1990 Iowa Turfgrass Research Report

IOWA STATE UNIVERSITY
EXTENSION
Ames, Iowa 50011

FG-457|July 1990

Introduction

The following research report is the tenth yearly publication of the results of turfgrass research projects performed at Iowa State University. The first cultivar and management studies at the field research area were seeded in August 1979, and many of these investigations are now in their eleventh season. The research area was expanded between 1979 and 1983 to 4.2 acres of irrigated and approximately 3.0 acres of nonirrigated research area. Funding was obtained in 1983 to add 2.7 acres of irrigated research plots to the existing site. This construction was completed in the spring of 1985. The expansion that has taken place since 1979 would not have been possible without the cooperation of the Iowa Agriculture Experiment Station, the Iowa Turfgrass Institute, the Iowa Golf Course Superintendent's Association, the Iowa Professional Lawn Care Association, and the Iowa Turfgrass Producers and Contractors (ITPAC) organization.

The 1988 and 1989 seasons were especially difficult due to the extended drought and lack of irrigation water at the research station. Few new projects were begun in 1989 and those that were initiated required much longer than usual to become established. With the apparent end to the drought in the spring of 1990, several new projects have been initiated, and some extensive renovation is scheduled for the fall of 1990. Hopefully, we will not see a similar drought for many years to come.

We would also like to acknowledge Richard Moore, Manager of the Turfgrass Research area, Mark Stoskopf, Superintendent of the ISU Horticulture Research Station, and all others employed at the field research area in the past year for their efforts in building the program.

Special thanks to Betty Hempe for her work on typing and helping to edit this publication.

Edited by Nick Christians, professor, turfgrass science; Michael Agnew, associate professor, turfgrass extension; and Melinda Jardon, extension communication specialist.

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HERBICIDE STUDIES

STRESS STUDIES AND FERTILIZER TRIALS

MISCELLANEOUS

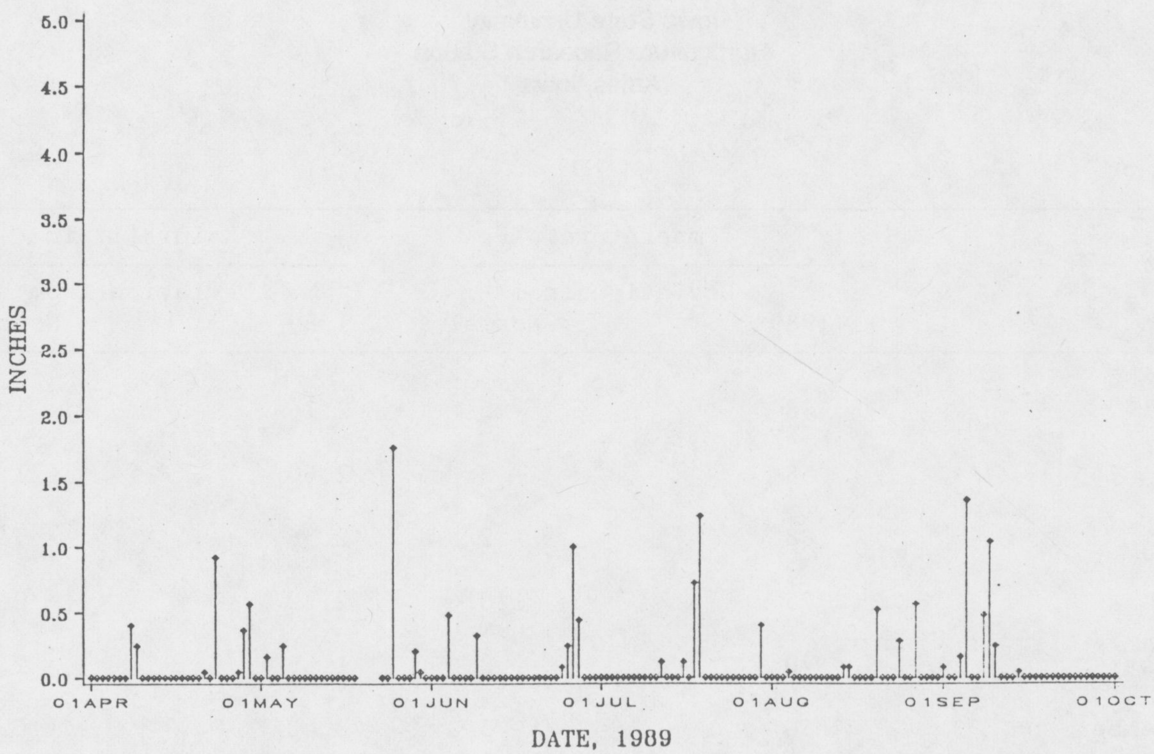
INTRODUCING

Weather Data for 1989

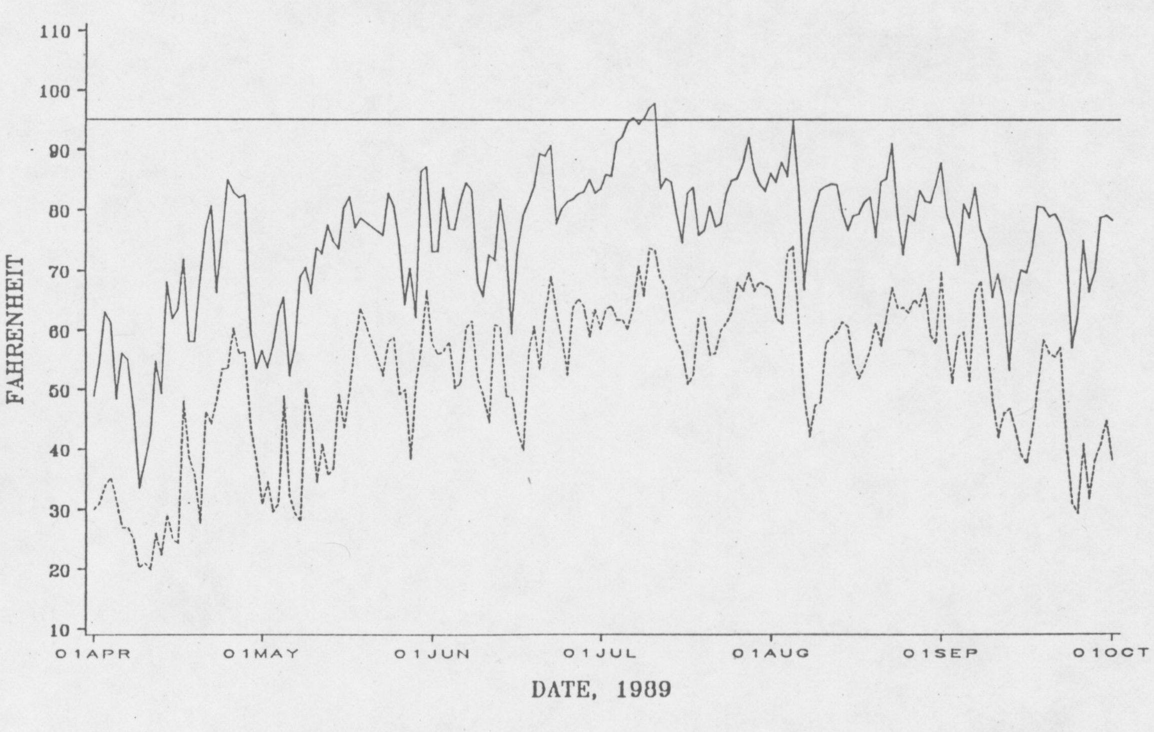
Iowa State University
Horticulture Research Station
Ames, Iowa

	Temperature, °F		Rainfall, in	
Month	1989	Deviation from Normal	1989	Deviation from Normal
April	48	- 5	2.16	- 1.03
May	58	- 3	2.60	- 1.90
June	68	- 2	2.56	- 3.24
July	75	± 0	2.60	- 0.64
August	70	- 2	1.56	- 2.09
September	60	- 5	3.40	+ 0.20

