program/Fall 1990 Evaluation

Cultivar/Var.	Rep	Aes	Scab	FB	CAR	PM	FE	Fruit Abund.	% Drop
'Adams'	1	1	0	0	0	0	0	3	5%
	2	2	0	0	0	0	0	3	10%
	3	1	0	0	0	0	0	3	5%
b. **'Jackii'**	1	2	0	0	0	0	0	2	0%
	2	3	0	0	0	0	0	3	0%
	3	3	0	0	0	0	0	1	0%
'Beverly'	1	4	0	0	0	0	0	2	10%
	2	3	0	0	0	0	0	2	5%
	3	3	0	0	0	0	0	2	0%
'Bob White'	1	2	0	0	0	0	0	4	0%
	2	1	0	0	0	0	0	4	5%
	3	2	0	0	0	0	0	4	0%
'Candied Apple'	1	1	0	0	0	0	0	4	0%
	2	0	0	0	0	0	0	5	0%
	3	*	*	*	*	*	*	*	*
'Centurion'	1	*	*	*	*	*	*	*	*
	2	*	*	*	*	*	*	*	*
	3	*	*	*	*	*	*	*	*
'Xmas Holly'	1	2	0	0	0	0	0	4	0%
	2	2	0	0	0	0	0	4	0%
	3	3	0	0	0	0	0	3	0%
'David'	1	3	0	0	0	0	1	1	0%
	2	2	0	0	0	0	0	2	0%
	3	2	0	0	0	0	0	2	0%
'Dolgo'	1	3	0	0	0	0	2	3	90%
	2	3	0	0	0	0	2	3	90%

Cultivar/Var.	Rep	Aes	Scab	FB	CAR	PM	FE	Fruit Abund.	% Drop
	3	3	0	0	0	0	2	3	95%
'Donald Wyman'	1	1	0	0	0	0	0	4	0%
	2	2	0	0	0	0	0	3	0%
	3	*	*	*	*	*	*	*	*
floribunda	1	3	0	0	0	0	0	4	0%
	2	3	0	0	0	0	0	4	0%
	3	2	0	0	0	0	0	4	0%
'Harvest Gold'	1	2	0	0	0	0	0	2	0%
	2	1	0	0	0	0	0	2	0%
	3	2	0	0	0	0	0	2	0%
'Henningi'	1	2	0	0	0	0	0	4	5%
	2	2	0	0	0	0	0	3	0%
	3	2	0	0	0	0	0	4	0%
'Hopa'	1	4	4	0	0	0	0	3	30%
	2	4	4	0	0	0	0	3	50%
	3	4	2	0	0	0	2	4	50%
hupehensis	1	3	0	0	0	0	1	2	0%
	2	3	0	0	0	0	1	4	0%
	3	2	0	0	0	0	0	4	0%
'Indian Magic'	1	2	0	0	0	0	2	3	5%
	2	2	1	0	0	0	2	2	0%
	3	2	1	0	0	0	2	3	0%
'Indian Summer'	1	*	*	*	*	*	*	*	*
	2	*	*	*	*	*	*	*	*
	3	*	*	*	*	*	*	*	*
'Jewelberry'	1	3	0	0	0	0	0	3	0%
	2	3	0	0	0	0	0	2	0%

Cultivar/Var.	Rep	Aes	Scab	FB	CAR	PM	FE	Fruit Abund.	% Drop
	3	3	0	0	0	0	0	2	0%
'Liset'	1	3	0	0	0	0	1	3	0%
	2	*	*	*	*	*	*	*	*
	3	3	0	0	0	0	0	2	0%
'Mary Potter'	1	3	0	0	0	0	0	4	0%
	2	3	0	0	0	0	0	3	0%
	3	3	0	0	0	0	0	3	0%
'Molten Lava'	1	2	0	0	0	0	0	4	0%
	2	3	0	0	0	0	0	3	0%
	3	2	0	0	0	0	0	4	0%
'Ormiston Roy'	1	3	0	0	0	0	0	4	0%
	2	2	0	0	0	0	0	3	0%
	3	*	*	*	*	*	*	*	*
'Pink Spires'	1	4	0	0	0	0	3	3	20%
	2	4	0	0	0	0	3	3	5%
	3	4	0	0	0	0	3	2	5%
'Prairifire'	1	*	*	*	*	*	*	*	*
	2	*	*	*	*	*	*	*	*
	3	*	*	*	*	*	*	*	*
'Prof. Sprenger'	1	2	0	0	0	0	1	4	5%
	2	1	0	0	0	0	1	5	0%
	3	2	0	0	0	0	1	4	0%
'Profusion'	1	1	0	0	0	0	2	4	0%
	2	2	0	0	0	0	0	3	5%
	3	2	0	0	0	0	0	4	0%
'Radiant'	1	4	4	0	0	0	0	2	10%
	2	4	3	0	0	0	0	2	30%

Cultivar/Var.	Rep	Aes	Scab	FB	CAR	PM	FE	Fruit Abund.	% Drop
	3	4	4	0	0	0	0	2	40%
'Ralph Shay'	1	2	0	0	0	0	2	4	20%
	2	1	0	0	0	0	0	4	5%
	3	3	0	0	0	0	2	4	10%
'Red Baron'	1	2	0	0	0	0	0	3	0%
	2	3	0	0	0	0	2	2	0%
	3	*	*	*	*	*	*	*	*
'Red Jade'	1	4	0	0	0	0	0	0	0%
	2	3	0	0	0	0	0	1	0%
	3	**	**	**	**	**	**	**	**
'Red Jewel'	1	3	0	0	0	0	0	2	0%
	2	2	0	0	0	0	0	2	0%
	3	3	0	0	0	0	0	2	0%
'Red Splendor'	1	3	0	0	0	0	1	3	0%
	2	3	0	0	0	0	2	3	5%
	3	3	0	0	0	0	3	3	10%
'Robinson'	1	4	0	0	0	0	3	2	0%
	2	2	0	0	0	0	0	3	0%
	3	1	0	0	0	0	0	3	25%
'Royalty'	1	3	0	0	0	0	2	2	50%
	2	4	0	0	0	0	3	1	50%
	3	3	2	0	0	0	0	1	50%
'Ruby Luster'	1	3	0	0	0	0	0	0	0%
	2	3	0	0	0	0	0	1	0%
	3	3	0	0	0	0	0	0	0%
sargentii	1	5	0	0	0	0	0	1	0%
	2	4	0	0	0	0	0	3	0%

Cultivar/Var.	Rep	Aes	Scab	FB	CAR	PM	FE	Fruit Abund.	% Drop
	3	**	**	**	**	**	**	**	**
'Selkirk'	1	3	0	0	0	0	0	2	50%
	2	4	0	0	0	0	1	2	50%
	3	4	0	0	0	0	3	2	50%
'Sentinel'	1	1	0	0	0	0	0	2	0%
	2	2	0	0	0	0	0	4	0%
	3	*	*	*	*	*	*	*	*
'Silver Moon'	1	4	0	0	0	0	1	1	0%
	2	*	*	*	*	*	*	*	*
	3	3	0	0	0	0	0	1	0%
'Snowdrift'	1	*	*	*	*	*	*	*	*
	2	2	0	0	0	0	0	3	0%
	3	2	0	0	0	0	0	3	0%
'Sberry Parfait'	1	4	0	0	0	0	1	2	0%
	2	3	0	0	0	0	0	1	0%
	3	4	0	0	0	0	0	1	0%
'Sugar Tyme'	1	1	0	0	0	0	0	4	0%
	2	3	0	0	0	0	0	1	0%
	3	2	0	0	0	0	0	3	5%
tschonoskii	1	3	0	0	0	0	2	0	0%
	2	**	**	**	**	**	**	**	**
	3	**	**	**	**	**	**	**	**
'Velvet Pillar'	1	2	0	0	0	0	0	1	0%
	2	2	0	0	0	0	0	0	0%
	3	2	0	0	0	0	0	1	0%
'White Angel'	1	3	0	0	0	0	1	2	0%
	2	3	0	0	0	0	0	2	5%

Cultivar/Var.	Rep	Aes	Scab	FB	CAR	PM	FE	Fruit Abund.	% Drop
	3	3	0	0	0	0	0	4	5%
'White Cascade'	1	4	0	0	0	0	0	3	0%
	2	4	0	0	0	0	0	4	0%
	3	3	0	0	0	0	0	1	0%
'Winter Gold'	1	1	0	0	0	0	0	3	0%
	2	*	*	*	*	*	*	*	*
	3	*	*	*	*	*	*	*	*
y. veitchii	1	5	0	0	0	0	0	0	0%
	2	5	0	0	0	0	0	0	0%
	3	**	**	**	**	**	**	**	**
zumi calocarpa	1	3	0	0	0	0	0	4	0%
	2	1	0	0	0	0	0	4	0%
	3	2	0	0	0	0	1	4	0%

*=new plant
**=dead plant
Aes=aesthetic rating - (0-5)/0=perfect, 5=unacceptable
Scab=apple scab rating - (0-4)/0=none, 4=severe
FB=fireblight rating - (0-4)/0=none, 4=severe
CAR=cedar apple rust rating - (0-4)/0=none, 4=severe
PM=powdery mildew rating - (0-4)/0=none, 4=severe
FE=frog-eye leafspot rating - (0-4)/0=none, 4=severe
Fruit abund.=fruit abundance at rating - (0-5)/0=none, 5=abundant
% Drop=%fruit drop at rating - (0-100%)

Weed Control With Landscape Fabrics

N. H. Agnew and J. K. Iles

Introduction

Due to reported adverse effects on landscape plant growth when plastic (black or clear) is used for weed control, and the increasing desire to reduce chemical use in the landscape, weed control alternatives are needed. The ability of landscape fabrics (also referred to as geotextiles or weed barriers) to suppress weed growth without jeopardizing the vigor of desirable landscape plants has been well documented. Unfortunately, weeds may still cause problems when they germinate and grow in the mulch layer covering the fabric. In the spring of 1990, a study was initiated to test the ability of several landscape fabrics to suppress the growth of weeds in the mulch layer on top of the fabric. Dalen Products, Inc. of Knoxville, Tennessee, provided funding and materials for this study.

Materials and Methods

The four landscape fabrics tested were:

Reemay's Typar - stiff polypropylene/nonwoven.
Blunk's Duon - softer polypropylene/nonwoven.
Easy Gardener's Weedblock - punched polyethylene film.
Dalen's Weed-X - porous polyethylene film/polyester nonwoven laminate.

Typar and Duon can be installed with either side up. Weedblock should be installed with the rough side down. Weed-X must be installed with the smooth black side up and the nonwoven side down.

1. Weed-free test plots (strips) were prepared.
2. Using a randomized block design, landscape fabric treatments (3 ft by 3 ft squares) were randomly assigned to 6 test strips (replications). Each fabric appeared 3 times in each replication.
3. Fabrics were covered with 1 to 1 1/2 in shredded hardwood mulch.
4. Seed from several species of challenge weeds were applied to the mulch covering the fabric to augment natural weed pressure.
5. In August, 1990, one-half of the experiment was rated visually for weed shoot growth occurring in the mulch.
6. In October, 1990, the same portion of the experiment was analyzed more thoroughly. Root mass below the fabric and shoot growth above the fabric were rated qualitatively and quantitatively.
7. The remaining plots will be evaluated in summer and fall of 1991.

Table 49. Subjective rating[z] of weed growth occurring in the mulch layer above the various weed control fabrics. Evaluated August, 1990.

	Fabric	Observation 1	2	3	Mean Rating
	Typar	2	3	3	2.7
Rep 1	Duon	3	3	2	2.7
	Weedblock	4	4	5	4.3
	Weed-X	1	1	1	1.0
	Typar	3	2	3	2.7
Rep 2	Duon	4	3	3	3.3
	Weedblock	4	3	3	3.3
	Weed-X	1	2	2	1.7
	Typar	3	3	2	2.7
Rep 3	Duon	3	3	2	2.7
	Weedblock	4	2	3	3.0
	Weed-X	1	1	1	1.0

z 1 = no weed growth, 5 = prolific weed growth.