DAILY RAINFALL - AMES

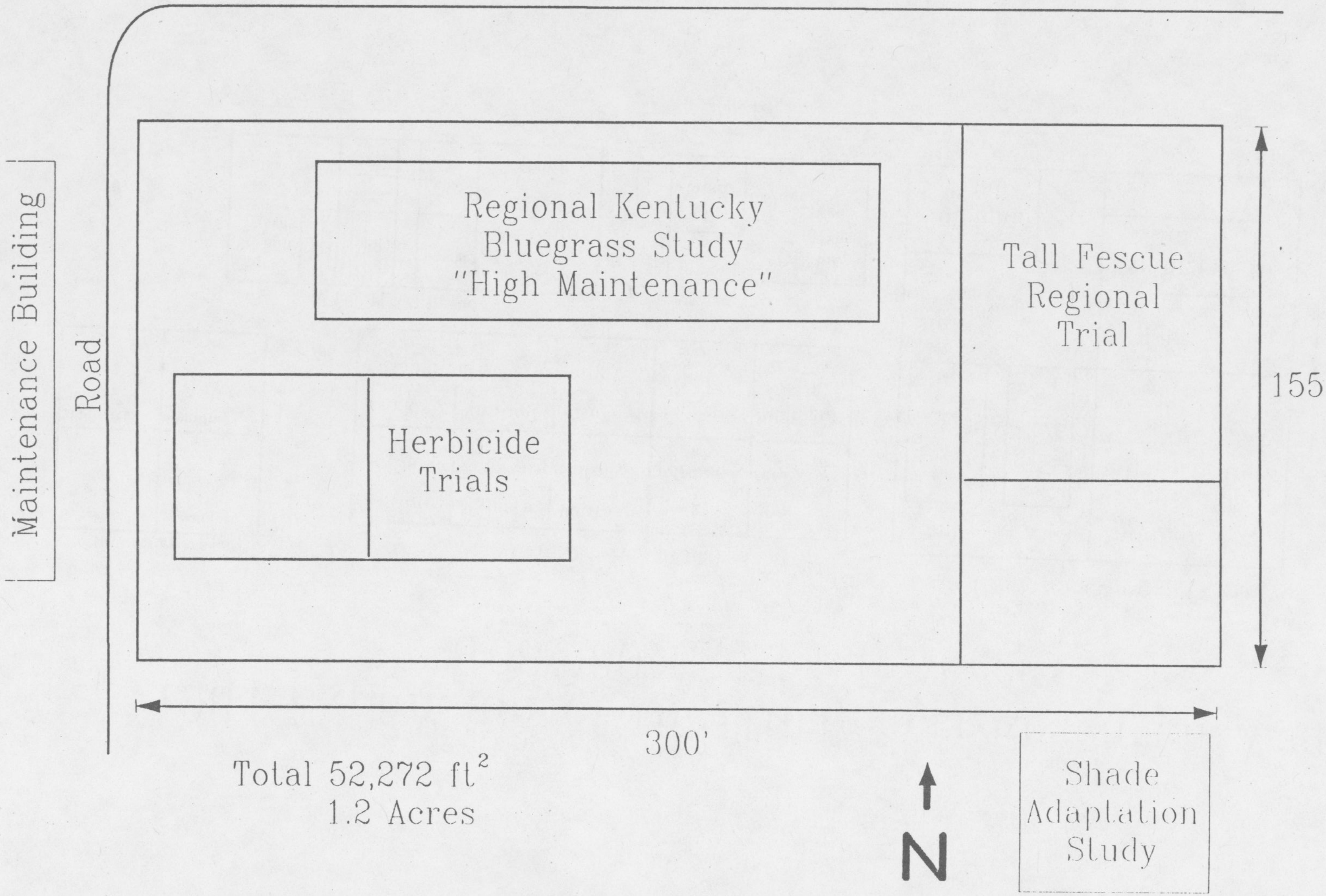


DAILY TEMPERATURE - AMES

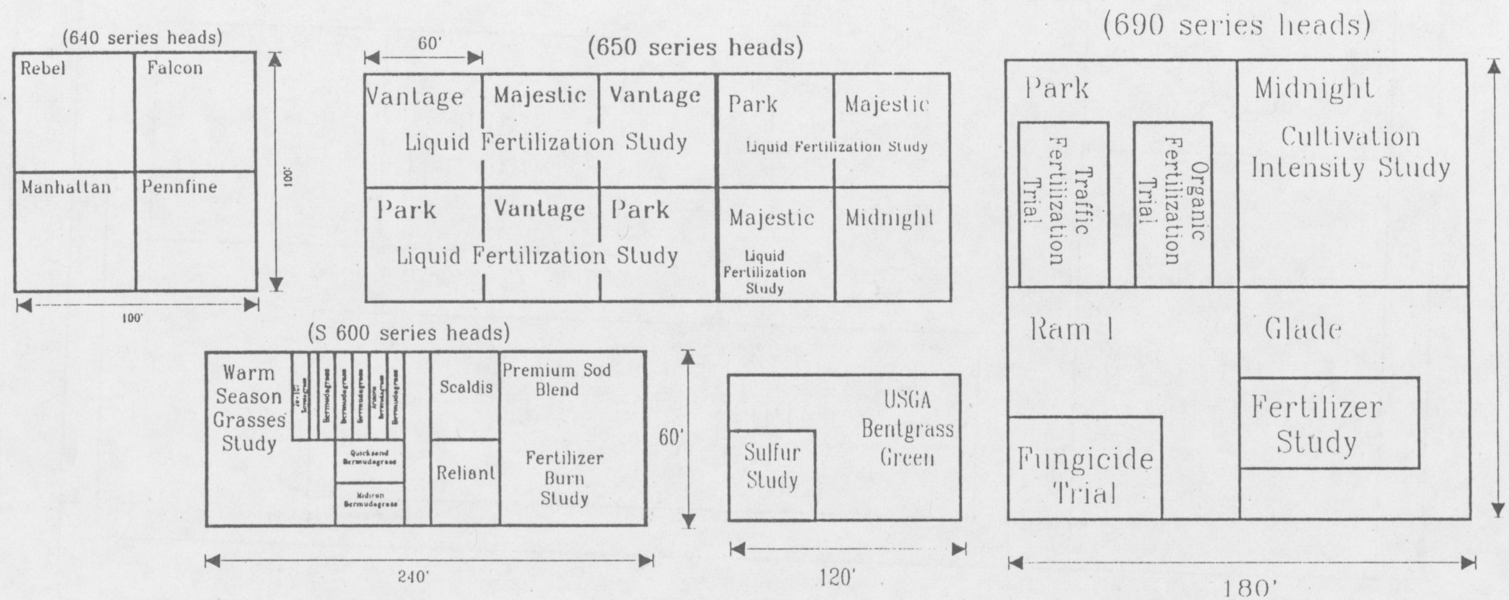


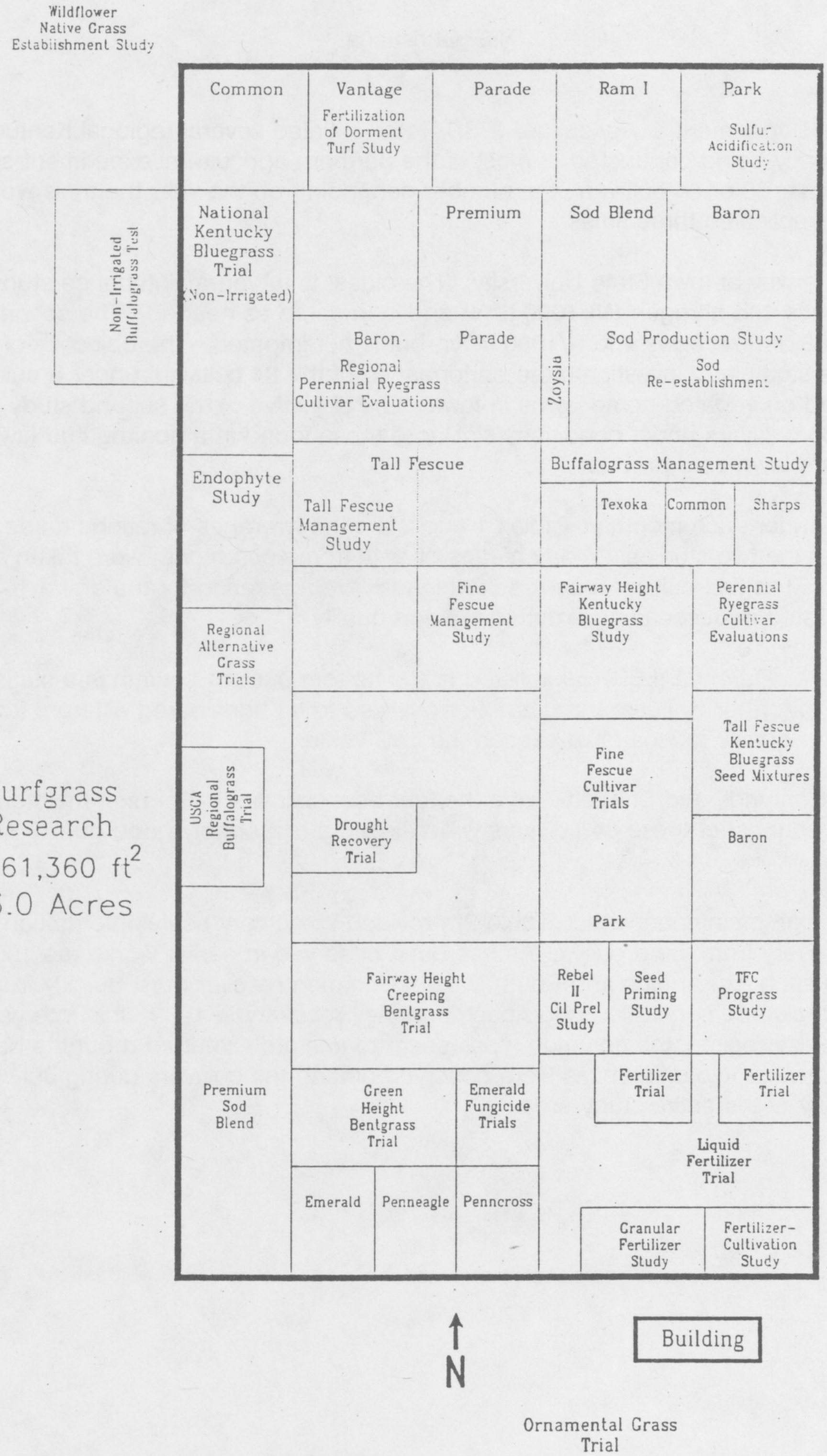
SOLID LINE= MAX DASHED LINE= MIN

East Research Area



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





Turfgrass Research
261,360 ft^2
6.0 Acres

1989 – Results of High- and Low-Maintenance

Kentucky Bluegrass Regional Cultivar Trials

N.E. Christians

The United States Department of Agriculture (USDA) has initiated several regional Kentucky bluegrass cultivar trials 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 are underway at Iowa State University. 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 a nonirrigated lawn that receives a 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 1989 season. The cultivars are listed in descending order of average quality.

The least significant difference (LSD) value listed at the bottom of each column is a statistical value that can be used to further evaluate the data. For cultivars to be considered different from one another, their mean quality ratings must exceed the LSD value.

Sydsport, Ram-I, Enmundi, and Charlotte were the four best cultivars in the high-maintenance trial (Table 1). However, most of these 84 cultivars will maintain a reasonably good quality if they are properly managed.

The nonirrigated, high-maintenance trial (Table 2) provided some very useful information again this year following recovery from the drought. As has been observed in earlier work (see 1989 report), common varieties such as Kenblue and South Dakota Common recover most quickly from dormancy. Joy and Huntsville also demonstrated good postdormancy recovery in 1989. It is interesting that even under a higher fertility regime, the common types seem to tolerate extended droughts better than most improved cultivars. No differences were observed among the cultivars during July due to complete dormancy of the entire study area.

Table 1. The 1989 quality ratings for the high-maintenance regional Kentucky bluegrass test that was established in the fall of 1981.

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
1.	SYDSPORT	7.7	8.0	7.3	6.7	7.3	8.0	7.5
2.	RAM-I	8.3	8.3	6.7	6.7	7.7	7.0	7.4
3.	ENMUNDI	7.7	8.0	7.3	7.0	7.3	7.3	7.4
4.	CHARLOTTE	7.0	8.0	7.0	7.7	7.7	7.0	7.4
5.	KIMONO	8.0	7.3	7.3	7.0	6.7	7.3	7.3
6.	MLM-18011	8.3	8.0	7.0	6.0	7.7	7.0	7.3
7.	A20-6	7.7	8.0	5.7	6.7	8.7	7.3	7.3
8.	ECLIPSE	7.7	7.3	6.7	7.0	7.7	7.7	7.3
9.	239	8.0	7.7	6.0	7.0	7.7	7.0	7.2
10.	I-13	6.7	8.0	6.3	6.3	7.7	8.0	7.2
11.	N535	8.0	7.7	6.3	6.7	6.7	7.7	7.2
12.	1528T(Midnight)	8.3	7.7	6.0	6.0	8.0	7.0	7.2
13.	BRISTOL	8.0	8.0	6.7	6.0	8.0	6.7	7.2
14.	VICTA	7.7	7.7	6.7	6.3	8.0	7.0	7.2
15.	NJ 735	7.3	8.3	6.0	7.0	8.0	6.7	7.2
16.	ESCORT	7.3	7.7	6.7	7.0	7.3	7.0	7.2
17.	PLUSH	7.0	7.3	6.7	7.0	7.3	7.0	7.1
18.	MAJESTIC	7.0	7.3	6.0	6.3	8.0	7.7	7.1
19.	SHASTA	8.0	7.3	5.7	6.3	7.7	7.3	7.1
20.	MER PP 300	7.7	7.7	6.0	6.0	7.7	7.0	7.0
21.	MONA	8.0	7.3	6.3	6.0	7.3	7.0	7.0
22.	MONOPOLY	7.3	7.3	5.7	6.3	7.3	7.3	6.9
23.	PSU-190	7.3	7.7	6.3	6.3	7.3	6.3	6.9
24.	SV-01617	7.7	7.7	6.3	6.3	7.7	5.7	6.9
25.	WELCOME	8.3	8.0	5.7	5.7	7.0	7.0	6.9
26.	HARMONY	7.0	7.0	7.0	7.0	7.3	6.3	6.9
27.	MOSA	7.3	6.7	7.0	6.3	7.3	7.0	6.9
28.	WW AG 478	7.3	6.3	6.7	6.7	7.3	7.0	6.9
29.	MERIT	6.7	7.7	6.0	7.0	7.3	7.0	6.9
30.	COLUMBIA	8.0	8.0	5.3	5.7	7.7	6.7	6.9
31.	BIRKA	7.3	7.0	6.7	6.3	6.7	6.7	6.8
32.	PARADE	7.0	6.7	6.0	6.7	7.3	7.0	6.8
33.	TRENTON	8.0	6.7	6.3	6.7	6.3	7.0	6.8
34.	VANESSA	7.0	7.0	6.7	6.3	7.0	6.7	6.8
35.	A20	7.3	7.3	5.3	6.0	8.0	7.0	6.8
36.	ENOBLE	8.0	7.0	6.0	5.7	7.7	6.7	6.8
37.	NUGGET	7.3	7.7	6.3	5.3	7.0	6.7	6.7
38.	DORMIE	7.0	7.0	6.3	6.3	7.0	6.7	6.7
39.	BONO	7.3	7.0	6.7	6.7	6.0	6.3	6.7
40.	BONNIEBLUE	7.3	6.7	5.7	6.3	7.3	7.0	6.7
41.	ARGYLE	6.7	6.3	6.3	6.7	7.3	6.7	6.7
42.	H-7	7.7	7.7	5.0	6.0	7.7	6.3	6.7
43.	A20-6A	7.7	7.0	5.7	5.7	7.0	7.0	6.7
44.	P141 (MYSTIC)	6.3	7.0	6.7	6.0	6.7	7.7	6.7
45.	K3-178	7.7	6.0	6.0	5.7	7.7	7.0	6.7
46.	BARBLUE	8.0	7.0	6.0	6.0	7.3	6.0	6.7
47.	FYLKING	6.7	6.7	6.3	6.3	7.0	6.3	6.6
48.	CHERI	8.0	7.7	6.3	5.3	6.3	6.0	6.6
49.	HOLIDAY	8.0	7.0	5.7	5.7	6.3	6.7	6.6
50.	WW AG 463	7.3	7.7	5.7	6.0	7.3	5.7	6.6

Table 1. The 1989 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	Oct	Mean
51.	PIEDMONT	6.3	6.7	6.0	6.7	7.3	6.3	6.6
52.	VANTAGE	6.3	7.0	6.3	6.3	6.7	7.0	6.6
53.	APART	7.0	7.0	6.0	5.7	7.3	6.7	6.6
54.	A-34	6.3	6.7	6.3	6.0	7.0	7.0	6.6
55.	MER PP 43	6.7	6.3	6.0	6.0	8.0	6.3	6.6
56.	225	7.0	7.3	6.3	5.7	6.7	6.7	6.6
57.	ADELPHI	7.0	6.7	5.7	6.0	6.7	7.0	6.5
58.	GERONIMO	7.3	7.0	5.3	5.3	7.3	6.7	6.5
59.	CEB VB 3965	8.0	7.0	5.7	5.3	6.7	6.3	6.5
60.	MERION	6.7	7.3	6.0	6.3	6.3	6.3	6.5
61.	ADMIRAL	7.3	6.3	6.0	6.3	7.0	6.0	6.5
62.	GLADE	7.3	7.0	6.3	4.7	7.0	6.3	6.4
63.	BANFF	7.3	7.3	5.7	5.3	6.7	6.0	6.4
64.	TOUCHDOWN	6.3	7.3	5.3	5.7	7.3	6.7	6.4
65.	WW AG 480	7.7	7.3	5.7	4.7	6.7	6.3	6.4
66.	SH-2	6.3	6.3	5.7	5.7	7.3	7.3	6.4
67.	BA-61-91	7.3	6.7	5.7	5.3	7.0	6.3	6.4
68.	243	7.3	7.0	5.7	5.3	7.0	5.7	6.3
69.	RUGBY	7.7	7.3	4.7	5.3	7.0	6.0	6.3
70.	ASPEN	7.3	7.3	5.3	5.0	6.7	6.0	6.3
71.	CELLO	6.7	7.0	6.0	4.7	6.7	6.7	6.3
72.	BAYSIDE	7.0	7.0	5.7	4.7	7.0	6.7	6.3
73.	BARON	7.0	7.3	5.0	5.7	6.7	5.7	6.2
74.	AMERICAN	7.7	6.3	4.7	5.3	7.0	6.0	6.2
75.	LOVEGREEN	6.0	7.0	6.0	5.3	7.0	6.0	6.2
76.	S.D. COMMON	5.7	6.3	5.7	5.7	7.3	6.3	6.2
77.	K3-179	6.7	6.3	6.0	5.7	6.7	6.0	6.2
78.	WABASH	6.7	6.0	5.0	5.0	7.0	6.3	6.0
79.	PSU-173	6.7	6.3	5.3	4.3	6.7	5.3	5.8
80.	S-21	6.0	5.3	6.0	5.0	6.0	5.7	5.7
81.	K3-152	7.0	5.7	4.7	4.7	6.3	5.7	5.7
82.	K3-162	5.3	5.0	6.0	5.3	6.0	6.0	5.6
83.	KENBLUE	5.7	5.3	5.7	4.7	5.7	6.0	5.5
84.	PSU-150	6.3	5.3	5.0	4.7	6.0	5.3	5.4
	LSD 0.05	1.2	1.5	1.6	2.1	1.7	1.7	1.2

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

Table 2. The 1989 quality ratings for the nonirrigated, high-maintenance Kentucky bluegrass trial established in the fall of 1985.

	Cultivar	May	June	Aug	Sept	Oct	Mean
1.	JOY	6.0	6.3	4.3	4.3	5.3	5.3
2.	SOUTH DAKOTA CERT.	5.7	6.7	4.7	4.7	5.0	5.3
3.	KENBLUE	6.3	6.3	4.0	4.3	5.0	5.2
4.	HUNTSVILLE	5.7	6.0	3.3	4.0	5.3	4.9
5.	F-1872 (Freedom)	6.0	6.7	3.0	3.7	5.3	4.9
6.	MONOPOLY	5.3	6.0	3.7	3.7	5.0	4.7
7.	LOFTS 1757	5.0	6.0	3.3	4.3	5.0	4.7
8.	WABASH	6.0	5.3	3.3	4.3	4.7	4.7
9.	HARMONY	4.7	5.7	4.0	4.3	5.0	4.7
10.	NE 80-14	5.7	5.0	4.0	3.7	5.0	4.7
11.	SOMERSET	4.7	5.7	3.3	4.7	4.7	4.6
12.	AQUILA	6.0	6.0	2.3	3.3	5.3	4.6
13.	ABLE I	4.7	5.7	3.7	4.0	4.3	4.5
14.	PARK	4.7	5.3	3.7	3.7	5.0	4.5
15.	RUGBY	4.7	5.3	3.7	3.0	5.3	4.4
16.	BARON	4.7	4.7	4.0	3.3	4.3	4.2
17.	ASPEN	5.7	5.0	3.0	3.0	4.3	4.2
18.	PST-CB1	4.3	5.7	2.7	3.7	4.7	4.2
19.	CLASSIC	4.7	5.7	3.0	3.0	4.3	4.1
20.	TENDOS	5.3	6.3	2.7	2.7	3.7	4.1
21.	GEORGETOWN	3.7	5.7	3.0	4.0	4.3	4.1
22.	ECLIPSE	4.7	6.0	2.7	2.7	4.7	4.1
23.	DAWN	5.3	5.7	2.0	3.0	4.3	4.1
24.	239 (Suffolk)	4.0	5.7	3.0	3.3	4.3	4.1
25.	K3-178	4.0	5.7	3.0	3.7	4.0	4.1
26.	NE 80-110	5.0	6.0	3.0	2.3	4.0	4.1
27.	A-34	3.3	5.0	3.7	3.7	4.3	4.0
28.	JULIA	4.0	4.3	2.7	4.7	4.3	4.0
29.	TRENTON	3.3	5.0	3.7	3.3	4.7	4.0
30.	WW AG 496	4.0	5.3	2.7	4.0	4.0	4.0
31.	VICTA	4.7	5.7	2.7	2.3	4.0	3.9
32.	BA 70-242	5.0	4.7	3.3	2.7	4.0	3.9
33.	NE 80-88	4.0	4.7	3.0	4.0	4.0	3.9
34.	AMERICA	3.0	4.0	3.7	4.7	4.0	3.9
35.	LIBERTY	4.0	5.0	3.7	3.0	4.0	3.9
36.	NASSAU	4.3	5.3	3.0	3.0	3.7	3.9
37.	IKONE	3.7	5.0	2.7	4.0	4.3	3.9
38.	WW AG 495	3.7	5.0	2.7	3.3	4.7	3.9
39.	MYSTIC	3.3	5.0	3.7	4.0	3.0	3.8
40.	PARADE	4.3	5.0	2.0	3.3	4.3	3.8
41.	WELCOME	4.7	5.0	2.3	3.0	4.0	3.8
42.	WW AG 468	4.7	5.7	3.0	2.3	3.3	3.8
43.	WW AG 491	4.0	6.0	2.0	3.0	4.0	3.8
44.	MERIT	4.3	5.0	2.7	2.7	4.0	3.7
45.	BRISTOL	3.7	4.7	3.0	3.0	4.3	3.7
46.	BA 72-441 (Abbey)	4.3	5.3	3.0	2.3	3.3	3.7
47.	BA 73-626 (Kelly)	4.3	5.0	3.0	3.0	3.3	3.7
48.	DESTINY	5.0	4.7	2.7	2.3	4.0	3.7
49.	GLADE	4.0	5.0	2.7	3.0	4.0	3.7
50.	NE 80-50	4.0	4.7	2.3	3.0	4.7	3.7

Table 2. The 1989 quality ratings for the nonirrigated, high-maintenance Kentucky bluegrass trial established in the fall of 1985. (continued)

	Cultivar	May	June	Aug	Sept	Oct	Mean
51.	GNOME	3.7	4.0	3.0	3.0	4.3	3.6
52.	P-104 (Princeton 104)	3.7	4.3	2.7	3.7	3.7	3.6
53.	BAR VB 577	3.7	5.0	2.0	3.3	4.0	3.6
54.	BAR VB 534	4.3	5.0	2.3	2.7	3.7	3.6
55.	CYNTHIA	4.3	4.3	2.7	2.7	4.0	3.6
56.	MERION	4.7	5.0	2.3	2.3	3.7	3.6
57.	K1-152	4.0	5.3	2.3	2.7	3.7	3.6
58.	NE 80-47	4.0	4.7	2.0	3.3	4.0	3.6
59.	NE 80-48	4.0	5.3	2.3	2.3	4.0	3.6
60.	RAM-I	3.3	5.0	3.0	2.7	3.7	3.5
61.	HAGA	4.0	5.0	2.3	2.7	3.3	3.5
62.	ANNIKA	3.3	5.3	2.3	2.7	3.7	3.5
63.	ASSET	3.7	4.3	2.7	3.3	3.3	3.5
64.	AMAZON	4.0	5.0	3.0	2.0	3.7	3.5
65.	CHALLENGER	4.0	4.7	2.7	3.0	3.3	3.5
66.	BLACKSBURG	3.7	5.0	3.0	2.0	4.0	3.5
67.	NE 80-30	3.0	4.3	2.7	3.0	4.3	3.5
68.	BARZAN	4.0	4.0	2.0	3.3	3.7	3.4
69.	BA 69-82	3.3	5.0	2.3	2.3	4.0	3.4
70.	MIDNIGHT	4.0	5.0	2.3	2.3	3.3	3.4
71.	CONNI	3.0	3.3	2.7	3.3	4.3	3.3
72.	BA 72-500 (Chateau)	4.3	4.3	2.3	2.0	3.7	3.3
73.	BA 73-540	4.0	4.7	2.0	2.7	3.3	3.3
74.	COMPACT	3.3	4.0	2.3	2.7	3.3	3.1
75.	SYDSPORT	3.3	4.0	2.0	2.7	3.3	3.1
76.	CHERI	4.0	4.7	2.0	2.0	3.0	3.1
77.	BA 72-492 (Estate)	2.7	4.0	2.3	2.0	4.0	3.0
78.	NE 80-55	3.0	4.0	2.0	3.0	3.0	3.0
79.	BA 70-139 (Coventry)	3.3	4.0	2.0	2.0	3.0	2.9
80.	HV 97	3.0	4.0	2.0	2.3	3.0	2.9
	LSD 0.05	1.6	1.4	1.3	1.7	1.7	1.0

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

Data were not collected during July due to complete dormancy during the drought. The study was terminated in late August.

Regional Perennial Ryegrass Cultivar Evaluation

R.W. Moore and N.E. Christians

This is the seventh 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 is to identify regional adaptation of the 48 perennial ryegrass cultivars. Cultivars are evaluated for turf quality each month of the growing season.

The trial is maintained at a 2 in mowing height with 3 to 4 lb N/1000 ft^2 through the growing season and is irrigated when needed to prevent drought. Preemergence herbicide is applied once in the spring and broadleaf herbicide is applied once in September to control weeds. The trial was not irrigated during the 1989 season because of the lack of water at the research station.

There are no statistical differences among the first 14 cultivars in Table 3. Notice that several of the top performers in 1989 are experimental numbered cultivars. Several of these numbered varieties have rated in the top 20 each of the past few years. There has been a considerable amount of breeding and selection of perennial ryegrasses conducted in the past decade and a number of new releases of well adapted cultivars can be expected in future years. Some of these numbered cultivars have been given names.

Repell (GT-II) is of particular interest. This variety contains an endophytic fungal organism that repels insect attacks. During the drought of 1989, sod webworms were a serious problem at the research station.

Table 3. Turf quality of perennial ryegrass cultivars in 1989.

	Cultivar	Ratings[a] May	June	July	Aug	Sept	Mean
1.	GT-II (Repell)	7.0	7.0	7.0	7.0	7.3	7.1
2.	PALMER	7.7	7.0	6.3	6.3	6.7	6.8
3.	282 (Citation II)	6.7	6.7	6.0	7.0	7.0	6.7
4.	SWRC-1	6.7	6.7	6.3	7.0	7.0	6.7
5.	IA 728 (Allstar)	6.7	6.3	6.3	7.0	7.0	6.7
6.	BLAZER	6.7	6.7	6.3	6.7	6.7	6.6
7.	HR-1	6.3	6.0	6.7	7.0	7.0	6.6
8.	PRELUDE	6.7	6.3	6.3	6.3	7.0	6.5
9.	HE 168	6.0	6.7	7.0	6.3	6.7	6.5
10.	BT-I (Tara)	7.3	7.0	5.7	6.0	6.3	6.5
11.	DIPLOMAT	6.7	6.0	6.3	6.3	6.7	6.4
12.	LP 702 (Mondial)	6.7	6.0	6.0	6.7	6.7	6.4
13.	RANGER	6.7	6.3	6.0	6.7	6.3	6.4
14.	PENNANT	6.3	5.7	6.3	6.7	7.0	6.4
15.	LP 210	6.7	6.0	6.3	6.3	6.3	6.3
16.	2EE (Cowboy)	6.3	6.0	6.0	6.7	6.3	6.3
17.	MANHATTAN II	7.3	6.0	6.0	6.0	6.3	6.3
18.	OMEGA	7.3	6.3	5.7	6.0	5.7	6.2
19.	PREMIER	6.3	6.3	6.0	6.7	5.7	6.2
20.	REGAL	6.3	5.3	6.0	6.3	7.0	6.2
21.	COCKADE	7.0	6.3	5.7	5.7	5.7	6.1
22.	NK 80389	7.3	6.0	5.0	5.7	6.3	6.1
23.	LP 792	7.0	6.3	5.3	5.7	5.7	6.0
24.	2ED (Birdie II)	6.3	5.7	5.7	6.3	6.0	6.0
25.	DELRAY	6.7	6.0	5.3	6.0	6.0	6.0
26.	CUPIDO	7.3	6.0	5.3	5.7	5.7	6.0
27.	DERBY	6.3	5.7	5.3	6.3	6.3	6.0
28.	YORKTOWN II	6.7	5.3	5.7	6.0	6.0	5.9
29.	FIESTA	6.3	5.7	5.3	6.0	6.3	5.9
30.	DASHER	6.3	5.3	5.7	6.0	6.0	5.9
31.	WWE 19	6.3	5.7	5.7	5.7	6.0	5.9
32.	M382	6.3	6.0	5.7	5.3	6.0	5.9
33.	NK 79307	5.7	5.7	5.7	6.3	6.3	5.9
34.	ELKA	6.3	7.0	5.0	5.3	5.7	5.9
35.	BIRDIE	7.3	5.7	4.7	5.3	6.7	5.9
36.	CIGIL	6.7	5.7	5.0	5.7	5.7	5.7
37.	MANHATTAN	6.3	6.0	5.0	6.0	5.3	5.7
38.	NK 79309	6.7	5.3	4.7	5.7	6.0	5.7
39.	GATOR	7.0	6.3	4.3	5.3	5.7	5.7
40.	BARRY	6.0	5.0	5.7	5.7	5.7	5.6
41.	LINN	5.3	5.0	5.7	6.0	6.0	5.6
42.	PENNFINE	5.7	5.3	5.3	6.0	5.7	5.6
43.	LP 736 (Ovation)	6.0	5.7	5.0	5.3	5.3	5.5
44.	ACCLAIM	6.3	6.0	4.7	5.0	5.3	5.5
45.	CROWN	6.0	5.3	4.3	5.7	5.3	5.3
46.	HE 178	6.0	5.0	4.7	5.3	5.7	5.3
47.	PIPPIN	6.3	5.3	4.7	5.0	5.0	5.3
48.	CITATION	6.0	5.0	4.0	5.0	5.3	5.1
	LSD 0.05	1.2	1.0	1.1	1.0	1.1	0.7

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

Fine Fescue Cultivar Trial

R.W. Moore and N.E. Christians

This was the seventh and final year for the fine fescue cultivar trial established in the fall of 1982. The purpose of the trial was to identify regional adaptation of the 32 fine fescue cultivars and blends in a full sun exposure. The data listed in Table 4 was the last rating taken before termination of the study in the spring of 1989.

The trial was maintained at a 2 in mowing height with 3 to 4 lb N/1000 ft^2/yr and was irrigated when needed to prevent drought. Preemergence herbicide was applied once in the spring and broadleaf herbicide was applied once in September to control weeds.

The best cultivars were FOF-WC, Scaldis/Atlanta, Dawson, Pennlawn, and Agram under these conditions in 1989 (Table 4). Most of the top ten cultivars in 1989 have consistently rated in the top ten over the past seven years of this study. Tournament, Duar, NK 79190, NK 79191, NK 80345, NK 80347, and NK 80348 had 20 to 80% Kentucky bluegrass in two or three of their replications. This may be due to their lack of competitiveness with Kentucky bluegrass.

This trial was terminated in 1989 due to the contamination by Kentucky bluegrass. A new, 94 cultivar, national fineleaf fescue trial is being established in 1990, and will replace this cultivar trial.

Table 4. Turf quality ratings of fine fescue cultivars and blends at termination of the trial in 1989.

Cultivar	September ratings			
	Rep I	Rep II	Rep III	Mean
1. FOF-WC (SF)	4	8	7	6.3
2. SCALDIS/ATLANTA	5	6	7	6.0
3. DAWSON (CR)	7	5	6	6.0
4. PENNLAWN (CR)	6	7	5	6.0
5. AGRAM (C)	6	6	6	6.0
6. AURORA (HF)	3	6	8	5.7
7. ATLANTA (C)	6	6	5	5.7
8. BANNER (CF)	4	7	5	5.3
9. BILJART (HF)	4	7	5	5.3
10. BANNER/CHECKER	5	6	5	5.3
11. WALDINA (HF)	2	7	6	5.0
12. SHADOW (C)	6	5	4	5.0
13. SCALDIS (HF)	3	6	6	5.0
14. RUBY (CR)	5	5	5	5.0
15. NK80346 (CR)	5	5	5	5.0
16. JAMESTOWN (C)	3	5	6	4.7
17. ENSYLVA (CR)	3	5	6	4.7
18. FORTRESS (CR)	4	5	5	4.7
19. CHECKER (C)	5	5	4	4.7
20. BARFALLA (C)	5	4	5	4.7
21. NK79191 (CR)	5	4	5	4.7
22. DAWSON/PENNLAWN	6	5	2	4.3
23. NK79189 (CR)	5	4	4	4.3
24. KOKET (C)	3	5	5	4.3
25. HIGHLIGHT (C)	3	5	5	4.3
26. DUAR (HF)	4	4	4	4.0
27. NK80348 (CR)	4	4	4	4.0
28. NK80347 (CR)	3	4	4	3.7
29. NK79190 (CR)	4	5	2	3.7
30. WINTERGREEN (C)	4	4	3	3.7
31. TOURNAMENT (HF)	2	7	2	3.7
32. NK80345 (CR)	2	3	4	3.0

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

The quality ratings in Table 5 are the means of monthly ratings taken on replicated plots from May to October. Reliant and Scaldis hard fescue had the best overall quality.

These same grasses performed satisfactorily even under the extreme conditions of a 1 in mowing height and 1 lb N/1000 ft^2/year, and they have performed consistently well for the 11 years this 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.

Table 5. The effects of mowing height and nitrogen fertilizer on the quality of 10 fine fescues in 1989.

	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]	5.7	5.3	5.7	5.5
2. Scaldis Hard Fescue	8.3	8.0	7.9	7.9	8.0
3. Ruby Red Fescue	4.9	5.3	5.6	6.2	5.5
4. Atlanta Chewings Fescue	5.4	5.6	5.6	5.7	5.6
5. K5-29 Red Fescue	5.2	5.1	5.4	5.1	5.2
6. Dawson Red Fescue	5.3	5.3	5.9	5.9	5.6
7. Reliant Hard Fescue	7.9	7.9	8.1	7.9	8.0
8. Ensylva Red Fescue	5.6	5.3	5.5	5.4	5.5
9. Highlight Chewings Fescue	3.3	3.3	3.8	3.5	3.5
10. Jamestown Chewings Fescue	5.6	6.1	5.4	6.1	5.8

[a] N rates are in lb N/1000 ft^2/yr. The N source is 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 is maintained at a 2 in mowing height and fertilized with 2 lb N/1000 ft^2/yr. The area is unirrigated and receives no fungicide or insecticide applications.

The data in Table 6 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. Yet, most cultivars had a mean quality over the acceptable level of 6.