Table 50. Number of shoots above the fabric. Evaluated October 1990.

	Fabric	Observation 1	2	3	Mean Rating
Rep 1	Typar	20	19	19	19.3
	Duon	25	23	17	21.7
	Weedblock	24	28	62	38.0
	Weed-X	3	2	3	2.7
Rep 2	Typar	25	18	23	22.0
	Duon	37	30	34	33.7
	Weedblock	34	22	28	28.0
	Weed-X	1	6	12	6.3
Rep 3	Typar	32	25	42	33.0
	Duon	22	26	27	25.0
	Weedblock	25	21	28	24.7
	Weed-X	5	2	2	3.0

Overal Means

Typar	24.8
Duon	26.8
Weedblock	30.2
Weed-X	4.0

Table 51. Subjective rating[z] of root penetration through fabric. Evaluated October, 1990.

	Fabric	Observation 1	Observation 2	Observation 3	Mean Rating
	Typar	0	1	2	1.0
Rep 1	Duon	2	2	1	1.7
	Weedblock	1	1	2	1.3
	Weed-X	0	0	0	0.0
	Typar	1	1	1	1.0
Rep 2	Duon	2	1	2	1.7
	Weedblock	2	1	1	1.3
	Weed-X	0	0	1	0.3
	Typar	1	1	1	1.0
Rep 3	Duon	1	2	1	1.3
	Weedblock	2	0	2	1.3
	Weed-X	0	0	0	0.0

z 0 = no roots visible, 1 = hair roots, minor surface soil lift, 2 = some larger roots, no deep soil disruption, 3 = larger roots, isolated deep soil lifting.

Table 52. Root dry weight (g) below fabric. Evaluated October 1990.

	Fabric	Observation 1	Observation 2	Observation 3	Mean Rating
Rep 1	Typar	0.00	0.15	0.68	0.28
	Duon	0.48	1.75	0.96	1.06
	Weedblock	0.73	0.85	1.68	1.09
	Weed-X	0.00	0.00	0.00	0.00
Rep 2	Typar	0.09	0.28	0.29	0.22
	Duon	1.17	0.60	0.73	0.83
	Weedblock	1.60	0.54	0.79	0.98
	Weed-X	0.00	0.00	0.25	0.08
Rep 3	Typar	0.14	0.16	0.50	0.27
	Duon	0.26	0.53	0.12	0.30
	Weedblock	0.80	0.00	1.83	0.88
	Weed-X	0.00	0.00	0.00	0.00

Overall Means

Typar	0.26
Duon	0.73
Weedblock	0.98
Weed-X	0.03

Shade and Flowering Tree Evaluation

J. K. Iles

The Shade and Flowering Tree Evaluation Project is sponsored by the Iowa Nurserymen's Research Corporation in cooperation with the Iowa State University Department of Horticulture. Forty-two selections of shade and ornamental trees were planted at the ISU Horticulture Research Station in 1986. Because of space constraints and poor drainage at the original site, a new evaluation site was established just east of the turfgrass research plots in fall of 1990. Trees planted in 1990 include:

Acer negundo **'Sensation'** (Sensation Box Elder) - Three trees were originally planted and **all** failed to survive the winter of 1990-91.

Acer platanoides **'Lamis'** (Crystal Norway Maple) - A Bailey Nursery selection made in Oregon by Max Lamis. This maple is expected to grow 50 to 60 ft tall and is noted for its vigorous, straight trunk. It reportedly has better branching than 'Emerald Lustre' with a lighter colored leaf tip. Of the three planted, **one** failed to survive the winter.

J. Frank Schmidt Nursery in Boring, Oregon, has introduced two new maples that are hybrids of *Acer truncatum* (Shantung Maple) and *Acer platanoides* (Norway Maple). According to Schmidt, both trees will mature at a size slightly smaller than a typical Norway maple, have a finer textured branching habit, and leaves will exhibit shades of orange and red in fall. These new introductions are described below.

Acer truncatum X *platanoides* **'Keithsform'** (Norwegian Sunset Maple) - An upright oval tree growing 35 ft tall and 25 ft wide with excellent orange-red fall color. Norwegian Sunset has a particularly nice branch structure and uniform canopy. The trademark name, Norwegian Sunset, reflects the tree's similarity to Norway Maple in growth rate, branch structure, and leaf shape. **All** test trees survived the first winter.

Acer truncatum X *platanoides* **'Warrenred'** (Pacific Sunset Maple) - This upright, spreading tree will grow 30 ft tall, spread 25 ft, and displays outstanding glossy summer foliage that changes to bright red in fall. Pacific Sunset colors earlier and a little brighter than Norwegian Sunset. Branch structure is a little finer textured and more spreading than Norwegian Sunset. **All** test trees survived the first winter.

Crataegus viridis **'Winter King'** (Winter King Hawthorn) - Is this ornamental tree truly hardy for Iowa? After receiving conflicting reports, this tree was included in the trial for closer observation. 'Winter King' has white spring flowers, attractive silver bark, showy and persistent red fruit, and is virtually thornless. **All** test plants survived their first Iowa winter.

Fraxinus pennsylvanica **'Mahle'** (Mahle Green Ash) - This selection comes from a tree in K. A. Mahle's yard in Woodbury, Minnesota. Expected to grow 50 to 60 ft tall, 'Mahle' branches exceptionally well as a young tree, forming a broad, oval head at maturity. Foliage is described as a good, glossy green, and the tree is seedless. **All** test trees survived the winter.

Tilia americana **'Fastigiata'** (Pyramidal American Linden) - A Bailey Nurseries selection expected to grow to 60 ft. The tree has a narrow, pyramidal form with fragrant yellow flowers. A good candidate for street tree duty. **All** test trees survived the winter.

Selections added to the trial in 1991 include the following:

Acer X *freemanii* **'Autumn Blaze'** (Autumn Blaze Maple) - A hybrid of red maple (*Acer rubrum*) and silver maple (*Acer saccharinum*) that grows approximately 50 ft tall and 40 ft wide. The tree has a dense, oval head with ascending branches. Summer foliage is a rich green, changing to orange-red in fall. The tree is thought to be more drought tolerant than cultivars of *Acer rubrum*. Selected by Glenn Jeffers, Fostoria, Ohio, in the late 1960s.

Acer platanoides **'Oregon Pride'** (Oregon Pride Norway Maple) - An interesting, cut-leaf form of Norway Maple with a gold-bronze fall color. Developing a heavy crown and possessing a rapid growth rate, 'Oregon Pride' will attain heights of 40 to 50 ft.

Acer saccharum **'Majesty'** (Flax Mill Majesty Sugar Maple) - This cultivar was originally found at Flax Mill Nursery in Cambridge, New York. 'Majesty' is characterized by a perfectly symmetrical, ovoid-shaped head, numerous branches (2 to 3 times the branch number of the species), and a rapid growth rate. Thick, dark green leaves turn orange-red in fall. Trees will grow to heights of 50 to 75 ft and are reportedly free from sunscald and frost-crack injury.

Cornus kousa (Kousa Dogwood) - A handsome small specimen tree growing to heights of approximately 20 ft, with an equal or greater spread. Flowers, with their showy, creamy-white bracts, form in early to mid-June. When young, the tree has a vase-shaped growth habit, becoming rounded with a distinct stratified branching pattern as it ages. Leaves are dark green in summer, changing to reddish purple or scarlet in fall. Kousa Dogwood may survive winters in central Iowa, but will it flower dependably?

Corylus colurna (Turkish Filbert) - A broadly pyramidal tree with an excellent formal character growing 40 to 50 ft in height with a spread of 20 to 30 ft. Turkish Filbert reportedly will thrive in areas with hot summers and cold winters and is pH adaptable. Leaves are dark green in summer, turning yellow or purple in fall. Insect and disease problems are rare.

Fraxinus pennsylvanica **'Dakota Centennial'** (Dakota Centennial Green Ash) - A globe-shaped, seedless selection of green ash from North Dakota State University growing 40 to 50 ft in height. The tree develops a strong central leader and desirable scaffold branches. Leaves are a glossy, dark green, turning yellow in fall.

Fraxinus pennsylvanica **'Prairie Spire'** (Prairie Spire Green Ash) - Another hardy, seedless, green ash from North Dakota State University. The tree is compact and columnar when young, becoming narrow pyramidal to elliptical with age, and attaining heights of 50 to 60 ft. Bright golden yellow fall color has been reported.

Tilia cordata **'Ronald'** (Norlin Linden) - A broadly pyramidal selection of littleleaf linden growing 35 to 45 ft tall. Norlin has a rapid growth rate, strong branches, and is more resistant to sunscald. Dark greenish-brown stems accent the dark green summer foliage.

Tilia cordata **'Baileyi'** (Shamrock Linden) - Selected and introduced by Bailey Nurseries, this littleleaf linden cultivar is similar to 'Greenspire', but has stouter branching and a more open canopy. Shamrock will grow 40 to 50 ft tall and take on a broad, conical form.

NCR-10 Regional Alternative Grass Trial

N. E. Christians and R. W. Moore

The North Central Region-10 (NCR-10) Regional Research Turfgrass Committee established an alternative grass trial in the fall of 1988 at nine cooperating universities in the midwest. The objective of this study is to evaluate the adaptation of 16 grasses that are presently not used as turf species in the region (Table 53).

The grasses were established in a strip-split plot arrangement at the nine state sites in 3 ft by 10 ft plots in three replications. The plots are further divided into three mowing height strips; no mow, 2 in, and 4 in. Fertilizer was applied at a rate of 2 lb P_2O_5 and 1 lb N/1000 ft^2 at establishment. No weed control other than hand weeding was used in the first year and no additional fertilizer was applied.

Data collection sheets were distributed to each of the states in 1990 and visual quality ratings based on a scale of 9 to 1 with 9 = best quality and 1 = dead turf, were performed monthly. The data were sent to Iowa State University for analysis in the late fall of 1990.

All but one of the nine states submitted data, and not every state submitted data for all months. Means of the data submitted were calculated for each state and an analysis of variance was conducted on the 1990 means.

Sheep fescue received the highest average rating for all state locations and all three mowing heights (Table 54). It was followed in order by Alta tall fescue, Reton red top, and Exeter colonial bentgrass.

Quality ratings for the 16 grasses are listed by state in Table 55 and by state and mowing height in Table 56. The buffalograsses survived the winter of 1988 in four of the eight states (these grasses were reestablished in the spring of 1990). Of the two reestablished Buffalograsses, Texoka has shown marked improvement in its' quality ratings over the 1989 data.

Ruff-crested wheatgrass continues to show considerable damage or complete loss at several locations. *Poa alpina* demonstrated a lower overall rating in 1990 as compared to the 1989 data.

This trial will continue for one or two more years at which time all data will be summarized for publication.

Table 53. Turfgrasses and seeding rates evaluated in the NCR-10 Regional Alternative Turfgrass Species Trial established in the fall of 1989.

Common name	Scientific name	Seeding rate lb seed/M
Fairway Crested Wheatgrass	*Agropyron desertorum* 'Fairway'	4.3
Emphraim Crested Wheatgrass	*Agropyron desertorum* 'Emphraim'	4.2
Sodar Streambank Wheatgrass	*Agropyron riparium* 'Sodar'	4.2
Ruff Crested Wheatgrass	*Agropyron desertorum* ' Ruff'	6.2
Reubens Canada Bluegrass	*Poa compressa* 'Reubens'	4.3
Durar Hard Fescue	*Festuca ovina* var. *duriuscula* 'Durur'	4.2
Covar Sheep Fescue	*Festuca ovina* 'Covar'	4.5
Alta Tall Fescue	*Festuca arundinacea* 'Alta'	4.5
Sheep Fescue	*Festuca ovina*	4.2
Bulbous Bluegrass	*Poa bulbosa*	4.2
Alpine Bluegrass	*Poa alpina*	4.0
Reton Red Top	*Agrostis alba* 'Reton'	4.0
Colt Rough-stalked Bluegrass	*Poa trivialis* 'Colt'	4.0
Exeter Colonial Bentgrass	*Agrostis tenuis* 'Exeter'	3.8
Texoka Buffalograss	*Buchloe dactyloides* 'Texoka'	plugs[1]
NE 84-315 Buffalograss	*Buchloe dactyloides* 'NE-84-315'	plugs[1]

[1]Plots were established with four 2-inch plugs per plot.

Table 54. Quality means of data submitted by the eight states for the 16 grasses. The grass species are listed from best to worst.

Species	Quality rating
Sheep Fescue	5.0
Alta Tall Fescue	4.9
Reton Red Top	4.6
Exeter Colonial Bentgrass	4.6
Durar Hard Fescue	4.4
Reubens Canada Bluegrass	3.7
Cover Sheep Fescue	3.6
Fairway Crested Wheatgrass	2.9
Colt *Poa trivialis*	2.6
Sodar Streambank Wheatgrass	2.6
Ephraim Crested Wheat	2.4
Texoka Buffalograss	2.3
Bulbous Bluegrass	2.0
Poa Alpina	1.9
Ruff Crested Wheatgrass	1.9
NE 84-315 Buffalograss	1.8
LSD 0.05	0.9

Table 55. Means of quality ratings for each species at the eight state locations.

	State							
Species	Iowa State	Kansas State	Michigan State	Purdue Univ	S. Ill Univ	Univ Ill	Univ MO	Univ WI
Fairway Crested Wheatgrass	2.3	3.3	3.2	3.3	1.8	3.3	5.0	1.1
Ephraim Crested Wheatgrass	2.4	3.2	2.3	2.1	1.1	2.6	4.2	1.2
Sodar Streambank Wheatgrass	1.7	3.2	3.0	2.1	1.6	3.5	4.2	1.3
Ruff Crested Wheatgrass	1.9	1.0	2.4	1.0	1.8	2.8	3.4	1.0
Reubens Canada Bluegrass	3.7	3.5	4.2	2.4	4.5	3.9	4.9	2.8
Durar Hard Fescue	3.7	3.6	4.8	4.9	4.3	4.1	6.3	3.3
Covar Sheet Fescue	3.0	3.5	3.8	3.8	2.8	4.0	5.9	1.6
Alta Tall Fescue	5.0	3.7	4.4	4.1	6.0	4.6	5.6	5.7
Sheep Fescue	5.3	4.3	5.3	3.4	5.4	5.5	6.5	4.1
Bulbous Bluegrass	2.1	2.7	2.0	1.4	1.8	2.2	2.8	1.0
Poa alpina	3.1	2.7	1.0	1.5	1.1	2.0	3.2	1.0
Reton Red Top	5.4	3.9	4.3	2.7	5.2	4.4	4.7	6.2
Colt *Poa trivialis*	4.4	3.8	1.8	1.2	1.6	2.5	1.1	4.7
Exeter Colonial Bluegrass	4.8	4.3	4.5	2.7	5.2	4.7	3.9	6.5
Texoka Buffalograss	1.2	2.7	1.7	3.5	4.4	1.3	2.7	1.0
NE 84-315 Buffalograss	1.3	2.8	1.8	2.0	1.0	2.0	2.6	1.0

Quality rating means for all months in which data were collected at a particular state location. Ratings are based on a scale of 9 to 1; 9 = best quality and 1 = dead turf.

Table 56. The effect of mowing height on the quality of the alternative grass species at each of the eight states.

	State																							
	1			2			3			4			5			6			7			8		
	Iowa State University			Kansas State University			Michigan St. University			Purdue University			Southern IL. Univ.			Univ. of Illinois			Univ. of Missouri			Univ. of Wisconsin		
	Mowing Height																							
	No Mow	2" In	4" In	No Mow	2" In	4" In	No Mow	2" In	4" In	No Mow	2" In	4" In	No Mow	2" In	4" In	No Mow	2" In	4" In	No Mow	2" In	4" In	No Mow	2" In	4" In
Fairway Crested Wheatgrass	2.4	2.2	2.3	3.7	3.0	3.2	3.9	2.6	3.1	3.8	2.4	3.5	1.5	2.0	1.9	3.3	3.2	3.3	5.1	5.4	4.5	1.2	1.0	1.2
Ephraim Crested Wheatgrass	1.9	2.3	2.8	3.2	3.2	3.1	2.3	2.2	2.3	3.0	1.4	1.8	1.3	1.0	1.1	2.5	2.4	2.8	4.2	5.1	3.4	1.2	1.3	1.0
Sodor Stream-bank Wheatgrass	1.5	1.7	1.8	2.9	3.0	3.6	3.1	2.9	2.9	2.4	1.8	2.0	1.7	1.5	1.7	3.4	3.7	3.6	4.1	4.9	3.7	1.5	1.2	1.2
Ruff Crested Wheatgrass	1.6	1.9	2.3	1.0	1.0	1.0	2.5	2.3	2.4	1.0	1.1	1.1	1.7	1.5	2.3	2.8	2.7	2.8	3.3	3.9	3.1	1.0	1.0	1.0
Reubens Canada Bluegrass	2.9	3.5	4.6	3.3	3.4	3.8	4.1	4.1	4.3	2.7	1.7	2.7	4.2	4.7	4.5	3.4	4.0	4.2	4.6	5.7	4.5	2.8	2.3	3.2
Durar Head Fescue	3.6	3.2	4.4	3.8	3.3	3.7	5.1	4.4	4.8	5.5	4.6	4.7	4.2	3.9	4.7	3.7	4.2	4.3	6.5	6.6	5.9	5.3	1.5	3.0
Cover Sheep Fescue	2.7	2.9	3.5	3.4	3.6	3.5	3.8	4.0	3.5	4.4	3.4	3.5	2.9	3.1	2.2	3.5	4.3	4.5	5.8	6.2	5.7	1.6	1.7	1.5
Alta Tall Fescue	4.9	4.7	5.4	3.4	3.8	3.9	4.1	4.3	4.8	4.5	3.4	4.5	6.3	6.1	5.6	3.8	5.0	4.8	5.7	5.9	5.3	6.5	4.3	6.3
Sheep Fescue	4.9	5.1	6.0	4.4	4.0	4.6	5.1	5.2	5.5	3.5	2.9	3.8	5.1	5.9	5.1	4.8	5.6	6.1	6.9	6.6	6.1	6.0	2.7	3.5
Bulbous Bluegrass	1.6	2.1	2.8	2.7	2.7	2.7	1.9	2.0	2.0	1.6	1.1	1.6	1.9	1.7	1.8	2.1	2.3	2.1	2.5	3.6	2.3	1.0	1.0	1.0
Poa alpina	1.8	3.9	3.5	2.7	2.8	2.7	1.0	1.0	1.0	1.7	1.3	1.4	1.0	1.2	1.1	1.7	1.7	2.7	3.1	3.2	3.2	1.0	1.0	1.0
Reton Red Top	5.0	5.0	6.1	3.2	4.2	4.2	3.9	4.3	4.7	3.2	2.2	2.7	5.3	5.5	4.9	3.9	4.7	4.7	4.7	5.5	3.9	6.3	5.2	7.0
Colt Poa trivialis	2,7	5.3	5.4	3.2	4.1	4.1	1.8	1.7	1.8	1.1	1.4	1.2	1.7	1.9	1.4	2.3	2.5	2.6	1.1	1.1	1.1	5.2	3.5	5.5
Exeter Colonial Bentgrass	3.6	4.8	5.8	3.6	4.9	4.4	3.9	5.3	4.4	2.8	2.7	2.8	4.3	5.7	5.6	4.2	4.9	4.8	3.7	4.5	3.5	5.3	6.8	7.3
Texoka Buffalograss	1.2	1.2	1.2	2.7	2.6	2.8	1.7	1.7	1.7	3.4	3.7	3.4	4.3	4.6	4.3	1.3	1.4	1.2	2.7	2.7	2.6	1.0	1.0	1.0
NE 84-315 Buffalograss	1.2	1.5	1.4	2.7	2.7	2.8	1.7	1.8	1.7	1.7	2.1	1.2	1.0	1.0	1.0	2.1	2.1	1.7	2.6	2.7	2.5	1.0	1.0	1.0

Selective Control of Quackgrass With Primisulfuron

D. L. Struyk and N. E. Christians

Primisulfuron is an herbicide used to control quackgrass in corn. The objective of these studies was to determine if primisulfuron, which will be known as 'ACE' in the turf market, can be used as a selective control of quackgrass in Kentucky bluegrass and perennial ryegrass. The effectiveness of two surfactants was also evaluated.

The first study was a field investigation consisting of five treatments and a control. The treatments were 20g ai/ha, 40g ai/ha, 60g ai/ha, 20g ai/ha + 20g ai/ha at a one-week interval, and 20g ai/ha + 20g ai/ha at a two week interval. All treatments used X-77 (0.25% v/v) as the surfactant. These were applied to a turf area with a high population of quackgrass. This trial was initiated on August 8, 1990, and an identical separate trial begun on October 6.

Three greenhouse studies were conducted during the winter. Greenhouse Study 1 (GH 1) involved individual pots of 'Ram I' Kentucky bluegrass and quackgrass. The pots were treated with 20, 40, 60, and 80g ai/ha. This trial also compared two surfactants, X-77 and Sunit (an experimental surfactant from CIBA-GEIGY that later had its name changed to 'Scoil'). Data was collected after 12 weeks (Figs. 14 and 15). Greenhouse Study 2 involved the same surfactants and treatments as GH 1, but included perennial ryegrass. The results of Greenhouse Study 2 are shown in Figs. 16 and 17. Greenhouse Study 3 involved individual pots of 'Ram I' and quackgrass treated with 20, 40, 60, 80, 100, 120, 140, and 160g ai/ha. All treatments used Scoil (formerly called Sunit) at 0.25% v/v. This trial was conducted to determine the single application tolerance of Kentucky bluegrass. Data was not available at the time this report was prepared.

The data obtained from the completed trials showed that primisulfuron will kill quackgrass and will not detrimentally effect Kentucky bluegrass or perennial ryegrass. (It should be noted that some initial stunting was observed on perennial ryegrass and some reduction of growth was observed at the highest rates of treatment.) Surfactants are important to the effectiveness of this compound, but no significant differences were observed between X-77 and Scoil (Sunit).

More work is planned on this subject during the summer and fall of 1991. There are still many questions to be answered on the effects of primisulfuron on other grass species as well as on different cultivars of the grasses already studied. Evaluation of the effects of primisulfuron on non-target species such as trees and shrubs must also be made before it can be labeled for the turf market.

Figure 14.