Table 6. 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 6. 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-50L	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 is a report on the sixth year of data from the experiment. It is 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 7). Turf quality increased with each increment of N for all of the cultivars at both mowing heights. Rebel and Houndog were the best cultivars under higher maintenance conditions in 1989. In general, each of the turf-type cultivars performed better than Kentucky 31 through the season.

Table 7. Turf quality of tall fescue cultivars at two clipping heights and three fertility levels in 1989.

	Cultivar	Clip hgt inch	lb N/ 1000 ft^2	Ratings[a] May	June	July	Aug	Sept	Mean
1.	REBEL	2	0	4.0	3.3	3.3	2.7	4.3	3.5
2.	REBEL	2	2	5.0	6.0	5.0	4.3	5.3	5.1
3.	REBEL	2	4	8.0	7.0	7.0	6.7	7.7	7.3
4.	REBEL	3	0	4.0	3.7	3.3	2.7	4.3	3.6
5.	REBEL	3	2	5.0	6.0	5.0	4.3	5.3	5.1
6.	REBEL	3	4	8.0	7.3	7.0	6.7	7.7	7.3
7.	MUSTANG	2	0	5.3	3.7	3.3	3.7	4.3	4.1
8.	MUSTANG	2	2	6.0	6.0	4.7	5.0	5.7	5.5
9.	MUSTANG	2	4	8.0	7.0	6.3	7.0	7.0	7.1
10.	MUSTANG	3	0	5.3	4.0	3.3	3.7	4.3	4.1
11.	MUSTANG	3	2	6.0	6.0	5.0	5.0	5.7	5.5
12.	MUSTANG	3	4	8.0	7.0	6.7	7.0	7.0	7.1
13.	KENTUCKY-31	2	0	4.3	3.0	3.3	4.3	4.0	3.8
14.	KENTUCKY-31	2	2	4.7	6.0	5.0	5.3	5.0	5.2
15.	KENTUCKY-31	2	4	8.0	7.0	6.3	6.3	6.7	6.9
16.	KENTUCKY-31	3	0	4.3	3.7	3.3	4.3	3.7	3.9
17.	KENTUCKY-31	3	2	4.7	5.7	5.0	5.3	5.0	5.1
18.	KENTUCKY-31	3	4	8.0	7.3	6.3	6.3	6.7	6.9
19.	HOUNDOG	2	0	4.7	3.3	3.0	3.7	4.0	3.7
20.	HOUNDOG	2	2	5.7	6.3	4.7	5.0	5.7	5.5
21.	HOUNDOG	2	4	8.0	7.7	6.7	7.0	7.0	7.3
22.	HOUNDOG	3	0	4.7	4.0	3.0	3.7	4.0	3.9
23.	HOUNDOG	3	2	5.7	6.7	4.7	5.0	6.0	5.6
24.	HOUNDOG	3	4	8.0	7.7	6.7	7.0	7.0	7.3
25.	FALCON	2	0	4.0	3.3	3.3	3.7	4.0	3.7
26.	FALCON	2	2	5.3	5.7	5.3	4.7	5.3	5.3
27.	FALCON	2	4	8.0	7.7	6.3	7.0	7.0	7.2
28.	FALCON	3	0	4.0	4.0	3.3	3.7	3.7	3.7
29.	FALCON	3	2	5.3	6.0	5.3	4.7	5.0	5.3
30.	FALCON	3	4	8.0	7.7	6.3	7.0	7.0	7.2
LSD cultivar averages				0.5	NS[b]	NS	NS	NS	NS
LSD fertilizer treatments				0.3	0.3	0.4	0.3	0.2	0.2

[a] Quality based on a scale of 9 to 1: 9 = best quality, 6 = acceptable quality, and 1 = poorest quality.
[b] NS = Not Significant.

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 varieties 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 are mowed at a 2 in height and receive 2 lb N/1000 ft^2/year. No weed control has been required on the area. Irrigation was used during the fall of 1987 and through the summer of 1988. Although this was originally planned as a nonirrigated study, the drought of 1989 resulted in a need for irrigation during the summer months.

Monthly quality data were collected in May through October. Several of the hard fescues (H.F.) and one creeping red fescue (C.R.F.) were the best performers in 1989 (Table 8). These were followed by the tall fescues, many of which maintained very good quality all season long. Ram-I was the only Kentucky bluegrass to maintain an acceptable quality. In general, the Kentucky bluegrasses were the poorest quality grasses in this study. The low ranking of Reliant H.F., which performed very well in full sun in the Fine Fescue Management Trial discussed elsewhere in this report, is due to the fact that it was the only variety that was sodded. The sod did not become well established in the drought of 1988.

Table 8. Turf quality ratings of shade trial in 1989. (Seeded Fall 1987)

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
1.	BILJART (H.F.)	7.3	7.3	8.0	6.7	7.7	8.0	7.5
2.	ST-2 (SR 3000) (H.F.	7.0	6.3	7.7	7.0	7.7	8.0	7.3
3.	ESTICA (C.R.F.)	6.7	6.7	7.0	6.3	7.7	7.7	7.0
4.	BAR FO 81-225 (H.F.)	6.0	7.0	7.0	6.7	7.7	7.3	6.9
5.	SPARTAN (H.F.)	7.3	6.3	7.3	6.0	7.0	7.7	6.9
6.	WALDINA (H.F.)	6.3	6.0	6.7	6.7	7.3	8.0	6.8
7.	REBEL (T.F.)	6.7	6.3	6.3	6.0	6.7	7.3	6.6
8.	REBEL II (T.F.)	5.7	5.7	6.7	6.7	7.0	7.7	6.6
9.	APACHE (T.F.)	6.7	6.0	7.0	6.3	6.3	7.3	6.6
10.	SCALDIS (H.F.)	6.0	6.3	6.7	5.7	7.0	7.3	6.5
11.	FALCON (T.F.)	6.7	6.3	6.0	6.3	6.7	6.7	6.4
12.	VICTOR (C.F.)	6.7	6.3	6.7	5.0	6.0	7.3	6.3
13.	ARID (T.F.)	7.0	6.0	6.3	5.3	6.0	7.0	6.3
14.	BONANZA (T.F.)	7.0	6.3	6.7	5.3	6.0	6.7	6.3
15.	MARY (C.F.)	5.3	6.0	6.3	6.0	6.3	7.3	6.2
16.	WALDORF (C.F.)	6.7	5.7	7.0	5.3	6.0	6.3	6.2
17.	RAM-I (K.B.)	5.7	6.0	6.3	5.7	6.3	6.7	6.1
18.	JAMESTOWN (C.F.)	5.7	6.3	5.7	5.7	6.0	6.7	6.0
19.	PENNLAWN (C.R.F.)	6.0	6.0	6.0	5.0	5.7	6.3	5.8
20.	CHATEAU (K.B.)	5.7	5.7	6.0	5.3	5.7	6.3	5.8
21.	ATLANTA (C.F.)	5.0	6.0	6.7	4.3	5.7	6.7	5.7
22.	BANNER (C.F.)	5.7	5.7	5.7	5.0	5.3	6.0	5.6
23.	AGRAM (C.F.)	6.0	6.0	5.3	4.3	5.0	7.0	5.6
24.	WINTERGREEN (C.F.)	6.0	6.0	6.0	4.3	5.7	5.7	5.6
25.	SHADOW (C.F.)	5.7	5.0	5.3	5.3	5.0	6.7	5.5
26.	KOKET (C.F.)	5.7	6.3	5.0	4.0	5.0	6.7	5.4
27.	ENSYLVA (C.R.F.)	5.3	4.3	5.0	5.3	5.7	7.0	5.4
28.	SABRE (*Poa trivialis*)	4.3	5.3	5.7	5.3	7.0	5.0	5.4
29.	COVENTRY (K.B.)	5.3	5.3	5.3	5.3	5.3	5.3	5.3
30.	GLADE (K.B.)	4.3	5.3	5.0	5.0	5.7	6.7	5.3
31.	HIGHLIGHT (C.F.)	4.7	5.0	5.0	4.3	5.0	5.7	4.9
32.	BRISTOL (K.B.)	4.3	4.7	5.0	4.0	4.7	5.3	4.7
33.	NASSAU (K.B.)	4.0	4.7	4.0	3.0	3.7	5.0	4.1
34.	MIDNIGHT (K.B.)	3.0	4.7	3.7	3.0	3.7	5.0	3.8
35.	RELIANT (H.F.)	3.3	4.7	3.7	3.0	4.0	3.7	3.7
	LSD 0.05	1.6	1.7	1.7	1.5	2.0	1.9	1.4

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

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

Tall Fescue Seeding / Fertilizer Study

M.L. Agnew

The objective of this study was to evaluate the effects of coating tall fescue (*Festuca arundinacea* 'Rebel II') seed with fertilizer and fungicide, to determine the optimum seeding rate, and to evaluate the need for a starter fertilizer during the establishment phase.

The experiment was established on April 20, 1989, at the Iowa State University Horticulture Station, Ames, Iowa. Plots measured 5 ft by 5 ft and were arranged in a randomized, complete-block design with three replications. Treatments included seeding rate, seed treatment, and the addition of starter fertilizer. Seeding rates were 4, 6, and 8 lb pure live seed (PLS)/1000 ft^2. This equated to 45.4 g/plot, 68.1 g/plot, and 90.8 g/plot for nontreated seed, while seeds treated with Nutri-Kote plus Apron were established at 90.8 g/plot, 136.2 g/plot, and 181.6 g/plot. Each seed treatment and seeding rate received either no additional fertilizer or a starter fertilizer at the time of seeding. The starter fertilizer was applied at a rate of 0.5 lb N/1000 ft^2 (urea) and 2 lb phosphorus (P)/1000 ft^2 (triple super phosphate). On May 30, all plots received 0.75 lb N/1000 ft^2 nitrogen (urea).

Data collected included percent cover on May 16, 18, 21, 26, 30, June 6, and November 10, 1989, visual quality on June 6, 11, and November 10, 1989, and height on June 9, 1989.

Percent cover was determined by visual observations of the plots. Each plot was sectioned into four quadrants. Percent cover was determined for each area and the data for each were combined. Visual quality was based on a scale of 1 to 9. A rating of 1 is equal to straw-brown turfgrass, whereas a rating of 9 is equal to a dark-green, dense turfgrass stand. A rating of 6 was the minimum acceptable quality level. Plant height was measured in six locations within each plot and the combined average was used.

The seed coating alone did not have an effect on any of the growth parameters (Figure 1). By the June 10 rating there were no differences between either treated or nontreated seeds.

The 8 lb seeding rate provided quicker plant coverage (Figure 2). However by November, this difference no longer existed.

There was no effect of starter fertilizer on percent cover (Figure 3), but it produced a positive effect on the visual quality and height of plants.

There was a combined effect of starter fertilizer and treated seed (Table 9). Starter fertilizer in combination with the 8 lb seeding rate and treated seed enhanced plant density. These plots had significantly higher percent cover ratings.

In summary, the addition of fertilizer to the seed enhanced plant coverage when combined with starter fertilizer at the 8 lb seeding rate. While the seed coating doubles the weight of the seed and thereby makes it easier to apply with a broadcast spreader, the turfgrass manager needs to consider whether the minor increase in establishment outweighs the additional cost of seed coating.

Table 9. The effects of seed treatment, starter fertilizer, and seeding rate on the establishment of Rebel II tall fescue.

	Treated seed						Non-Treated Seed						LSD (0.05)[a]				
	4 lb		6 lb		8 lb		4 lb		6 lb		8 lb						
	Start	None	Start	None	Start	None	Start	None	Start	None	Start	None	Rate	Treat	Start	TR*ST	RT*TR*ST
	Density (% Cover)																
5/16	10	5	10	12	8	10	13	17	12	18	15	17	NS	*	NS	NS	NS
5/18	26	13	30	32	43	25	30	38	28	40	38	42	NS	NS	NS	*	*
5/21	30	42	50	43	60	35	43	48	47	47	62	60	NS	NS	NS	*	NS
5/26	55	52	63	65	78	58	53	60	58	55	73	67	*	NS	NS	**	**
5/30	63	60	63	73	80	70	72	70	73	67	85	82	*	NS	NS	NS	*
6/06	73	57	72	72	80	72	72	65	73	67	82	78	*	NS	NS	NS	NS
11/10	88	88	90	91	93	92	91	91	91	90	90	93	NS	NS	NS	NS	NS
	Quality (1-9)[b]																
6/06	7.0	5.3	7.0	5.3	8.3	5.7	7.0	5.7	7.0	5.0	7.7	5.0	*	NS	*	NS	NS
6/11	8.0	6.3	7.0	7.0	8.3	7.7	8.0	6.0	8.3	7.0	8.0	6.7	NS	NS	*	NS	NS
11/10	6.7	6.7	6.3	6.3	6.3	6.7	6.3	6.7	7.0	6.3	6.0	6.0	NS	NS	NS	NS	NS
	Height (mm)																
6/09	93.8	65.4	93.3	72.5	96.7	81.7	88.8	72.1	117.5	72.9	108.4	78.3	NS	NS	**	NS	NS

a Significant levels: * = 0.05 level and ** = 0.10 level.

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

Figure 1. Seed treatment effects on stand density.

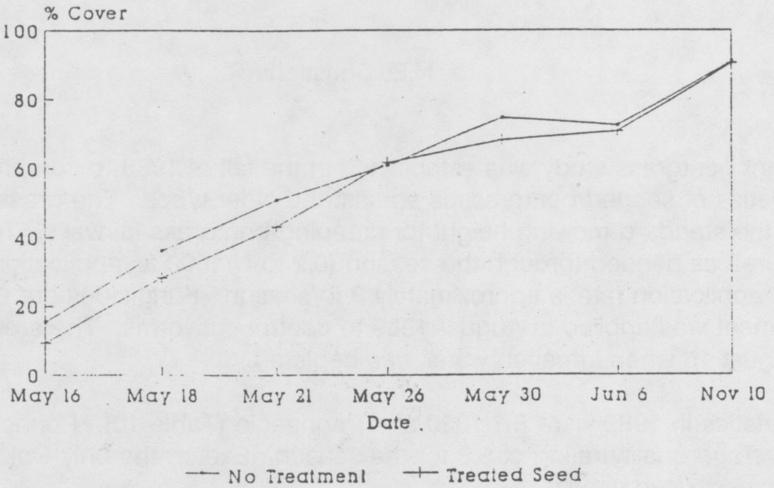


Figure 2. Seeding rate effects on stand density.