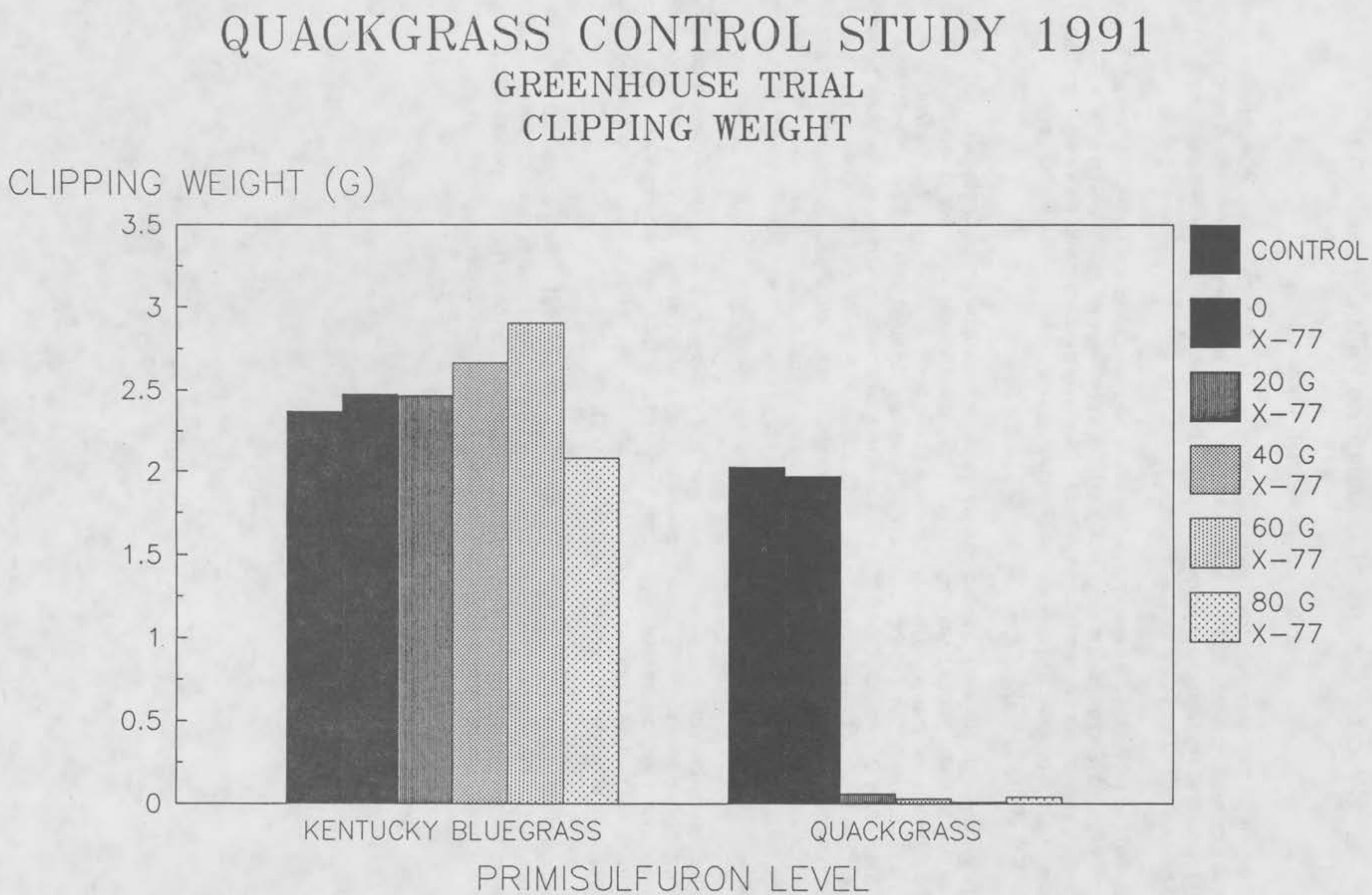

QUACKGRASS CONTROL STUDY 1991
GREENHOUSE TRIAL
CLIPPING WEIGHT
CLIPPING WEIGHT (G)
3.5
3
2.5
2
1.5
1
0.5
0
KENTUCKY BLUEGRASS
QUACKGRASS
PRIMISULFURON LEVEL
CONTROL
0 X-77
20 G X-77
40 G X-77
60 G X-77
80 G X-77

Figure 15.

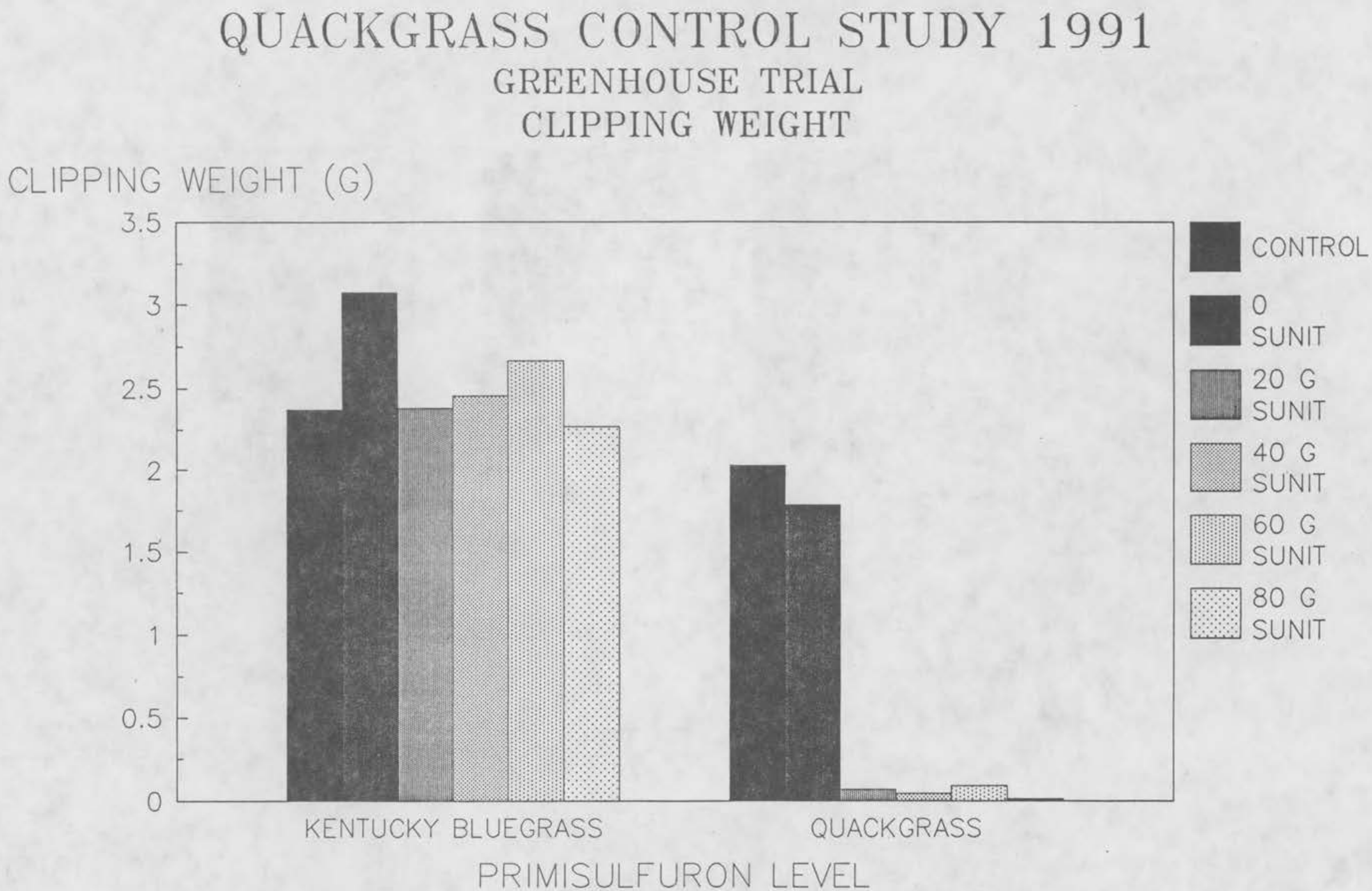
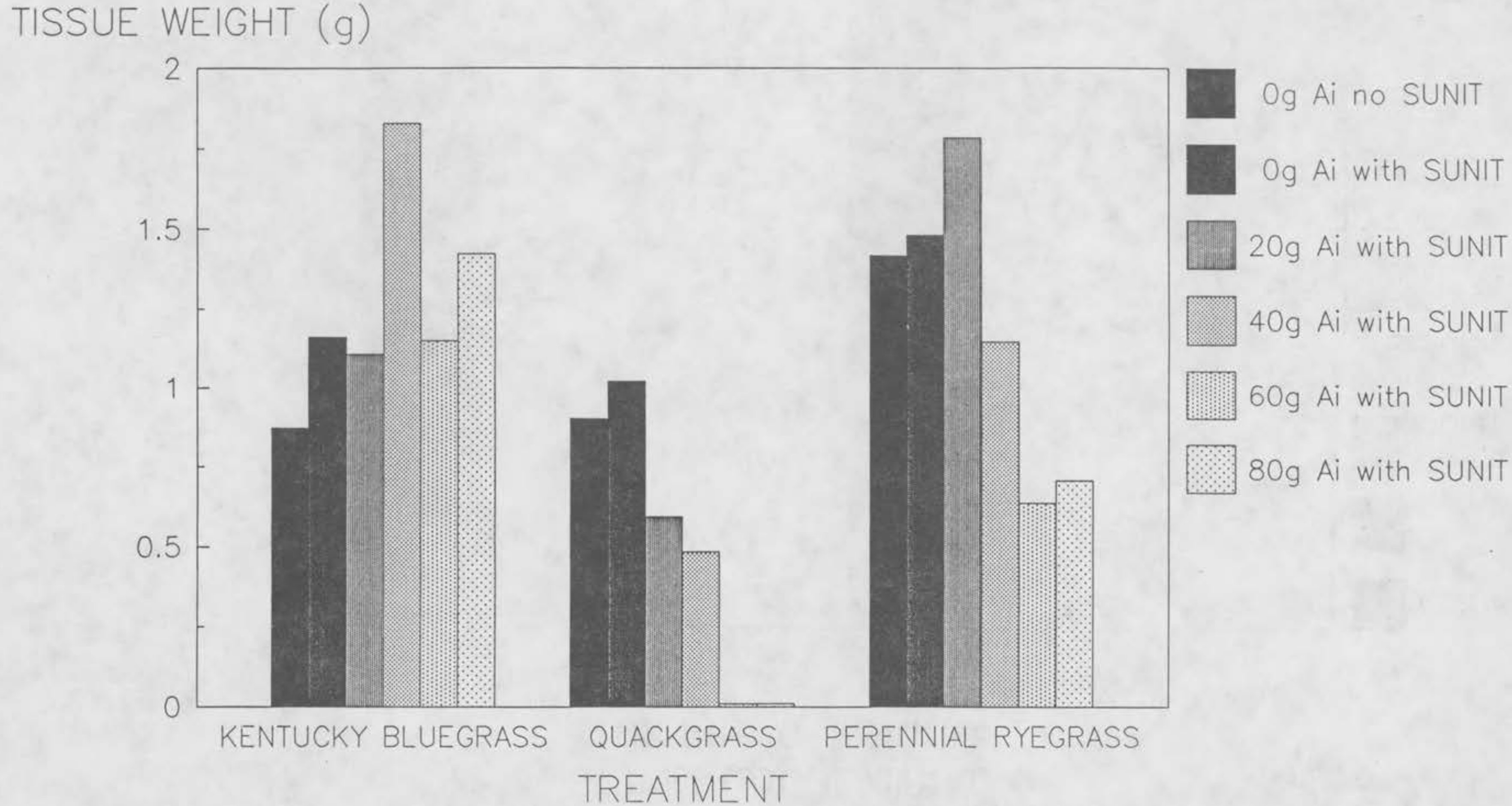

QUACKGRASS CONTROL STUDY 1991
GREENHOUSE TRIAL
CLIPPING WEIGHT
CLIPPING WEIGHT (G)
3.5
3
2.5
2
1.5
1
0.5
0
KENTUCKY BLUEGRASS
QUACKGRASS
PRIMISULFURON LEVEL
CONTROL
0 SUNIT
20 G SUNIT
40 G SUNIT
60 G SUNIT
80 G SUNIT

Figure 16.

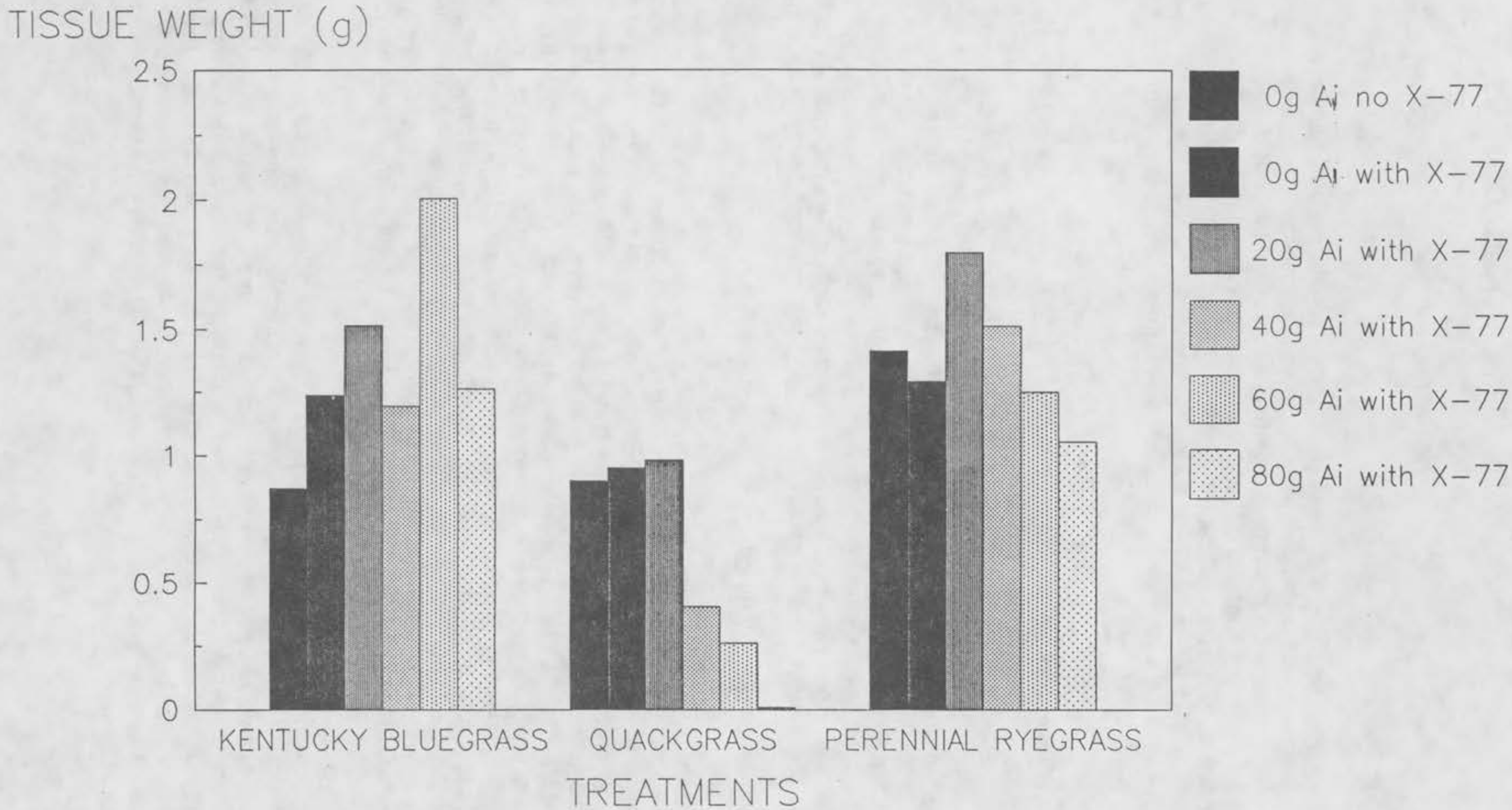
QUACKGRASS CONTROL WITH PRIMISULFURON AND SUNIT



SUNIT AT .25 v/v

Figure 17.

QUACKGRASS CONTROL WITH PRIMISULFURON AND X-7



X-77 .25 v/v

1990 BEDDING PLANT FIELD TRIAL

Nancy H. Agnew

INTRODUCTION:

A **bedding plant field trial** was developed in 1990 to evaluate the garden performance of various bedding plant cultivars under central Iowa growing conditions. The trial was planted May 17 1990. Plants were maintained under standard garden conditions. Phosphorus (P) and potassium (K) fertility were determined by soil tests and P and K were added prior to planting. Two maintenance nitrogen fertilizer applications were made at the rate of 1 lb actual N/1000 ft^2 of garden area. Routine manual weed control and faded flower removal were employed to keep the plants and plantings in top condition. Irrigation and/or rainfall of at least 1 in per week was applied to the plantings.

DATA:

Monthly performance ratings were scored on the 20th of each month from June to September. Performance was scored on a scale of 1 to 5: 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent. Season-average performance was the mathematical mean of the June through September scores. Performance evaluations were based on observations of plant vigor, habit, disease resistance, and amount and consistency of bloom. Weather tolerance was scored using the same scale as performance ratings. Throughout the season, plants were observed for tolerance to wind and rain. A single score was used for the season. Heat tolerance also was scored using the 1 to 5 rating scale. Throughout the season, plants were observed for tolerance to high temperatures. A single score was used for the season. Plant height and spread and flower size were recorded at the end of the growing season. These measurements were recorded with the September performance rating.

PERFORMANCE REVIEW BY SPECIES:

CATHARANTHUS (annual vinca)

The best season performance among vinca groups was recorded for the Little series. A high scoring cultivar was Morning Mist. Many of the other cultivars scored in the very good to excellent category. They were: 'Coolers', 'Parasol' (1991 All-America Selections Winner), and 'Polka Dot'. The Pretty In series did not score as well because they were not as vigorous and had a more upright and open habit than the other vincas. Two 1991 All-America Selections winners come from this series ('Pretty in Pink' and 'Pretty in Rose'). 'Pretty in Pink' contains none of the purple to violet undertones that all the other vinca varieties display. The Carpet series again performed best late in the season with 'Snow Carpet' scoring exceptionally well for the season. The Carpets differ from most vincas because of their ground hugging habit (6 to 8") and their adaptability to hanging baskets. The Sahara Madness series did not perform as well but scores remained in the good to very good category. Scores were lower because they tended to start slowly in the garden. This series has a compact and well-branched habit.

MARIGOLD (dwarf french)

The high-scoring marigold series were Laguna, Spice, and Boy. The Laguna series scored high last season also. The large, flat flowers, similar to the Sophia flower, form are long lasting and create a continuous carpet of color all season. We teamed 'Laguna Gold' with 'Geranium Orbit Red' in the ISU Horticulture Garden to create an impressive display. The Spice series flowers are similar to the Lagunas, but with a slightly smaller flower size. The Boy series scored well and represents the industry standard for dwarf french marigolds with a "pompon type" flower form.Summer 1990 was a good year for marigolds. Moderate temperatures and abundant rainfall resulted in performance ratings of no less than good for all cultivars tested.

PELARGONIUM (geraniums from seed)
The Orbit series scored highest among all groups of geranium cultivars. Specific cultivars 'Orbit Cardinal', 'Orbit Cherry', 'Orbit Appleblossom', 'Orbit Scarlet', and Orbit Hotpink scored the highest among all cultivars. Very good color, flower presentation, and weather resistance characterized this group of geraniums. 'Geronimo' a single introduction from Sluis and Groot also scored very high. 'Orange Appeal', an intense true orange geranium, is a breakthrough color geranium from Goldsmith. The color is indeed eye-catching, but the performance was not as good as other geraniums. We would like to reserve judgement until it has been trialed for 2 to 3 years. The Multibloom series performed similar to last year with early flowering and very good early garden performance. Unfortunately, it tends to decline late in the summer.

GRANDIFLORA PETUNIA
Summer 1990 was not a great year for petunias. Cool, damp weather is not optimal for petunias that thrive in warm temperatures and well-drained soils. The Supermagic Series scored highest for the season with 'Supermagic Pink' and 'Supermagic Lilac'. Both of these plants were noted as good performers last year when temperatures were warm and drought conditions prevailed. Other notables include the Laser and Dreams series which were included in the trial for the first time this year and scored in the good to very good range. The Supercascade series scored second in the series season scores along with the Frost series. Supercascade was noted last year as a good performing group.

MULTIFLORA PETUNIA
The multiflora petunias are valued for their profuse flower numbers and well-branched, compact habit that stays compact in warm weather. The Carpet and Madness series performed equally as well in the 1990 trials, both displaying characteristics typical of the multiflora hybrids. The Madness series had more cultivars scoring high individually with Red, Orchid, Rose, Silver, and Simply Madness scoring very well. The new Primetime series also scored well with Primetime Coral, Plum, and Rose scoring very well. The Polo and the Pearl series scored in the good to very good range; but not as high as the others. Flower production and habit were good, but flower size was smaller so the color and floral display of these series was not as impressive.

Top Five Series for Each Species

Catharanthus
(annual vinca)

1. Little Series (4.2)
2. Cooler Series (4.0)
3. Pretty in. Series (3.8)
4. Carpet Series (3.4)
5. Sahara Madness (3.3)

Marigold
(dwarf french)

1. Laguna Series (4.4)
2. Spice Series (4.4)
3. Boy Series (4.2)
4. Sophia Series (4.1)
5. Marietta Series (3.9)

Pelargonium
(seed geranium)

1. Orbit Series (4.0)
2. Elite Series (3.4)
3. Pinto Series (3.3)
4. Multibloom Series(3.2)
5. Ringo Series (2.9)

Petunia
(grandiflora)

1. Supermagic (3.8)
2. Supercascade (3.5)
3. Frost (3.5)
4. Falcon (3.4)
5. Laser (3.4)

Petunia
(multiflora)

1. Carpet (3.5)
2. Madness (3.5)
3. Primetime (3.3)
4. Celebrity (3.2)
5. Polo (3.1)

What's New in the 1991 Bedding Plant Field Trial?

SALVIA Thirty-three cultivars of *Salvia splendens* have been added to the trial this year. Many new introductions in recent years warrant the addition of this species. New shades of the traditional scarlet sage have been introduced and these colors include: violet, salmon, purple, white, rose, and burgundy. Three cultivars of *Salvia farinacea* have also been added. These varieties of mealycup sage are excellent performers. We have added them to demonstrate their usefulness.

NICOTIANA A new group of flowering tobacco has been introduced by the Ball Seed Company. It is called the Starship series. We've added it to the trial and will compare it with the Nicki series. Flowering tobacco is a useful addition to other annuals used for bedding display and it is as easy as petunia to grow.

IMPATIENS We have been able to add a shading structure thanks to a grant from the Society of Iowa Florists and Growers Liaison Committee. All the major impatiens series are represented in this trial.

NEW GUINEA IMPATIENS New Guinea Impatiens grow more popular with consumers every year. We have added a field trial that includes all the major commercial series in addition to some new commercial series and ISU's Cyclone series.

Cultivars With a Season Performance Score of 4.00 or More

Table 57.

Catharanthus
(annual vinca)

Little Bright Eye (4.3)
Little Linda (4.3)
Little Pinkie (4.3)
Morning Mist (4.3)
Pretty in Pink (4.3)
Snow Carpet (4.0)
Grape Cooler (4.0)
Peppermint Cooler (4.0)
Little Blanche (4.0)
Little Delicata (4.0)
Parasol (4.0)
Polka Dot (4.0)

Petunia
(grandiflora)

Falcon Rose(4.5)
Falcon Salmon (4.5)
Laser Blue (4.5)
Supermagic Pink (4.5)
Ultra Salmon (4.5)
Salmon Cloud (4.3)
Salmon Dreams (4.3)
Falcon Mid Blue (4.3)
Falcon Rose and White (4.3)
Falcon White (4.3)
Supercascade Lilac (4.3)
Ultra White (4.3)
Sugar Daddy (4.0)
Pink Dreams (4.0)
Laser Lavender (4.0)
Picotee Rose (4.0)
Supermagic Orange (4.0)

Marigold
(dwarf french)

Sophia Orange (5.0)
Bonanza Deep Orange (4.5)
Orange Boy (4.5)
Yellow Boy (4.5)
Laguna Gold (4.5)
Laguna Yellow (4.5)
Yellow Marietta (4.5)
Spice Saffron (4.5)
Harmony Boy (4.3)
Laguna Orange (4.3)
Spice Ginger (4.3)
Spice Orange (4.3)
Regular Sophia (4.3)
Golden Boy (4.0)
Disco Marietta (4.0)
Orange Jacket (4.0)
Janie Harmony (4.0)
Legend Yellow (4.0)
Early Queen Sophia (4.0)
Calico Yellow (4.0)
Gold Supreme Nugget (4.0)

Pelargonium
(seed geranium)

Cardinal Orbit (5.0)
Cherry Orbit (5.0)
Scarlet Orbit (4.8)
Appleblossom Orbit (4.8)
Hotpink Orbit (4.5)
Orchid Orbit (4.3)
Pink Orbit (4.3)
Red Orbit (4.3)
Pink Elite (4.0)
Rose Orbit (4.0)
Deep Salmon Orbit (4.0)
Scarlet Eyed Orbit (4.0)
Light Salmon Orbit (4.0)

Petunia
(multiflora)

Red Madness (4.5)
Celeb Strawberry Ice (4.3)
Orchid Madness (4.3)
Rose Madness (4.3)
Silver Madness (4.3)
Simply Madness (4.3)
Plum Madness (4.0)
Sheer Madness (4.0)
Primetime Coral (4.0)
Primetime Plum (4.0)
Primetime Rose (4.0)

Ornamental Grass Studies-1990

R. G. Roe and N. E. Christians

This study is being conducted on the Turfgrass Research Plots at the Iowa State University Horticulture Research Station near Ames, Iowa. This study was started in 1989. The purpose of the study is to investigate the suitability of nineteen species of ornamental grass for the Iowa climate (Fig. 18 & 19). It is expected that the trial will run for 5 to 8 years.