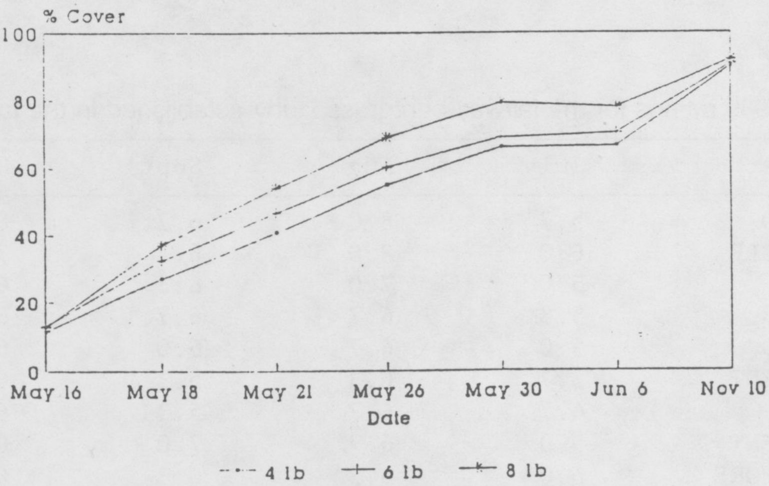
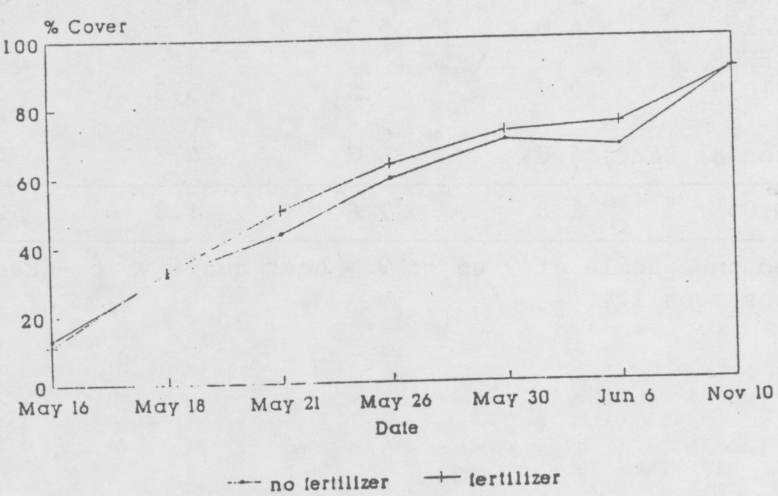


Figure 3. Starter fertilizer effect on stand density.



1989 -- Fairway Height Bentgrass Study

N.E. Christians

The fairway height bentgrass study was established in the fall of 1988 to compare the response of several new varieties of seeded bentgrasses against the older types. The grass was kept at an 0.5 in mowing height, the standard mowing height for creeping bentgrass fairways. The area receives liquid applications of urea as needed through 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 are used as needed. One insecticide treatment was applied in August 1989 to control cutworms. The area was irrigated as needed until August 15 when irrigation water was depleted.

The best two varieties in 1989 were SR 1020 and Penneagle (Table 10). Penncross maintained an unacceptable average quality rating of 5.8 for the season. Exeter, the only Colonial bentgrass in the study, was the lowest rated variety.

This is a new study and rankings are likely to change in future years.

Table 10. The 1989 ratings for the fairway bentgrass study established in the fall of 1988.

	Cultivar	July	Aug	Sept	Oct	Mean
1.	SR 1020	5.7	8.0	6.7	8.0	7.1
2.	PENNEAGLE	6.0	8.0	6.7	7.0	6.9
3.	COBRA	5.0	7.0	6.3	6.3	6.3
4.	ISI 123	5.3	6.7	6.7	6.3	6.2
5.	EMERALD	5.0	6.7	6.0	6.3	6.2
6.	PROMINENT	5.7	6.3	5.3	6.0	6.0
7.	PUTTER	4.7	6.7	5.3	6.7	5.9
8.	J.H. BENT	5.0	6.7	7.0	6.0	5.8
9.	SOUTHSHORE	5.0	6.3	6.3	6.0	5.8
10.	PENNCROSS	5.0	6.3	6.0	5.7	5.8
11.	ISI 124	4.0	5.7	5.7	6.7	5.5
12.	CARMEN	3.7	6.0	6.0	5.7	5.3
13.	PENNLINKS	2.7	5.3	5.3	5.3	5.0
14.	NATIONAL	4.0	5.3	4.3	5.0	4.7
15.	PROVIDENCE (SR 1019)	2.7	5.3	5.3	5.3	4.7
16.	EXETER (Colonial Bent)	4.0	4.7	4.3	4.3	4.3
	LSD 0.05	1.8	1.6	1.8	2.0	1.5

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

1989 – Fairway Height Kentucky Bluegrass Trial

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 in to test the cultivars under conditions similar to a Kentucky bluegrass fairway.

The study will be irrigated as needed and fertilized at a rate of 4 lb N/1000 ft^2/yr in the future. In 1989, the lack of irrigation water at the research station resulted in the area being maintained in a nonirrigated condition. No July data were collected because of uniform dormancy on the study area.

Surprisingly, two older varieties, Wabash and Merion, were the best performers in 1989 (Table 11). It was also surprising that Adelphi, a variety known for its tolerance of low mowing heights, was the lowest rated cultivar. These unusual responses were likely due to the lack of irrigation water and the severe stress of the 1988 and 1989 seasons. The data is of interest, however, because of the fact that many of the Kentucky bluegrass fairways on Iowa courses are not irrigated. The study will be irrigated as necessary when irrigation water is available in future years.

Table 11. The 1989 quality ratings for the fairway height Kentucky bluegrass trial.

	Cultivar	May	June	Aug	Sept	Oct	Mean
1.	WABASH	7.3	6.3	5.3	8.0	7.0	6.8
2.	MERION	7.3	6.7	5.7	7.0	6.3	6.6
3.	(WTN) H-7	8.3	7.3	4.7	6.3	6.3	6.6
4.	A-20	7.3	6.7	4.7	7.0	6.7	6.5
5.	FANFARE	7.0	6.3	5.0	7.3	6.7	6.5
6.	ASPEN	7.3	6.3	5.3	6.7	6.0	6.3
7.	BARBIE	7.3	6.7	4.3	6.7	6.3	6.3
8.	PLUSH	6.7	7.0	5.0	6.3	6.3	6.3
9.	VICTA	7.3	6.7	5.0	6.7	6.0	6.3
10.	GLADE	7.0	6.3	4.3	7.0	6.7	6.3
11.	(WTN) I-13	6.7	7.0	4.3	6.7	6.7	6.3
12.	PARK	7.3	6.3	5.0	6.3	6.0	6.2
13.	SYDSPORT	6.3	6.3	5.3	6.7	5.7	6.1
14.	SENIC	7.3	6.0	5.3	6.3	5.3	6.1
15.	TOUCHDOWN	7.3	6.3	4.3	6.0	6.7	6.1
16.	N-535	7.3	6.7	4.3	6.0	6.3	6.1
17.	BONNIEBLUE	7.7	6.7	4.3	6.0	5.7	6.1
18.	K3-160	7.3	6.3	4.3	6.0	6.0	6.0
19.	TRENTON	7.3	6.7	4.3	6.0	5.7	6.0
20.	PARADE	7.3	6.7	4.0	5.7	6.0	5.9
21.	CHERI	7.0	6.3	4.7	6.0	5.7	5.9
22.	COLUMBIA	7.3	7.0	4.0	5.7	5.3	5.9
23.	P-164-B	7.0	6.3	4.3	6.0	5.7	5.9
24.	K76-86-4	7.0	5.7	4.0	6.7	6.0	5.9
25.	COMMON	6.3	6.3	4.3	6.3	5.7	5.8
26.	BRISTOL	6.7	6.0	3.7	6.7	6.0	5.8
27.	RUGBY	6.3	6.3	4.7	6.0	5.7	5.8
28.	AMERICA	6.7	6.3	4.0	6.0	5.7	5.7
29.	BFB-35	7.3	7.0	3.7	5.3	5.3	5.7
30.	PENNSTAR	6.3	5.7	4.7	6.3	5.7	5.7
31.	VANTAGE	6.7	6.0	4.0	6.0	6.0	5.7
32.	ENMUNDI	6.7	6.0	4.0	6.0	5.7	5.7
33.	SV O 1617	6.0	5.7	4.7	6.7	5.7	5.7
34.	RAM-I	7.0	6.7	4.0	5.3	5.0	5.6
35.	ARISTA	6.3	6.0	4.0	6.0	5.7	5.6
36.	FYLKING	6.7	6.3	4.3	5.3	5.3	5.6
37.	MAJESTIC	6.7	5.7	4.7	5.7	5.3	5.6
38.	(WTN) A-34	7.0	6.3	3.7	5.3	5.0	5.5
39.	SVING	6.7	6.7	3.7	5.3	5.0	5.5
40.	KIMONO	7.0	6.3	3.7	5.7	5.0	5.5
41.	NUGGET	6.7	6.3	3.7	5.0	5.7	5.5
42.	MIDNIGHT	6.3	6.3	3.0	6.0	5.7	5.5
43	BARON	6.3	5.7	4.0	5.7	5.7	5.5
44.	BIRKA	6.3	6.0	4.3	5.7	5.3	5.5
45.	MERIT	6.0	5.7	4.3	6.0	5.3	5.5
46.	A-20-6	6.3	6.0	3.7	5.7	5.3	5.4
47.	AQUILLA	6.3	5.7	4.0	6.0	5.0	5.4
48.	ESCORT	6.7	6.3	3.3	5.7	5.0	5.4
49.	ADELPHI	5.7	4.7	3.7	6.0	5.7	5.1
	LSD 0.05	1.4	1.2	1.1	1.4	1.4	0.9

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

1989 – Ornamental Grass Study

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. The purpose of the study is to investigate the suitability of 11 species of ornamental grass to the Iowa climate. It is expected that the trial will run for five to eight years. The 11 species in the trial are blue stem (*Andropogon*), feather grass (*Stipa*), fountain grass (*Pennisetum*), hair grass (*Deschampsia*), moor grass (*Molinea*), northern sea oats (*Chasmanthium*), reed grass (*Calamagrostis*), ribbon grass (*Phalaris*), silver grass (*Miscanthus*), switch grass (*Panicum*), and wild rye (*Elymus*). A total of 34 cultivars of these 11 species, two plants of each cultivar, were planted in mid-September of 1989. The grass plants were supplied at a substantial discount by the Kurt Blumel Nursery, Maryland, a premier ornamental grass nursery in the U.S.

The area chosen for the study is on the west side of the turfgrass maintenance building. Sixty-eight plots measuring 4 ft by 5 ft were placed in a bow-shaped bed measuring 270 ft by 5 ft (Figure 4). 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, with the two plants of each cultivar planted on the right and left of the center grass plot. Each plot is of sufficient size to allow adequate growth of the grasses, and to enable them to grow without competition. The plants were well watered at establishment and were watered regularly until freezing. Data on survivability were taken when growth began in the spring of 1990.

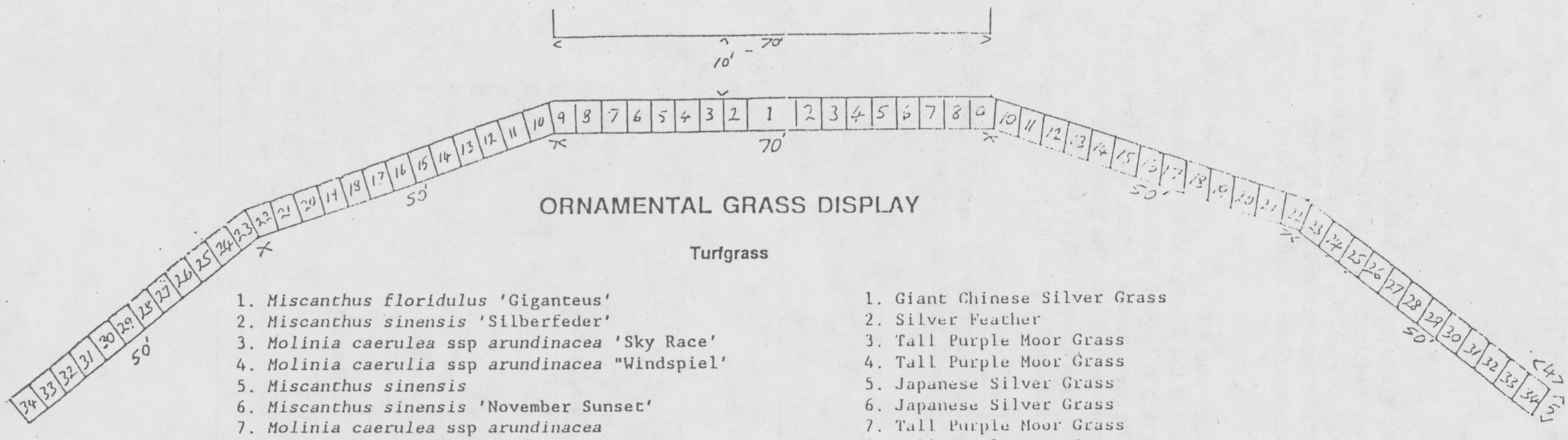
By June 1, the following grasses were showing 100% survival, and were in active growth (Table 12). The remaining grasses exhibited 50% or 100% death loss the first winter. Further studies will be needed on these grasses to determine their suitability for Iowa. These results are very preliminary, and several more years will be required before a definitive plant list can be determined.

Table 12. Survival rate of ornamental grass study -- 1989.

Common / Botanical Name	100 percent survival	50 percent kill	100 percent kill
1. Giant Chinese Silver Grass *Miscanthus floridulus* 'Giganteus'			X
2. Silver Feather *Miscanthus sinensis* 'Silberfeder'		X	
3. Tall Purple Moor Grass *Molinia caerulea* ssp *arundinacea* 'Sky Race'	X		
4. Tall Purple Moor Grass *Molinia caerulia* ssp *arundinacea* 'Windspiel'	X		
5. Japanese Silver Grass *Miscanthus sinensis*			X
6. Japanese Silver Grass *Miscanthus sinensis* 'November Sunset'		X	
7. Tall Purple Moor Grass *Molinia caerulea* ssp *arundinacea*	X		
8. Tall Purple Moor Grass *Molinia caerulea* ssp *arundinacea* 'Staefa'	X		

Table 12. Survival rate of ornamental grass study -- 1989. (continued)

Common / Botanical name	100 percent survival	50 percent kill	100 percent kill
9. Switch Grass *Panicum virgatum*		X	
10. Feather Reed Grass *Calamagrostis acutiflora stricta*	X		
11. Mountain's Friend *Molinea caerulea* ssp *arundinacea* 'Bergfreund'	X		
12. Karl Foerster's Feather Reed *Calamagrostis arundinacea* 'Karl Foerster'	X		
13. Tall Purple Moor Grass *Molinia caerulea* ssp *arundinacea* 'Transparent'	X		
14. Big Blue Stem *Andropogon gerardi*	X		
15. Scottish Tufted Hair Grass *Deschampsia caespitosa* 'Schottland'	X		
16. Variegated Maiden Grass *Miscanthus sinensis* 'Morning Light'			X
17. Giant Feather Grass *Stipa gigantea*			X
18. Giant Blue Wild Rye Grass *Elymus giganteus* 'Vahl Glaucus'	X		
19. Small Japanese Silver Grass *Miscanthus oligostachys*			X
20. Red Switch Grass *Panicum virgatum* 'Haense Herms'	X		
21. Red Switch Grass *Panicum virgatum* 'Rehbrun'	X		
22. Red Switch Grass *Panicum virgatum* Rotstrahlbusch'		X	
23. Fountain Grass *Pennisetum alopecuroides*			X
24. Feather Grass *Stipa capillata*	X		
25. Northern Sea Oats *Chasmanthium latifolium*			X
26. Tufted Hair Grass *Deschampsia caespitosa* 'Bronzeschleier'	X		
27. Tufted Hair Grass *Deschampsia caespitosa* 'Goldgehaenge'	X		
28. Tufted hair Grass *Deschampsia caespitosa* 'Tautraeger'	X		
29. Late Blooming Tufted Hair Grass *Deschampsia caespitosa tardiflora*	X		
30. Tufted Hair Grass *Deschampsia caespitosa* 'Goldstaub'	X		
31. Blue Wild Rye *Elymus glaucus*	X		
32. Purple Moor Grass *Molinia caerulea*	X		
33. Sorceress of the Bog *Molinia caerulea* 'Moorhexe'		X	
34. Golden Variegated Ribbon Grass *Phalaris arundinacea luteo-picta*	X		



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 4

1989 – Ornamental Grass Field Trial

R.G. Roe and N. Agnew

This trial is being conducted at the Iowa State University Horticulture Research Station near Ames, Iowa. The trial is being conducted on a Nicolett (fine-loamy, mixed mesic, Aquic Hapludoll) soil with a pH of 6.9 and 2.3% organic matter. A complete fertilizer, 5-10-5 (N-P_2O_5-K_2) was applied at the rate of 2 lb/100 ft^2 before tilling. The trial has 15 ornamental grasses in a field nursery planting with a total of 225 plants. The purpose of this trial is to investigate the suitability of these species of ornamental grass to the Iowa climate (Table 13).

These grasses were started from seed in the greenhouse, potted into 4 in pots in June and allowed to develop in the greenhouse. They were moved in July to shade at the ISU Horticulture Research Station near Ames and allowed to harden-off before transplanting in August. The experimental design was a randomized, complete-block with three replications. The rows were 4 ft apart, with plants 12 in apart within the row. Five plants of each grass were planted per replication. The grasses received irrigation for the remainder of the growing season. The grasses were evaluated on May 30 to determine survivability. These data were then analyzed statistically and the results are presented in Table 13.

Further studies will be needed on these grasses to determine their suitability for Iowa. These results are very preliminary, and several more years will be required before a definitive plant list can be determined.

Table 13. Survival rate of ornamental grass field trial - 1989.

Common name	Botanical name	Percent alive on May 30
1 Fountain Grass	*Pennisetum alopecuroides*	0.0
2 June Grass	*Koeleria cristata*	100.0
3 Hairy Mellic	*Melica ciliata*	86.6
4 Wild Canadian Rye	*Elymus canadensis*	100.0
5 Switch Grass	*Panicum virgatum*	100.0
6 Prairie Dropseed	*Sporobolus heterolepis*	80.0
7 Indian Grass	*Sorghastrum nutans*	86.6
8 Pampas Grass	*Cortaderia selloana*	0.0
9 Blue Fescue	*Festuca ovina 'Glauca'*	86.6
10 Big Blue Stem	*Andropogon gerardi*	73.3
11 Feather Top Fountain Grass	*Pennisetum villosum*	0.0
12 Sand Hills Big Blue Stem	*Andropogon hallii*	40.0
13 Little Blue Stem	*Andropogon scoparius*	93.3
14 Bottle Brush Grass	*Hystrix patula*	100.0
15 Quaking Grass	*Briza media*	100.0
LSD 0.05		16.49

1989 – Ornamental Grass Container Overwintering Trial

R.G. Roe and N. Agnew

This trial has 17 species of ornamental grass in 1 gal containers, with a total of 255 plants (Table 14). The purpose of the trial is to determine the survivability of grasses in containers during the winter. The method of protection chosen was a low-cost system using protective mats of plastic and straw.

These grasses were started from seed in the greenhouse, potted into 4 in pots in June, and allowed to develop in the greenhouse. They were repotted into 1 gal containers in July and moved to shade at the Iowa State University Horticulture Research Station, to harden-off before being placed on nursery beds under irrigation in August. The pots were moved to the over-wintering area and covered in October before a killing frost. The experimental design was a randomized, complete-block with three replications. Five plants of each grass were planted per replication. The three replications were covered as one block, 15 pots deep and 18 pots wide, 15 pots filled with soil completed the block. The grasses received irrigation and were sprayed with a fungicide. Rodenticide pellets were placed among the grasses before covering with plastic, straw, and a top sheet of plastic. The grasses were uncovered in April 1990, when it was considered unlikely that a severe cold spell would return. Insufficient equipment prevented the recording of temperatures under the cover. Data collected from a similar trial, protected by the same method, showed the following temperatures: in December a minimum air temperature of -29.07°C resulted in a crown temperature of -6.12°C and a soil temperature of -4.08°C; in January a maximum air temperature of 16.25°C resulted in a crown temperature of 5.75°C and a soil temperature of 5.45°C. The grasses were evaluated on May 30 to determine survivability. These data were then analyzed statistically and are presented in Table 14.

Further studies will be needed on these grasses to determine their suitability for Iowa. These results are very preliminary, and several more years will be required before a definitive plant list can be determined.

Table 14. Survival rate of ornamental grass container overwintering trial - 1989.

	Common name	Botanical name	Percent alive
1	Fountain Grass	*Pennisetum alopecuroides*	0.0
2	June Grass	*Koeleria cristata*	100.0
3	Hairy Mellic	*Melica ciliata*	100.0
4	Canada Wild Rye	*Elymus canadansis*	100.0
5	Switch Grass	*Panicum virgatum*	100.0
6	Prairie Dropseed	*Sporobolus heterolepis*	93.3
7	Indian Grass	*Sorghastrum nutans*	93.3
8	Pampas Grass	*Cortaderia selloana*	0.0
9	Blue Fescue	*Festuca ovina 'Glauca'*	100.0
10	Big Blue Stem	*Andropogon gerardi*	93.3
11	Feather Top Fountain Grass	*Pennisetum villosum*	0.0
12	Sand Hills Big Blue Stem	*Andropogon hallii*	93.3
13	Mosquito Grass	*Bouteloua gracilis*	86.6
14	Little Blue Stem	*Andropogon scoparius*	100.0
15	Bottle Brush Grass	*Hystrix patula*	100.0
16	Viviparous Hair Grass	*Deschampsia vivipara*	100.0
17	Quaking Grass	*Briza media*	100.0
	LSD 0.05		10.08

Observations on the Droughts of 1988 and 1989

N.E. Christians

The following articles titled *The Drought of 1988* and *Fertilizer and Herbicide Applications on Dormant Kentucky Bluegrass Lawns* are a summary of observations concerning the droughts of 1988 and 1989 as they related to the professional lawn care industry. The first was originally published in *Lawn Servicing Magazine*, October 1988. The second article appeared in *Lawn Care Industry*, October 1988.

The Drought of 1988

Reprinted from *Lawn Servicing Magazine*, October 1988

The growing season is nearly over, but memories of the great drought of 1988 will remain for years to come. Through much of the United States, the driest and hottest conditions in memory reduced crop yields and damaged lawns and other plants in the landscape. In parts of the central states, the drought exceeded anything since records were first kept in the 1870s.

Although most of the publicity centered on production agriculture, other segments of the economy were also affected. The professional lawn care industry was particularly hard hit, with many companies reporting significant losses due to customer cancellations and suspension of treatments during the dry summer months.

At the universities it was a busy season. Calls about the drought and its affects from newspapers, radio and television stations, homeowners, and lawn care specialists were common. Among the most often asked of these questions were:

1. Do Kentucky bluegrass lawns need to be watered to survive?
2. How long can a lawn go without water and still be expected to recover?
3. Should lawn care treatment be applied to dormant lawns during stress periods?
4. What effect is this year's drought going to have on lawns next season?

Each question will be dealt with separately.

DO KENTUCKY BLUEGRASS LAWNS NEED TO BE WATERED TO SURVIVE?

If a Kentucky bluegrass lawn **can be** watered, it **should be** watered. That does not mean that a lawn will necessarily die if it is not irrigated, but extended droughts will thin turf and may allow more drought tolerant perennial weeds such as quackgrass to expand and eventually take over the area. Summer germinating annuals like spurge and *Oxalis* are also a bigger problem in drought stressed lawns. It makes sense for those who care enough about their lawns to hire professionals to care for them to go that extra step and keep the area green during drought periods.

However, there are cases where customers simply refuse to water because of the cost, or are unable to water because of restrictions placed on lawn irrigation by municipal water commissions. Customers should understand there are right ways and wrong ways to treat turf in these situations.

Kentucky bluegrass has an incredible ability to survive drought. It can turn brown and the leaves can die, but buds on the crowns and rhizomes will remain alive for extended periods and the lawn will usually recover when temperatures cool and moisture is again available for growth. This process of going into and coming out of dormancy is hard on the plant, however. Each time the plant emerges from summer dormancy, stored carbohydrates needed by the plant for stress survival are consumed. These carbohydrates are replenished by photosynthesis, but if the plant is allowed to go back into dormancy before replacement is complete, the plant is weakened and the likelihood of recovery the next time is reduced. The customer should be warned against watering in such a way as to bring the lawn out of dormancy only to let it go back into dormancy before it has had a chance to completely recover. If the lawn is to be watered enough to turn it green, it should be maintained in that condition as long as possible.

A second practice to warn the customer against is that of taking the lawn into an environmentally stressful situation in midsummer in a lush, green condition and then abruptly stopping irrigation. Unfortunately, this is a common problem usually due to the shock of midsummer water bills. A lawn should be allowed to **'harden off'** slowly if it is to be allowed to go into dormancy, or damage can easily occur. Those in charge of municipal watering systems should also be made aware of this problem so that if water restrictions become necessary in midsummer, they can be phased in slowly to allow homeowners time to cut back on irrigation gradually.

There is some controversy among experts as to whether a dormant lawn should be watered at all during extended droughts if complete watering is not possible. Some say not to water to avoid the risk of bringing buds out of dormancy and thereby weakening the turf by depleting carbohydrates. There are also those who recommend applying as much as 1 in of water every two weeks. Research on this subject is limited and most who have worked in these area cite unpublished research as the source of their information. It is my personal opinion, based on my own observations and on discussions with several experts on the subject, that some light watering is advisable during extended dormancy periods. It is apparent that Kentucky bluegrass buds can dehydrate and die if the area remains dry long enough. However, precautions should be taken that the lawn is not watered so much that it breaks dormancy. The amount of water to apply is a judgement call that must be based on a variety of factors. In most cases, on midwestern bluegrass lawns, from 1/4 to 1/2 in of water every two weeks should be sufficient to keep buds hydrated.

IF THE LAWN IS NOT WATERED, HOW LONG CAN IT BE EXPECTED TO SURVIVE?

This sounds like a simple question that should have a simple answer, but it is not. The problem is that the answer depends on so many variables. For instance, soil type can have a major impact on how long a lawn can remain dormant and still recover. Turf grown on sandy sites will often show much greater damage following an extended drought than similar lawns on clay-loam soils that have been dry for the same length of time.

The many cultivars of Kentucky bluegrass also vary considerably in their ability to recover from extended droughts. Research at Iowa State University by graduate student Michael Burt has shown that the older 'common' types of Kentucky bluegrass such as Kenblue and S.D. Common growing under low-maintenance conditions will recover much more readily from extended dormancy periods than will many of the new 'improved' types. This observation makes a lot of sense when it is considered that the common types were selected at a time when the intensity of culture was relatively low. The improved types were generally selected under more intensive management regimes.

Nitrogen (N) fertilization rates, particularly spring applications, can have a major effect on recovery from drought as do the mowing height and irrigation practices before the drought period. To severely damage a Kentucky bluegrass lawn in a hot dry year, simply fertilize heavily with a water soluble N source in the spring, water the area to keep it lush and green, then on a 100°F day in July, scalp the lawn to a 1 in mowing height, and stop watering. I have observed Kentucky bluegrass lawns in Iowa so severely damaged by this type of abuse that they had to be completely reestablished in the fall.

There is no one answer to the above question. However, based on my experience and on discussions with others who have professionally worked with turf for as long as 40 years, Kentucky bluegrass that has been properly managed can be expected to survive at least eight weeks of dormancy without serious damage.

SHOULD LAWN CARE TREATMENTS BE APPLIED TO DORMANT LAWNS DURING STRESS TREATMENTS?

This was one of the most often asked questions in the months of June and July 1988, by both lawn care professionals and customers. Many customers have the idea that lawn care treatments applied to dormant lawns will cause severe damage or provide no benefit. Lawn care specialists disagree and would prefer to complete all their rounds, even if lawns are not being irrigated. There is surprisingly little information on the harm or benefit of these treatments.

On July 7, 1988, a demonstration area was established at the Iowa State University Research Station turfgrass plots with the cooperation of All American Turf Beauty, a central Iowa lawn care company. A standard second round program applied at 3 gal material/1000 ft^2 to deliver 0.52 lb N from methylene urea (Powder Blue)/1000 ft^2, .42 lb N/1000 ft^2 from urea, 1.2 lb Pendimethalin (Pre-M 60 DG)/A, and 1.5 qt Mec-Amine-D / A, was applied at 1X, 2X, 4X, 6X, and 10X rates with an untreated control area to a Park Kentucky bluegrass turf that had been dormant for several weeks. At the 10X rate, 9.5 total lb of N was applied/1000 ft^2 along with 10X the standard rate of both herbicides. Plot areas measured 10 ft by 10 ft. The air temperature was 99°F at the time of treatment. The materials were not watered in and they remained on the turf for approximately seven days at a time when temperatures ranged from the upper 90s to the lower 100s. One week after treatment, the area was irrigated and kept moist until it had completely recovered from dormancy.

It had been anticipated that the high rates would show some damage, but very little damage was observed even at the 10X rates. The 1X, 2X, and 4X treatments were clearly better than the control after the area had recovered from dormancy.

This doesn't mean that high treatment rates are recommended on dormant turf in midsummer, but it does demonstrate that the practice is unlikely to be the cause of lawn damage and that reasonable treatments can have a beneficial effect.

WHAT EFFECT WILL THE 1988 DROUGHT HAVE ON LAWNS IN THE 1989 SEASON?

There will unquestionably be some thinning of Kentucky bluegrass lawns in areas where the drought was severe and there will likely be many areas that will need to be reseeded this fall. Kentucky bluegrass, though, has an incredible ability to recover from drought. If rainfall levels return to normal in the fall of 1988 and the spring of 1989, the extent of recovery, even on areas that appeared to be severely damaged, will be surprising. Late summer and fall applications of N and broadleaf herbicides will be an important part of this recovery process and customers who canceled during the drought should be made aware of this fact through advertising and press releases.