The area chosen for the study is on the west side of the turfgrass maintenance building. Individual plots measured 4 ft by 5 ft, for a total of 68 plots, in a bow-shaped bed measuring 270 ft by 5 ft (Fig. 18). The grasses were planted with the tallest, giant Chinese silver grass (*Miscanthus floridulus* 'Giganteus') in the center. The remaining grasses were placed in descending size order, with the 2 plants of each cultivar being planted on the right and left of the center grass. Each plot is of sufficient size to allow adequate growth of the grasses, and to enable them to grow without competition. A total of 34 cultivars or varieties, 2 plants each, were planted in mid-September of 1989. Several plants did not survive the first winter, possibly due to the late planting date-these were replaced the spring of 1990. The grass plants were supplied at a substantial discount by the Kurt Blumel Nursery in Maryland, which is one of the premier ornamental grass nurseries in the United States.

Larger plots measuring approximately 4 ft by 12 ft, for a total of 12 plots, contain an additional 14 varieties (Fig. 19). These grass plants were in the 1989 container overwintering trial. The grasses were started from seed in the greenhouse, potted into 4" pots in June, and allowed to develop in the greenhouse. They were potted into 1 gal containers in July and moved to shade at the Horticulture Research Station to harden prior to being placed on nursery beds under irrigation in August. The pots were moved to the over wintering area and covered in October prior to a killing frost. The grasses received irrigation and were sprayed with a fungicide. Rodenticide pellets were placed among the grasses prior to covering with plastic, straw, and a top sheet of plastic. The grasses were uncovered in April when it was considered unlikely that a severe cold spell would return. They were planted into the beds in May, 1990.

After two winters the following grasses exhibit adaptability to Iowa:

Common Name	Botanical Name
Big blue stem	*Andropogon gerardii*
Blue fescue	*Festuca ovina* 'Glauca'
Blue wild rye grass	*Elymus glaucus*
Bottle brush grass	*Hystrix patula*
Canada wild rye	*Elymus canadensis*
Feather grass	*Stipa capillata*
Feather reed grass	*Calamagrostis acutiflora stricta*
Giant blue wild rye grass	*Elymus giganteus* 'Vahl Glaucus
Giant chinese silver grass	*Miscanthus floridulus* 'Giganteus'
Giant feather grass	*Stipa gigantea*
Golden variegated ribbon grass	*Phalaris arundinacea luteo-picta*
Hairy mellic	*Melica ciliata*
Japanese silver grass	*Miscanthus sinensis* 'November Siberfeder
Japanese silver grass	Miscanthus siensis 'November Sunset'
June grass	*Koeleria cristata*
Karl foerster's feather reed grass	*Calamagrostis arundinacea* 'Karl Foerster'
Late blooming tufted hair grass	*Deschampsia caespitosa tardiflora*
Little blue stem	*Andropogon scoparius*

Mosquito grass	*Boutelous gracilis*
Prairie dropseed	*Sporobolus heterolepis*
Purple moor grass	*Molinia caerulea*
Purple moor grass	*Molinia caerulea* 'Moorhexe'
Quaking grass	*Briza media*
Red switch grass	*Panicum virgatum* 'Haense Herms
Red switch grass	*Panicum virgatum* 'Rehbrun'
Red switch grass	*Panicum virgatum*
Sand hills big blue stem	*Andropogon hallii*
Scottish tufted hair grass	*Deschampsia caespitosa*'Schottland'
Sideoats grama	*Bouteloua curtipendula*
Small Japanese silver grass	*Miscanthus oligostachys*
Switch grass	*Panicum virgatum*
Tall purple moor grass	*Molinia caerulea sp arundianacea* 'Sky Race'
Tall purple moor grass	*Molinia caerulea* sp *arundinacea* 'Bergfreund'
Tall purple moor grass	*Molinia caerulea sp arundinacea* 'Transparent'
Tall purple moor grass	*Molinia caerulea* sp *stimfomsvrs* 'Windspiel'
Tall purple moor grass	*Molinia caerulea* sp *arundinacea*
Tall purple moor grass	*Molinia caerulea* sp *arundinacea* 'Staefa'
Tufted hair grass	*Deschampsia caespitosa* 'Bronzeschleier'
Tufted hair grass	*Deschampsia caespitosa* 'Goldgehaenge'
Tufted hair grass	*Deschampsia caespitosa* 'Tautraeger'
Tufted hair grass	*Deschampsia* 'Goldstaub'
Variegated maiden grass	*Miscanthus sinensis* 'Morning Light'
Viviparous hair grass	*Deschampsia vivipara*

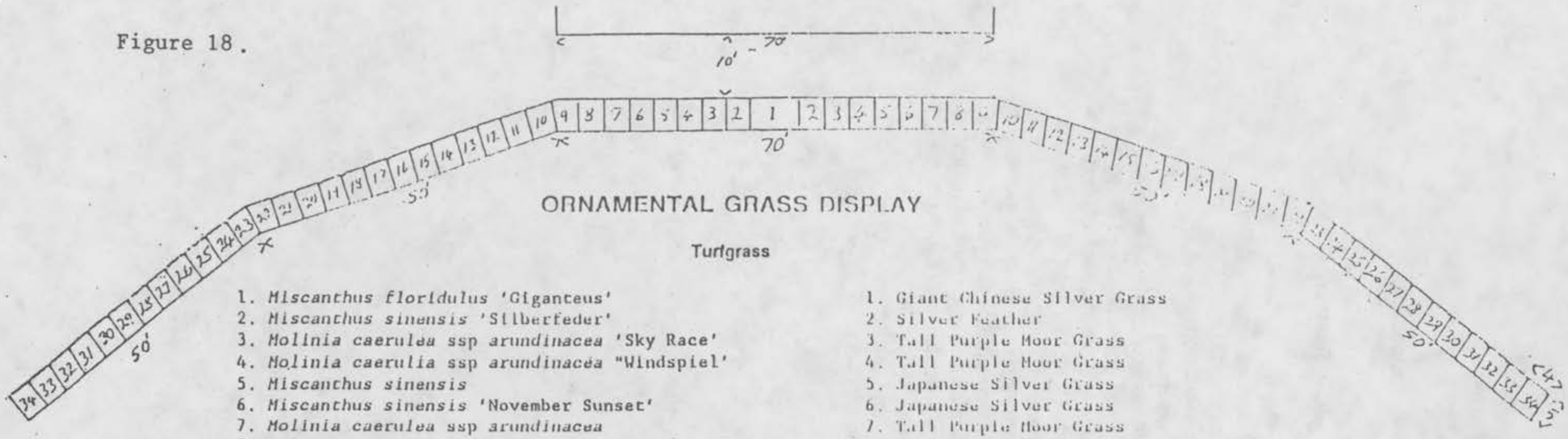
The following grasses were less adaptable, exhibiting poor growth and some winter kill:

Giant feather grass	*Stipa gigantea*
Japanese silver grass	*Miscanthus sinensis* 'November Sunset'
Scottish tufted hair grass	*Deschampsia caespitosa* 'Schottland'
Tufted hair grass	*Deschampsia caespitosa* 'Goldgehaenge'
Tufted hair grass	*Deschampsia caespitosa* 'Tautraeger'
Tufted hair grass	*Deschampsia* 'Goldstaub'
Variegated maiden grass	*Iscanthus sinensis* 'Morning light'

The following grasses suffered winter kill:

Hairy mellic	*Melica ciliata*
Japanese silver grass	*Miscanthus sinensis*
Northern seat oats	*Chasmanthium latifolium*

Figure 18.