The biggest cause of concern will be if there is a reoccurrence of the drought in 1989. Drought effects on Kentucky bluegrass lawns can be cumulative. Those who lived through the droughts of the 1930s tell us that the problems that developed on golf courses and other turf areas in those years were not so much the result of any single drought year as they were the result of successive droughts that prevented the turf from completely recovering. Kentucky bluegrass lawns that will be particular problems are those containing perennial weeds like quackgrass, bromegrass, and tall fescue. These perennial weeds tend to gradually take over bluegrass turf in dry weather. If the fall and spring are dry, the lawn should be watered if at all possible. The turf will benefit more from sufficient moisture during these cool periods than during any other time of the year. Waiting until next summer to irrigate thinned lawns would be an expensive mistake.

Fertilizer and Herbicide Applications on Dormant Kentucky Bluegrass Lawns

Reprinted from *Lawn Care Industry*, October 1988

During the 1988 season, the midwest suffered one of the worst droughts in memory. In areas where nonirrigated Kentucky bluegrass generally spends short periods in summer dormancy, lawns went into dormancy in May and remained brown until late August. The drought presented serious problems for lawn care specialists. Customers who normally received four or five treatments per season were canceling second and third rounds, cutting deeply into lawn care profits.

A question that was often raised during the drought concerned the effect of lawn care treatments on dormant lawns. Lawn care operators understandably wanted to make treatments during this period to maintain cash flow. Customers were hesitant to accept treatment during dormancy and many expressed the opinion that these treatments would be the cause of turf damage.

To determine the effect of fertilizer and herbicide treatments on dormant Kentucky bluegrass turf, a demonstration, and a replicated research trial were established at the Iowa State University Horticulture Research Station during the summer of 1988. The demonstration trial was established on July 8, 1988, with the help of All American Turf Beauty of Winterset, Iowa. The treatments involved the company's standard second round application which included 0.52 lb of N from methylene urea (Powder Blue)/1000 ft^2, 0.42 lb N/1000 ft^2 from urea, 1.2 lb Pendimethalin (Pre-M 60 DG)/A, and 1.5 qt of Mec-Amine-D / A applied with water in a total volume of 3 gal/1000 ft^2. This treatment was applied to 10 ft by 10 ft plots of dormant Park Kentucky bluegrass at a single application (1X), two (2X), four (4X), six (6X), and ten (10X) times the single application rate. An untreated control was also included. The treatments were allowed to remain on the surface of the turf for seven days at temperatures in the upper 90s and lower 100s. The area was then watered to bring it out of dormancy. The fertilizer and herbicide treatments did not significantly damage the turf. Even at the 10X rate, which was chosen as an excessively high rate that would be expected to do significant turf damage, there was only minor thinning. Turf treated with the 1X and 2X rates emerged from dormancy in better condition than the untreated control. A more complete description of this trial was published in the October 1988 issue of *Lawn Servicing* magazine.

In the replicated trial, which was established on an adjacent area of dormant Ram-I Kentucky bluegrass on July 8, 1988, the treatments listed in Table 15 were applied in three replications. This area was treated in the same way as the demonstration trial. When the Ram-I emerged from dormancy, no detrimental effects were observed on any of the treated plots. The quality of the turf on treated plots did not exceed that of the untreated control in this study.

The results of these two studies indicated that fertilizer and herbicide treatments on dormant lawns were unlikely to cause damage to the turf and may even be beneficial as the turf emerges from dormancy. As is usually the case in research, however, more questions were raised than were answered. What would the effect of these treatments be on irrigated turf? Would the beneficial effects of the lower application rates observed in the demonstration trial occur on turf that has been dormant for a shorter period of time? Could the results be duplicated in more extensive trials?

On July 13, 1989, at the Iowa State University Turfgrass Research Field Day, another more extensive trial was established to observe the effects of summer lawn care treatments on both irrigated and nonirrigated Kentucky bluegrass. All American Turf Beauty again supplied the equipment and materials. The single application treatment included 0.95 lb N/1000 ft^2 (0.54 lb N from Powder Blue and 0.41 lb N from urea), 3 pt Mec-Amine-D/A, 1.3 lb Pendimethalin/A, 0.15 lb K/Z (K_2SO_4), and 1.7 oz chelate/1000 ft^2. As before, the treatment was applied in 3 gal total solution/1000 ft^2. The treatments, which were replicated three times, included a control (no treatment), 1X, 2X, 4X, and 8X. The study was established on a dormant Vantage Kentucky bluegrass and in an adjacent area on an irrigated, 4-cultivar blend of Kentucky bluegrass.

As would be expected, the excessively high treatments burned the irrigated turf, although the effects of the highest treatments were not as serious as might be expected given the high rates of fertilizer and herbicides applied at these rates. By the fifteenth day after treatment, most of the visible damage had subsided and the grass had begun to respond to the N. The nonirrigated area remained dormant through July and most of August. At no time did any of the treatments have any visible detrimental effect on any of the treated plots. As the area began to emerge from dormancy following rains in August, it became apparent that the grass was benefiting from the N on the treated areas.

I am by no means advocating the use of any of these fertilizer or herbicides at rates above those included in the 1X treatment. The higher rates were included **only** to determine the margin of safety that exists when these products are used. All of the work conducted in the last two years on dormant Kentucky bluegrass indicates there is a significant margin of safety, and that there is no reason to believe that standard lawn care treatments on dormant turf will damage the lawn. There is also evidence that the turf will benefit from the treatment when it emerges from dormancy.

Are treatments on dormant turf agronomically necessary? The answer to that question is clearly no. Waiting to apply fertilizer and herbicide treatments to Kentucky bluegrass at the end of the drought as it emerges from dormancy would still be the recommended procedure. But for a company that must make treatments over a several week period for a large number of customers, these applications may be an economic necessity. In that situation, there is nothing wrong with the practice.

Table 15. Fertilizer and herbicide applications on dormant Kentucky bluegrass turf in the 1988 replicated trial.

	Treatment	Rate
1.	Control	———
2.	Urea	0.5 lb N/1000 ft^2
3.	Urea	1.0 lb N/s000 ft^2
4.	Sulfur-coated Urea	0.5 lb N/1000 ft^2
5.	Urea + Pendimethalin	0.5 lb N/1000 ft^2 + 1.5 lb ai/A
6.	Urea + Dacthal 75 WP	0.5 lb N/1000 ft^2 + 10.5 lb ai/A
7.	Urea + Trimec	0.5 lb N/1000 ft^2 + 3.5 pt/A
8.	Urea + Pendimethalin + Trimec	0.5 lb N/1000 ft^2 + 1.5 lb ai/A + 3.5 pt/A

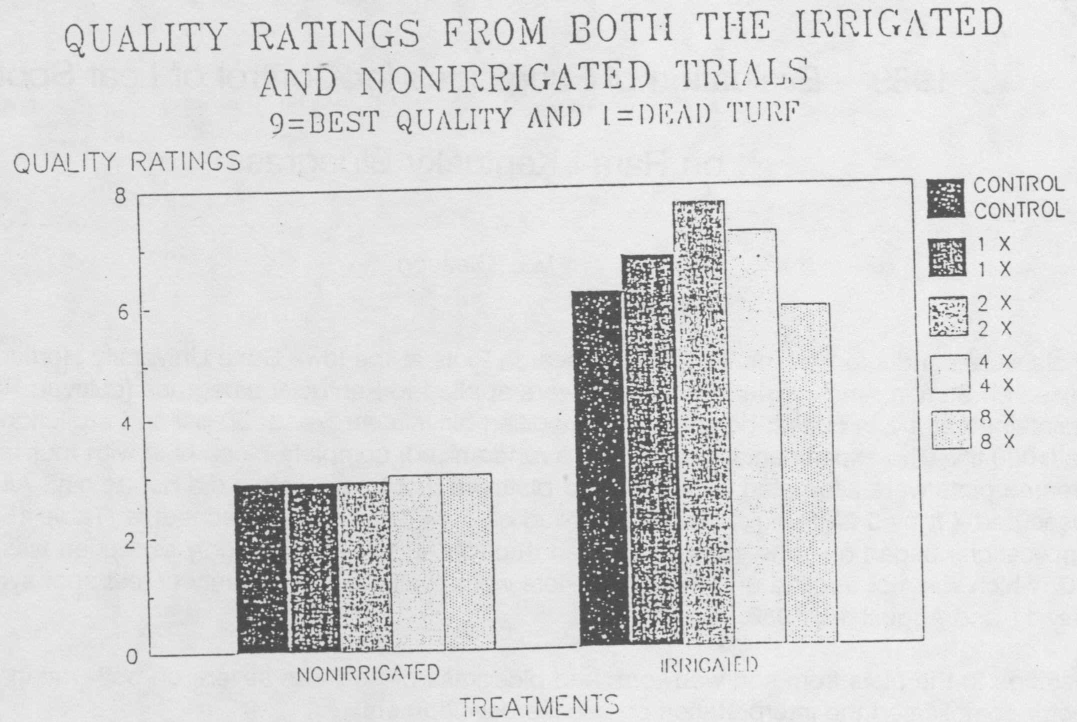


Figure 5 . Quality ratings averaged over a seven week period for the irrigated and nonirrigated studies in 1989.

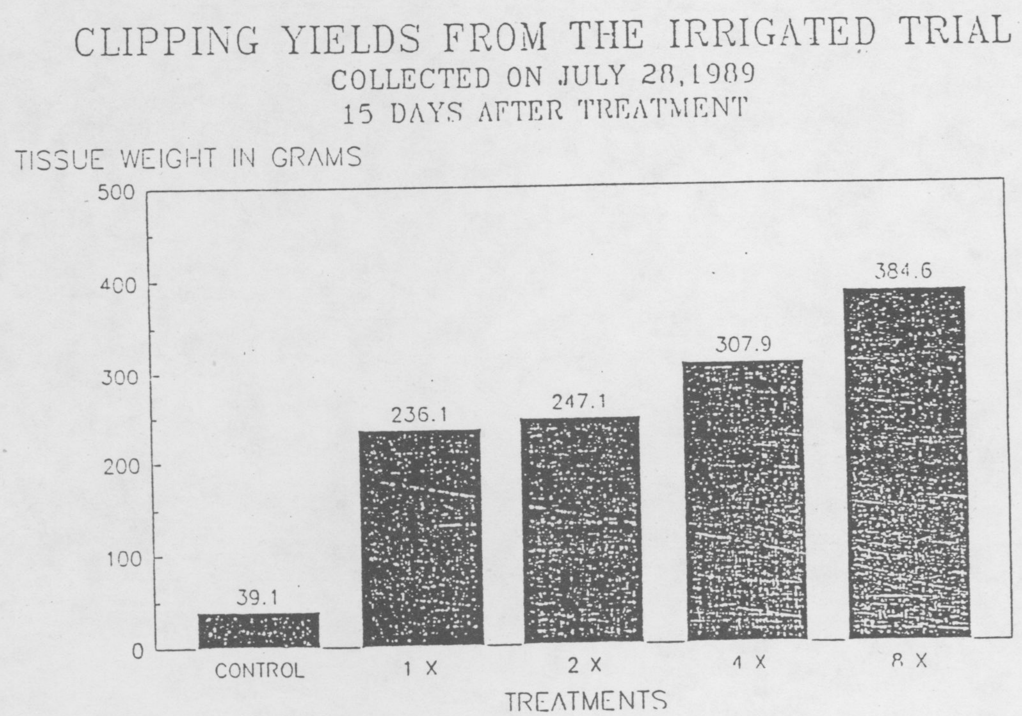


Figure 6. Clipping yields from the plots on the 1989 irrigated trial collected 15 days after treatment.

1989 -- Evaluation of Fungicides for Control of Leaf Spot on Ram-I Kentucky Bluegrass

M.L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Iowa State University Horticulture Research Station Ames, Iowa. Fungicides were applied to Kentucky bluegrass (cultivar: Ram-I), maintained at a 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. Treated plots were alternated with untreated plots, so that treated plots did not adjoin. All plots measured 4 ft by 5 ft. Fungicides were applied on a 14, 21, or 28 day schedule (Table 16). Applications began on June 1 and continued through August 10. The only exception was Bravo 90 DG, which was not applied until June 15. Plots were evaluated for severity of leaf spot symptoms on July 11 and August 10, 1989.

Damage to the plots from sod webworm and bluegrass billbug was severe on both rating dates. This factor complicated the interpretation of disease development.

Leaf spot was present at very low (trace) levels on both rating dates. No treatments had leaf spot levels significantly below the check on either rating date. No phytotoxicity symptoms were noted on either rating date.

Table 16. The 1989 evaluation of fungicides for control of leaf spot in Ram-I Kentucky bluegrass.

Company	Treatment	Rate per 1000 ft^2	Timing (days)	Disease rating[a] July 11	Disease rating[a] August 10
Control	Check	----	----	0.5 a	0.0 a
Nor-Am	Prochloraz 40 EC (CR 17217)	4.50 oz	21	0.0 a	0.3 a
Rohm and Haas	RH-3866	0.60 oz	14	0.0 a	0.3 a
Sierra	Vorlan 50 DF + Fungo 50 WP	1.00 oz/1.00 oz	21	0.5 a	0.0 a
	Vorlan 50 DF + Fungo 50 WP	2.00 oz/2.00 oz	21	0.5 a	0.0 a
	Vorlan 50 DF	2.00 oz	21	0.5 a	0.0 a
Sandoz	Cyproconazole 40 WG	0.17 oz	14	0.3 a	0.0 a
	Cyproconazole 40 WG	0.25 oz	14	0.0 a	0.3 a
	Cyproconazole 40 WG	0.25 oz	28	0.3 a	0.0 a
	Cyproconazole 40 WG	0.33 oz	28	0.8 a	0.0 a
	SAN 832 50 WG	3.00 oz	14	0.8 a	0.0 a
	SAN 832 50 WG	4.50 oz	14	0.8 a	0.0 a
Rhone-Poulenc	Chipco 26019 FLO	3.00 oz	21	0.0 a	0.3 a
	Chipco 26019 FLO	4.00 oz	21	0.5 a	0.3 a
Cleary	3336-F	4.00 oz	14	0.3 a	0.3 a
	3336-F	8.00 oz	14	0.0 a	0.3 a
Fermenta	Daconil 2787	6.00 oz	14	0.0 a	0.0 a
	Bravo 90 DG	3.50 oz	14	0.0 a	0.0 a

[a] Means of ratings from four replicate plots. Ratings were based on the following scale: 0 = no disease; 1 = trace; 2 = low disease; 3 = moderate disease; 4 = severe disease.

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

1989 -- Evaluation of Fungicides for Control of Dollar Spot on Emerald Bentgrass

M.L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Iowa State University Horticulture Research Station 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 four replications. Treated plots were alternated with untreated plots, so that treated plots did not adjoin. All plots measured 4 ft by 5 ft. Fungicides were applied on a 14, 21, or 28 day schedule (Table 17). Applications began on June 5 and continued through July 26. Plots were evaluated for severity of leaf spot symptoms on June 29, July 13, and July 26, 1989.

The entire plot was inoculated with rye grains infested with the Dollar Spot pathogen on May 30, six days before fungicide applications were begun.