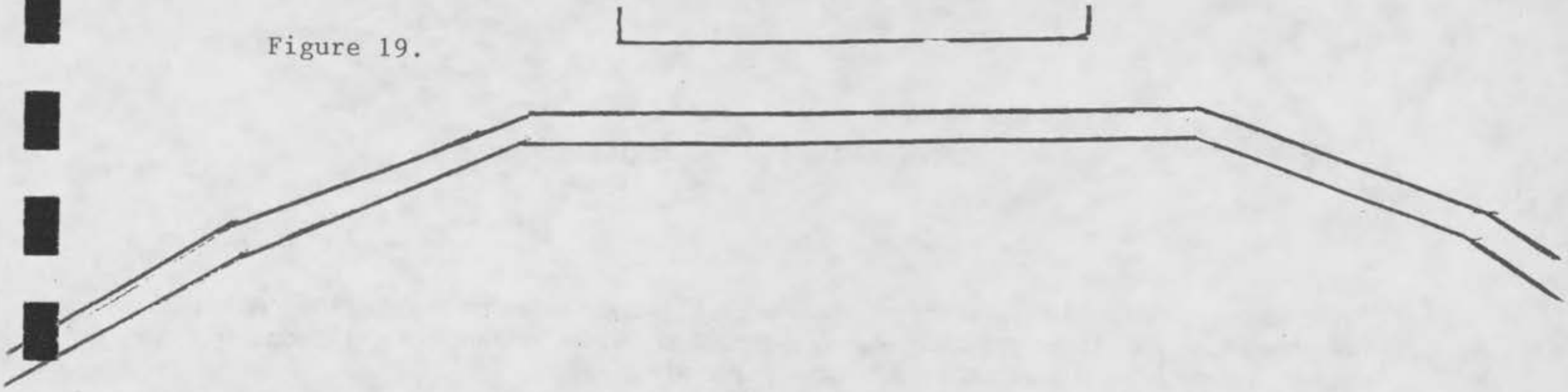


ORNAMENTAL GRASS DISPLAY

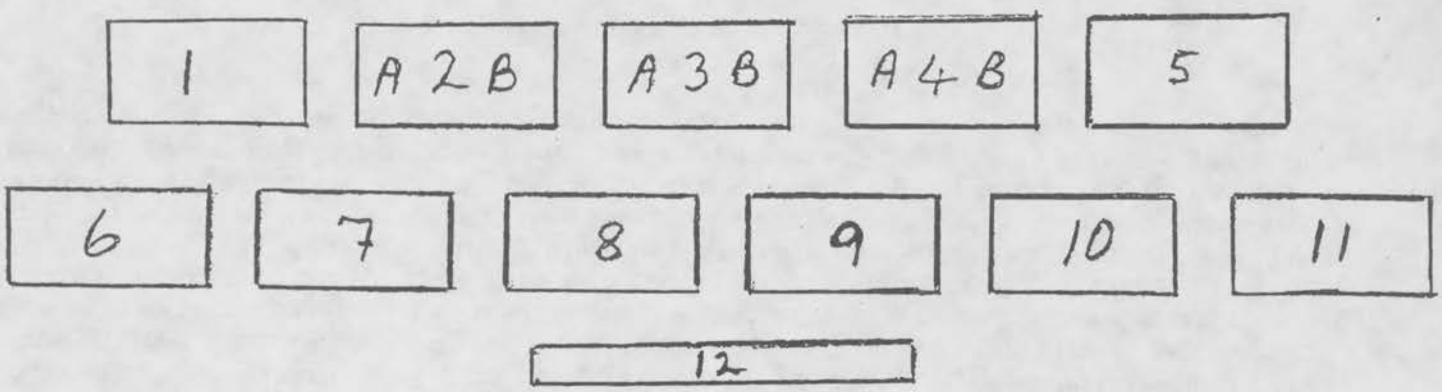
Turfgrass

1. *Miscanthus floridulus* 'Giganteus'	1. Giant Chinese Silver Grass
2. *Miscanthus sinensis* 'Silberfeder'	2. Silver Feather
3. *Molinia caerulea* ssp *arundinacea* 'Sky Race'	3. Tall Purple Moor Grass
4. *Molinia caerulia* ssp *arundinacea* "Windspiel'	4. Tall Purple Moor Grass
5. *Miscanthus sinensis*	5. Japanese Silver Grass
6. *Miscanthus sinensis* 'November Sunset'	6. Japanese Silver Grass
7. *Molinia caerulea* ssp *arundinacea*	7. Tall Purple Moor Grass
8. *Molinia caerulea* ssp *arundinacea* 'Staefa'	8. Tall Purple Moor Grass
9. *Panicum virgatum*	9. Switch Grass
10. *Calamagrostis acutiflora stricta*	10. Feather Reed Grass
11. *Molinea caerulea* ssp *arundinacea* 'Bergfreund'	11. Mountain's Friend
12. *Calamagrostis arundinacea* 'Karl Foerster'	12. Karl Foerster's Feather Reed Grass
13. *Molinia caerulea* ssp *arundinacea* 'Transparent'	13. Tall Purple Moor Grass
14. *Andropogon gerardi*	14. Big Blue Stem
15. *Deschampsia caespitosa* 'Schottland'	15. Scottish Tufted Hair Grass
16. *Miscanthus sinensis* 'Morning Light'	16. Variegated Maiden Grass
17. *Stipa gigantea*	17. Giant Feather Grass
18. *Elymus giganteus* 'Vahl Glaucus'	18. Giant Blue Wild Rye Grass
19. *Miscanthus oligostachys*	19. Small Japanese Silver Grass
20. *Panicum virgatum* 'Haense Herms'	20. Red Switch Grass
21. *Panicum virgatum* 'Rehbrun'	21. Red Switch Grass
22. *Panicum virgatum* Rotstrahlbusch'	22. Red Switch Grass
23. *Pennisetum alopecuroides*	23. Fountain Grass
24. *Stipa capillata*	24. Feather Grass
25. *Chasmanthium latifolium*	25. Northern Sea Oats
26. *Deschampsia caespitosa* 'Bronzeschleier'	26. Tufted Hair Grass
27. *Deschampsia caespitosa* 'Goldgehaenge'	27. Tufted Hair Grass
28. *Deschampsia caespitosa* 'Tautraeger'	28. Tufted hair Grass
29. *Deschampsia caespitosa tardiflora*	29. Late Blooming Tufted Hair Grass
30. *Deschampsia caespitosa* 'Goldstaub'	30. Tufted Hair Grass
31. *Elymus glaucus*	31. Blue Wild Rye
32. *Molinia caerulea*	32. Purple Moor Grass
33. *Molinia caerulea* 'Moorhexe'	33. Sorceress of the Bog
34. *Phalaris arundinacea luteo-picta*	34. Golden Variegated Ribbon Grass

Figure 19.



ORNAMENTAL GRASS TRIALS



No.	Common Name	Botanical Name
1	Viviparous Hair Grass	Deschampsia vivipara
2A	Quaking Grass	Briza media
2B	Blue Fescue	Festuca ovina 'Glauca'
3A	Prairie Dropseed	Sporobolus heterolepis
3B	Mosquito Grass	Bouteloua gracilis
4A	Hairy Mellic	Melica ciliata
4B	June Grass	Koeleria cristata
5	Sideoats Grama	Bouteloua curtipendula
6	Switch Grass	Panicum virgatum
7	Canada Wild Rye	Elymus canadensis
8	Big Blue Stem	Andropogon gerardi
9	Sand Hills Big Blue Stem	Andropogon hallii
10	Little Blue Stem	Andropogon scoparius
11	Bottle Brush Grass	Hystrix patula
12	Switch Grass	Panicum virgatum

Environmental Research

Several of our more in-depth research projects involving graduate research assistants are aimed at environmental issues. These projects generally require 2 to 4 years to complete and reports on the progress of these projects are usually not included in the annual report.

Beginning this year, brief descriptions of these projects will be included. These descriptions concern work in progress. Full reports on the work will become available as the projects are completed.

Non-Target Movement of Herbicides Applied to Turfgrass Areas

H. H. Valenti, N. E. Christians, and M. D. Owen

Pesticide spray drift has been and will continue to be an important concern. The lawn care industry has been under special scrutiny because their predominant customer base is homeowners. Most studies conducted to investigate the effect of meteorological conditions, formulations, and application parameters on spray deposition have dealt with agricultural sprayers. Very little research has been directed toward the evaluation of equipment and the application parameters used in other areas such as in the lawn care industry. Therefore, research has been undertaken to determine the efficiency under varying wind conditions of three common lawn-care spray nozzles and to quantify the level of off-target particle movement with each. The three sprayers used were a hydraulic sprayer with a ChemLawn gun®, a carbon-dioxide pressurized backpack sprayer with 8004 VS® nozzles, and a hydraulic sprayer with RA-6® nozzles. The delivery rates for the three sprayers were 3.5, 0.27, and 0.54 gal/min, respectively. The operating pressure and ground speed were adjusted for each sprayer so the mean volume rates were 120, 20, and 40 gal/a, respectively. The triethylamine salt of triclopyr [(3, 5, 6-trichloro-2-pyridinyl)oxy] acetic acid was applied at a rate of 0.45 lb ai/a with the addition of 0.01% w/v Fluorescein, a fluorescent dye.

The spray application was made along a line perpendicular to wind direction. Three sampling lines were set perpendicular and downwind from the spray-swath edge. Sample location spacing was 1, 3, 5, and 7 ft. Two mylar sheets mounted on poster board and two tomato plants were placed at each location. Plants were spaced in a fan-like arrangement so that there would be no interference at each distance. Two crystallizing dishes at five locations were used to sample within the spray swath. Between the crystallizing dish locations, 2 potted turfgrass samples were placed. Immediately following application, plant samples, mylar sheets, and crystallizing dishes were collected and individually stored until fluorescent analysis could be completed. One of the 2 tomato plants at each sampling site was returned to the greenhouse for visual observations of triclopyr injury.

In 1990, the experiment was run twice during September and November and although not all the data has been statistically analyzed, several observations were made. First, tomato plants next to the spray swath unavoidably received direct-spray contact with the Chemlawn gun® and RA-6® nozzles. These plants showed severe herbicide injury. Second, plants further downwind showed very little or no injury with both types of equipment. Third, tomato plants at all four distances showed herbicide injury with the flat-fan nozzles. On both application dates the wind speed was very low (1-3 mph), which indicates potential danger when using flat-fan nozzles.

Isolation and Identification of Allelopathic Compounds

D. L. Liu and N. E. Christians

Allelopathy is a term used to describe a chemical interaction among plants. It is often referred to as the detrimental effects of higher plants of one species (the donor) on the germination, growth, or development of plants of another (receptor) species. The detrimental effect is exerted through release of a chemical by the donor. Several chemical groups including phenolic acids, flavonoids, quinones, terpenoids, steroids, purines, long-chain fatty acids and acetylenes, organic acids, unsaturated lactones, and others have been classified. Although the specific chemicals involved in allelopathy remain obscure, they have an important role in crop production and crop protection. To determine the chemical specificity for allelopathy, identification of the causative agents is required.

Based on preliminary studies, allelopathic compounds exist in grain that inhibit the establishment of a variety of plant species by limiting root formation during germination. It will be environmentally and economically desirable to exploit the phenomenon of allelopathy in grain products as potential alternatives to conventional herbicides. If the purification method of extracting the allelopathic compounds can be established, it could potentially be marketed as a naturally-occurring, environmentally-safe-herbicide.

The purposes of the study underway at Iowa State University are to evaluate the phytotoxicity of various grain by-products, to extract and purify the allelopathic compound(s) from the selected grain products, and to identify the chemical structure(s) of the allelopathic compound(s).

Evaluation of Species of *Pseudomonas* and *Streptomyces* as Potential Biocontrol Agents for Dollar Spot and Leaf Spot[a]

C. F. Hodges, N. Christians, and D. F. Campbell

Isolates of bacteria in the genus *Pseudomonas* and of actinomycetes in the genus *Streptomyces* are being evaluated for their ability to control infection of grasses by the dollar spot (*Sclerotinia homoeocarpa*) and leaf spot (Bipolaris *sorokiniana*) pathogens. The evaluation process will include laboratory bioassays to determine biocontrol activity and field evaluation to determine the potential for control in the field. Preliminary laboratory studies have established biocontrol activity against dollar spot in three isolates each of *Pseudomonas* and *Streptomyces*. The isolates of both organisms substantially decrease the development of dollar spot infection over a 3 day period. The average decrease in disease (measured as loss of chlorophyll and yellowing) by the six isolates is 97.5%. The *Pseudomonas* species are less active in controlling leaf spot, decreasing disease by an average of 81%. One isolate of *Streptomyces*, however, has almost completely prevented leaf spot in preliminary studies.

The studies conducted to date are preliminary and the potential control activity found in laboratory bioassays has not been evaluated in the field. Field studies are planned for the summer of 1991 to determine the potential use of these microbes for controlling dollar spot and leaf spot in the field.

[a]This research is being supported in part with a grant from the Soil Technologies Corporation.

Physiological Management of Chlorosis Associated with Foliar Pathogens of Turfgrasses[a]

C. F. Hodges

Research is in progress to determine the potential for manipulation of symptom expression by leaf spot (*Bipolaris sorokiniana*) infected turfgrasses. Studies conducted over the last eight years have established that foliar yellowing of leaves infected by leaf spot (and possibly other leaf infecting pathogens) is due to a combination of hormonal imbalances and the production of fungal toxins during the process of infection. Preliminary research suggests that several substances are active against the hormone-induced yellowing during infection. These substances function by either interrupting the biosynthesis of the hormones during infection, or by preventing the mode of action of the hormones after they are produced. Preliminary studies in which leaf spot infection causes at least a 50% loss in chlorophyll over four days can be decreased to a 9% loss in plants treated with one substance under study. The remaining loss of chlorophyll is believed due to a toxin that functions independently of the hormone imbalance.

The intent of these studies is to develop a new approach to foliar disease control that would not prevent infection, but would limit the expression of yellowing by infected leaves. With frequent mowing, the infected tissue would be removed and the small lesions produced by the pathogen without yellowing would not interfere with the aesthetics of the turf.

[a]This research is being supported in part by a grant from the United States Golf Association.

Plant and Soil Response to Nitrogen Fertilizer Source

J. N. Ryan, M. L. Agnew, and N. E. Christians

Turfgrass managers have several nitrogen sources from which to choose. Quick-release sources provide fast green-up and are relatively inexpensive. Slow-release sources extend the feeding time by slowing the release rate of available nitrogen. Some advantages claimed from using slow-release sources are reduced chance of fertilizer burn, less volatilization, and less leaching.

With the environmental concerns currently surrounding fertilizers and the leaching of nitrates into the groundwater, it is important to understand the possible differences among nitrogen sources as they pertain to nitrogen use efficiency and the movement of nitrates in the soil.

This study will evaluate 8 fertilizer sources as to their effects on plant growth and nitrogen content in plant tissue. In addition, the movement of nitrates through the soil will be monitored. The study was initiated in the spring of 1991 on an established turf of 'Glade' Kentucky bluegrass mowed at two in.

The following is the list of treatments:

1) CORON 28-0-0
2) Nutralene 40-0-0
3) Sulfur-Coated Urea 37-0-0
4) Urea 46-0-0
5) Ringer Lawn Restore 10-2-6
6) Ureaform 38-0-0
7) N-Sure 28-0-0
8) ISU Experimental 10-1.5-.5
9) Control - No fertilizer

Treatments will be applied at a rate equivalent to 1 lb N/1000 ft^2 on four dates scheduled for May 2, June 1, August 15, and September 15.

Measurements of plant growth will include weekly observations of visual quality, clipping yields, and chlorophyll content. Plant development will be monitored by measuring plant density, thatch depth, thatch organic matter content, rhizome weights, and root distribution. These measurements will be taken prior to the first treatment, in the middle of summer, and at the end of the season.

Nitrogen content in leaf tissue will be measured weekly and nitrate content in the soil at several different depths up to 3 ft will be taken initially, in midsummer, and at season's end.

Allelopathic Effects of Several Terpenoids on Plant Growth

J. N. Ryan, N. E. Christians, and J. H. Dekker

Allelopathy may be defined as biochemical interactions between plants. In the past, interactions covered by the term allelopathy have included both beneficial and deleterious effects imposed by one plant upon another although it is more commonly used to refer to the harmful effects. The "toxins" produced by plants are referred to as allelochemicals.

Concern about environmental pollution by pesticides has increased immensely within the past few years. The possible use of allelochemicals as naturally-occurring herbicides of low toxicity has become more appealing to companies responsible for producing pesticides.

This particular research project will screen naturally-produced chemical compounds starting with chemicals from the terpenoid family. The following chemicals will be screened for allelopathic effects:

1) Borneol 2) Camphene 3) Camphor 4) Carvone

5) Carophyllene 6) 1,8-cineole 7) Dipentene 8) Limonene

9) Linalool 10) 4-ol-terpinen 11) 12-terpineol

Chemicals will be screened for phytotoxic activity on several turf and weed species using petri-dish assays in the lab and pot experiments in the greenhouse. These initial procedures should provide some candidates for further greenhouse study and possible field research.

Organic Lawn Care Trial

S. M. Kassmeyer, N.E. Christians, and M. L. Agnew

This trial was established in the summer of 1990 in Ames, Iowa, on the corner of 13th Street and Haber Road. The objective of this study is to observe the effects of two "no pesticide" natural organic fertilizer products at split rates, and one complete fertilizer system, using a home lawn scenario including herbicides and insecticides. The study is being conducted under non-irrigated conditions.

The treatments included:

- Scott's Complete 4-step program
- ISU Experimental - 4 lb. N /1000 ft^2 applied in spring
- ISU Experimental - split treatment of 2 lb N spring & 2 lb N late summer
- Ringer 10-2-6 - 4 lb. N/1000 ft^2 applied in spring
- Ringer 10-2-6 - split treatment of 2 lb N spring & 2 lb N late summer

This study was replicated three times in a randomized, complete-block design. All plots are mowed weekly by the University Student Housing Department maintenance personnel.

Pesticide and Fertilizer Fate in Turfgrasses Managed Under Golf Course Conditions in the Midwestern Region

S. K. Starrett, N. E. Christians, and A. B. Blackmer

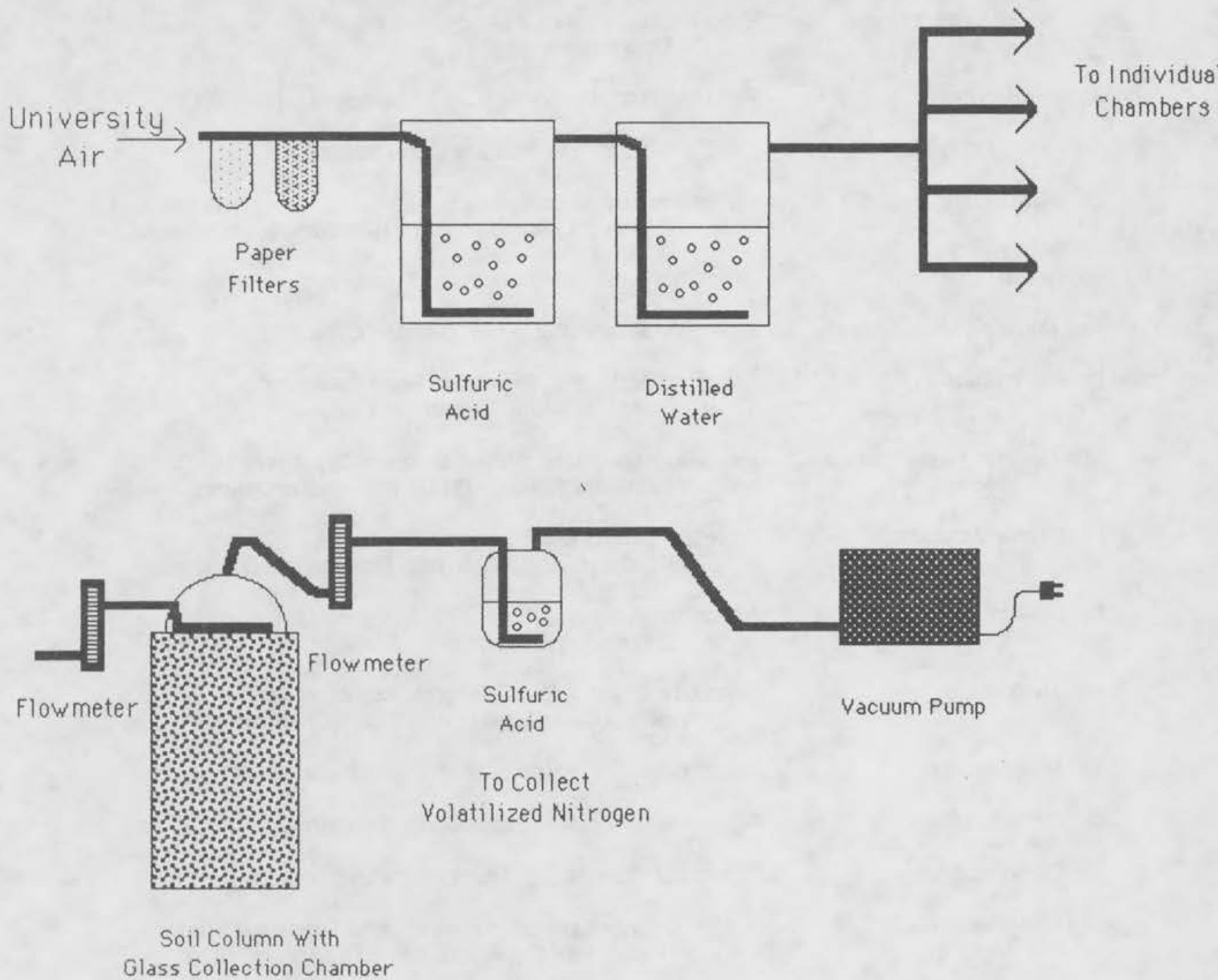
Various chemicals and nutrients are widely used by the turfgrass industry to maintain a high quality stand of turf. Runoff and leaching of fertilizers and pesticides from golf courses, recreational, agricultural, municipal, and industrial operations are perceived to be an important environmental problem. In this study, we are trying to answer the following question. How much of the nitrogen, phosphorous, Trimec®, Pendimethalin, Isazophos, Chlorpyrifos, Metalaxyl, and Chlorothalonil applied to a turf area maintained as a golf course fairway move past the root system to the groundwater? This three-year research project is being funded by the United State Golf Association (USGA).

For the first year of the project, the fate of nitrogen and phosphorous will be studied. The soil that was used was excavated from the Horticulture Farm with an established stand of turf cut at fairway height. Undisturbed soil columns were brought into the greenhouse in November, 1990, and testing started in February, 1991.

The one-week testing procedure starts with applying nitrogen and phosphorous in a liquid form to the turf. The source of nitrogen is urea and for phosphorous, calcium phosphate was used. To distinguish between nitrogen that is stored in the soil and nitrogen that is applied, the urea is labeled with ^{15}N which is only present in extremely low levels in nature.

To determine the effects of irrigation rates, two watering schemes were used.One is an application of 1 inch immediately after nutrients are applied and the other is 4 separate quarter inch applications distributed throughout the one week test period. Volatilizing nitrogen and any soil water that leaches through the column is collected and tested for nutrients at the end of the test period, and the soil and vegetative materials are dried and sent to the analytical lab for testing. The following figure is a diagram showing the method of collecting volatilized nitrogen and soil water leachate.

Schematic of Volatilizing Nitrogen Collection



Introducing

Iowa State University Personnel
Affiliated with the Turfgrass Research Program

Dr. Michael Agnew	Associate Professor, Extension Turfgrass Specialist. Horticulture Department.
Ms. Susan Berkenbosch	Extension Associate, Horticulture Department
Mr. Tim Bormann	Field Technician, Horticulture Department
Mr. Doug Campbell	Lab Technician, Horticulture Department
Dr. Nick Christians	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
Mr. Robert Clause	Field Technician. Horticulture Department
Ms. Paula Flynn	Extension Associate. Plant Disease Clinic
Dr. Mark Gleason	Assistant Professor, Extension Plant Pathologist. Plant Pathology Department.
Ms. Harlene Hatterman-Valenti	Extension Associate. Weed Science Department. Graduate Student Ph.D. (Christians/Owen).
Dr. Clinton Hodges	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
Dr. Donald Lewis	Associate Professor, Extension Entomologist. Entomology Department.
Ms. Dianna Liu	Graduate Student and Research Associate. Horticulture Department PhD. (Christians).
Mr. Matt Mixdorf	Field Technician. Horticulture Department
Mr. Richard Moore	Research Associate. Horticulture Department.
Mr. Glenn Pearston	Computer Consultant. Horticulture Department.
Mr. Gary Petersen	Jasper County Extension Director and Graduate Student. Horticulture Department M.S. (Agnew, M.).
Mr. Roger Roe	Graduate Student and Research Associate. Horticulture Department M.S. (Christians/Agnew N.)
Mr. Jeff Rosener	Horticulture undergraduate student.
Mr. Jeff Ryan	Graduate Student and Research Associate. Horticulture Department M.S. (Christians/Agnew M.)
Mr. Jeff Schmidt	Field Technician, Horticulture Department
Ms. Marcy Simbro	Field Technician. Horticulture Department.

Mr. Steve Starrett Graduate Student and Research Associate.
Horticulture Department M.S. (Christians)

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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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American Hoechst Corporation
Agricultural Chemicals Department
Route 1 - Box 7
Brownsdale, Minnesota 55918

BASF Corporation
1000 Cherry Hill Road
Parsippany, New Jersey 07054

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10405 'J' Street
Omaha, Nebraska 68127

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Lincoln, Nebraska 68501

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Midland, Michigan 48674

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2000 Princeton Corporation Center
Monmouth Junction, New Jersey 08852

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Augusta, Georgia 30906

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Post Office Box 348
7528 Auburn Road
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Grain Processing Corporation
Post Office Box 349
Muscatine, Iowa 52761

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Post Office Box 4003
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GrassRoots Turf
6143 Southwest 63rd
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Post Office Box 899
Clinton, Iowa 52732

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820 First Street
Post Office Box 168
Halsey, Oregon 97348

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Lebanon, Pennsylvania 17042

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Elyria, Ohio 44035

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Post Office Box 684
Milwaukee, Wisconsin 53201

Milorganite
735 North Water Street
Milwaukee, Wisconsin 53200

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Agricultural Products Division
800 North Lindbergh Boulevard
St. Louis, Missouri 63167

NOR-AM Chemical Company
3509 Silverside Road
Post Office Box 7495
Wilmington, Delaware 19803

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1217 West 12th Street
Post Office Box 4090
Kansas City, Missouri 64101-9984

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Post Office Box 888
Tangent, Oregon 97389

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133 Kenyon Road
Champaign, Illinois 61820

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Black Horse Lane
Post Office Box 125
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Box 218
Quimby, Iowa 51049

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Irrigation Division
Riverside, California 92500

Tri State Turf & Irrigation Co.
6125 Valley Drive
Bettendorf, Iowa 52722

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Omaha, Nebraska 68100

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