Disease ratings for Dollar Spot were made by counting the number of Dollar Spot infection centers per plot. Disease began to appear on June 27. Disease pressure was moderate to severe on June 29 and severe on July 13 and 26.

All preventative treatments suppressed Dollar Spot significantly better than the check (unsprayed) treatment. 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 17. Evaluation of fungicides for control of Dollar Spot in Emerald bentgrass, 1989.

Company	Treatment	Rate per 1000 ft^2	Timing (days)	Disease rating[a] June 29	Disease rating[a] July 13	Disease rating[a] July 26
Control	Check	----	-----	60.5 ab	103.8 a	161.3 a
Nor-Am	Prochloraz 40 EC (CR 17217)	4.50 fl oz	21	0.8 e	0.3 c	0.0 d
	Prochloraz 40 EC (CR 18742)	4.50 fl oz	21	1.5 e	0.3 c	0.5 d
Ciba-Geigy	Banner 1.1 E	1.00 fl oz	21	1.0 e	1.3 c	0.0 d
Rohm & Haas	RH-3866	0.60 oz	14	0.8 e	0.0 c	0.0 d
BASF	BAS 480 00F 25 WP	0.03 lb ai/A	14[b]	43.0 bc	10.3 b	23.3 b
	BAS 480 00F 25 WP	0.06 lb ai/A	14[b]	71.5 a	9.8 b	4.5 cd
	BAS 480 00F 25 WP	0.12 lb ai/A	14[b]	31.8 cd	2.3 c	0.0 d
	BAS 480 00F 25 WP	0.03 lb ai/A	14	13.8 de	1.3 c	4.3 cd
	BAS 480 00F 25 WP	0.06 lb ai/A	14	2.5 e	0.0 c	0.0 d
	BAS 480 00F 25 WP	0.12 lb ai/A	14	1.3 e	0.0 c	0.0 d
Sierra	Vorlan 50 DF	1.00 oz	21	0.3 e	1.0 c	0.3 d
	Fungo 50 WP	1.00 oz				
	Vorlan 50 DF	2.00 oz	21	1.0 e	1.0 c	0.0 d
	Fungo 50 WP	2.00 oz				
	Vorlan 50 DF	2.00 oz	21	0.3 e	1.5 c	0.0 d
Mobay	Lynx 25 DF	0.125 oz ai	28	14.3 de	3.0 c	7.8 cd
	Lynx 25 DF	0.25 oz ai	28[b]	40.0 bc	1.8 c	14.8 bc
	Bayleton 25 T/O	0.5 oz ai	28[b]	28.5 cd	0.0 c	1.8 d
Sandoz	Cyproconazole 40 WG	0.17 oz	28	9.3 de	0.0 c	2.0 d
	Cyproconazole 40 WG	0.25 oz	28	0.8 e	0.0 c	0.0 d
	SAN 832F 50 WP	4.0 oz	28	14.8 de	0.0 c	2.5 d

[a] Means of counts of number of infection centers per plot from four replicated plots.
[b] These treatments were applied on a curative schedule (i.e., applications began after symptoms appeared).
Means followed by the same letter are not significantly different (DMRT, P = 0.05).

1989 – Evaluation of Fungicides for Control of Brown Patch on Bentgrass

M.L. Gleason

Trials were conducted on a bentgrass green at Veenker Memorial Golf Course, Iowa State University, Ames, Iowa. Fungicides were applied to bentgrass maintained at 5/32 in cutting height, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized, complete-block plan with three replications. Treated plots were alternated with untreated plots, so that no treated plots were adjacent to each other. All plots measured 4 ft by 5 ft. Fungicides were applied on a 14, 21, or 28 day schedule (Table 18). Applications began on June 1 and continued through August 10, 1989. Application of three treatments of BAS 480 were not begun until weather was judged to favor Brown Patch activity (June 29). Plots were evaluated for percent of diseased turf on July 26 and August 10.

Brown Patch development on July 26 was light and sporadic. By August 10, disease development on check plots was severe. On August 10, several treatments had Brown Patch development that was not significantly less than the check plots. These included Vorlan DF at 2.0 oz and Terraneb 65W at 3.5 oz. Most treatments reduced Brown Patch symptoms significantly below levels in check plots on August 10, and eight of these treatments gave 100% suppression of Brown Patch.

Several treatments produced a slightly enhanced green color in the turf on August 10. These included: Cyproconazole, SAN 832F, Banner, and RH-3866 at all rates tested.

Table 18. Evaluation of fungicides for control of Brown Patch in Bentgrass, 1989.

Company	Treatment	Rate per 1000 ft^2	Timing (days)	Disease Rating[a] June 26	Disease Rating[a] August 10
Control	Check	----	----	0.0 b	4.0 a
Nor-Am	SN84364 50 WP (NA 211)	4.0 oz	21	0.0 b	0.0 d
	SN84364 50 WP (NA 229)	2.5 oz	21	0.0 b	0.0 d
	SN84364 50 WP (NA 211) + SN99731 25 WDG	2.0 oz 1.0 oz	21	0.0 b	0.7 d
	SN84364 50 WP (NA 211) + Banner 1.1 E	2.0 oz 1.0 fl oz	21	0.0 b	0.0 d
Ciba-Geigy	Banner 1.1 E	2.0 fl oz	14	0.0 b	0.0 d
Rohm & Haas	RH-3866	1.25 oz	14	0.0 b	0.3 d
BASF	BAS 480 00 F	0.03 lb	14[b]	0.7 a	2.7 bc
	BAS 480 00 F	0.06 lb ai/A	14[b]	0.0 b	1.3 cd
	BAS 480 00 F	0.12 lb ai/A	14[b]	0.0 b	0.0 d
	BAS 480 00 F	0.06 lb ai/A	14	0.0 b	1.3 cd
Sierra	Vorlan 50 DF Fungo 50 WP	1.0 oz 1.0 oz	14	0.0 b	1.3 d
	Vorlan 50 DF Fungo 50 WP	2.0 oz 2.0 oz	14	0.7 a	2.0 c
	Vorlan 50 DF	2.0 oz	14	0.7 a	3.3 ab
Mobay	Lynx 25 DF	0.25 oz ai	28	0.0 b	0.0 d
Sandoz	Cyproconazole 40 WG	0.25 oz	21	0.0 b	0.0 d
	Cyproconazole 40 WG	0.33 oz	21	0.0 b	0.0 d
	SAN 832F 50 WG	4.0 oz	21	0.0 b	0.3 d
	SAN 832F 50 WG	5.0 oz	21	0.0 b	0.3 d
Kincaid	Terraneb 65 W	2.0 oz	14	0.0 b	2.3 bc
	Terraneb 65 W	3.5 oz	14	0.0 b	4.0 a
	Terraneb 65 W	5.0 oz	14	0.0 b	2.0 c
Elanco	Rubigan A.S.	1.5 fl oz	14	0.0 b	2.0 c

[a] Means of ratings from three replicate plots per treatment. Rating scale is as follows: 0 = no disease; 1 = 0-10% of plot covered by disease; 2 = 10-30%; 3 = 30-50%; 4 = more than 50%.

[b] These treatments were not begun until the onset of weather favorable to Brown Patch (June 29).
Means adjacent to the same letter do not differ significantly (DMRT, P = 0.05).

1989 -- Evaluation of Fungicides for Control of Dollar Spot on Ram-I Kentucky Bluegrass

M.L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Iowa State University Horticulture Research Station near Ames, Iowa. Fungicides were applied to Ram-I bluegrass maintained at a 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 with four replications. Treated plots were alternated with untreated plots, so that 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 19). Applications began on June 1 and continued through August 10. The only exception was Bravo 90 DG, which was not applied until June 15. Plots were evaluated for severity of disease symptoms on July 11 and August 10.

The trial was set-up and fungicides were selected for control of leaf spot. However, Dollar Spot also appeared during the trials. Development of Dollar Spot is rated in this report.

Damage to the plots from sod webworm and bluegrass billbug was severe on both rating dates. This factor complicated the interpretation of disease development. Dollar Spot appeared in early July. Disease pressure was very low on the first rating date, and moderate when the second rating was made. Symptoms took the form of generalized browning and yellowing within plots.

On July 11, disease development was significantly more severe in Daconil and Bravo treatments than in Check plots. On August 10, all treatments gave significantly better disease control than the check plots. Four treatments gave 100% suppression of Dollar Spot on August 10. No phytotoxicity symptoms were observed on either rating date.

Table 19. 1989 evaluation of fungicides for control of Dollar Spot in Ram-I Kentucky bluegrass.

Company	Treatment	Rate per 1000 ft^2	Timing (days)	Disease rating[a] July 11	Disease rating[a] August 10
Control	Check	----	----	1.5 b	2.8 a
Nor-Am	Prochloraz 40 EC (CR17217)	4.5 oz	21	0.8 bc	0.5 bcd
Rohm and Haas	RH-3866	0.6 oz	14	0.3 c	0.3 cd
Sierra	Vorlan 50 DF + Fungo 50 WP	1.0 oz/1.0 oz	21	0.3 c	0.8 bcd
	Vorlan 50 DF + Fungo 50 WP	2.0 oz/2.0 oz	21	0.5 c	1.0 bc
	Vorlan 50 DF	2.0 oz	21	0.5 c	0.5 bcd
Sandoz	Cyproconazole 40 WG	0.17 oz	14	0.0 c	0.3 cd
	Cyproconazole 40 WG	0.25 oz	14	0.0 c	0.5 bcd
	Cyproconazole 40 WG	0.25 oz	28	0.5 c	0.0 d
	Cyproconazole 40 WG	0.33 oz	28	0.5 c	0.0 d
	SAN 832 50 WG	3.0 oz	14	0.3 c	0.5 bcd
	SAN 832 50 WG	4.5 oz	14	0.5 c	0.0 d
Rhone-Poulenc	Chipco 26019 FLO	3.0 oz	21	0.8 bc	0.8 bcd
	Chipco 26019 FLO	4.0 oz	21	0.8 bc	0.3 cd
Cleary	3336-F	4.0 oz	14	0.0 c	0.8 bcd
	3336-F	8.0 oz	14	0.3 c	0.0 d
Fermenta	Daconil 2787	6.0 oz	14	4.0 a	1.3 b
	Bravo 90 DG	3.5 oz	14	3.5 a	1.0 bc

[a] Means of ratings from four replicate plots. Ratings were based on the following scale: 0 - no disease; 1 - trace; 2 - low disease; 3 - moderate disease; 4 = severe disease.

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

1989 – Preemergence Annual Grass Control

G.T. Spear and N.E. Christians

The 1989 preemergence annual grass control study was located at the Iowa State University Horticulture Research Station near Ames, on a Nassau Kentucky bluegrass turf established September 22, 1988. The soil is a Nicolett (fine-loamy, mixed mesic, Aquic Hapludoll) soil with a pH of 7.5, 26 lb/A phosphorus (P), 198 lb/A potassium (K), and 2.3% organic matter.

The area was seeded with crabgrass at a rate of 1 lb seed/1000 ft^2 on September 22, 1988, and again on April 21, 1989.

The treatments included Dacthal, Fermenta; Bensulide, ICI Americas; Prodiamine, Sandoz Chemical; Pendimethalin, Lesco; Turf Weedgrass Control and Turf Fertilizer (30-3-10) + Pre-E, O.M. Scott; Ronstar, Rhone-Poulenc; Mon 15104, Mon 15111, Mon 15112, Mon 15151, and Mon 15175, Monsanto; BAS 514 OOH and Team, Elanco; and Basagran, BASF.

Liquid treatments were applied to 25 ft^2 plots on April 25, 1989, in the equivalent of 2.75 gal water/1000 ft^2. Granular treatments were applied with a hand-held shaker. The study was replicated three times. Repeat applications of Treatments 14 and 15 were made May 25, 1989.

Phytotoxicity data were recorded several times throughout the season. In the first three rating dates, the scale was based on a 9 to 1 scale; with 9 = no phytotoxicity and 1 = dead turf. The last three ratings, collected by research technician Richard Moore, were based on a turf quality scale where 9 = the best possible turf quality. Phytotoxicity is reflected in lower quality ratings during this time period. Damage was noted May 1, 1989, on the Ronstar 50 WP plots (Treatment 9). This grass recovered by the next rating date. On the remaining readings the greatest phytotoxicity was seen on Team plots (Treatment 30). This damage first appeared on July 8 and was still visible on August 4 (Table 20).

Both the 1988 and 1989 growing season were drier than usual. The area was irrigated to keep the bluegrass from going dormant. The crabgrass counts were made August 16, 1989.

Many treatments provided excellent season long crabgrass control. These included Bensulide, both Ronstar products, Prodiamine at both rates, Turf Fertilizer (30-3-10), Turf Weedgrass Control, Prograss at the higher rate, and all Monsanto products at all rates.

Some treatments in the study provided unacceptable crabgrass control. These included Dacthal, BAS 514 OOH at all rates, Basagran without oil concentrate, and Team. It should be noted that Basagran is a postemergence herbicide and little preemergent activity was expected.

Table 20. The 1989 preemergence herbicide phytotoxicity ratings and crabgrass control data.

Treatment	Rate (lb ai/A)	Dates 5/1	7/8	7/13	7/21	7/27	8/4	Crabgrass counts per plot	Percent Control
1. Control	----	9	9	9	8	7	7	71	0
2. Dacthal 6F	10.5	9	9	9	8	7	6	46	35
3. Bensulide 4E	7.5	9	9	9	8	7	7	3	96
4. Pendimethalin 60DG	0.5	9	9	9	8	7	7	39	45
5. BAS 514 OOH 50WP	1.0	9	9	9	8	7	6	51	28
6. BAS 514 OOH 50WP	2.0	9	9	9	7	7	7	53	25
7. BAS 514 OOH 50WP	3.0	9	8	9	7	7	6	68	4
8. Ronstar 2G	3.0	9	9	9	8	7	6	0	100
9. Ronstar 50WP	3.0	5	9	9	8	7	7	0	100
10. Prodiamine 65WG	0.5	9	9	9	8	7	7	0	100
11. Prodiamine 65WG	0.75	9	9	9	8	7	7	0	100
12. Turf Fertilizer (30-3-10) + PRE-E 1.3%	1.5	9	9	9	8	7	7	9	87
13. Turf Weedgrass Control 1.71%	1.5	9	9	9	7	6	6	4	94
14. Prograss 1.5 EC + [Prograss 1.5 EC*]	1.0 + [1.0]	8	9	9	8	7	7	28	61
15. Prograss 1.5 EC + [Prograss 1.5 EC*]	1.5 + [1.5]	9	9	9	7	6	5	4	94
16. Basagran	1.0	9	9	9	8	8	7	62	13
17. Basagran + Oil Concentrate	1.0 1 qt	9	9	9	8	7	7	32	55
18. Basagran + Oil Concentrate	2.0 1 qt	9	9	9	8	6	7	34	52
19. MON-15151 1EC	0.38	9	9	9	8	7	6	3	96
20. MON-15151 1EC	0.50	9	8	9	7	6	6	0	100
21. MON-15151 1EC	0.75	9	9	9	8	7	6	0	100
22. MON-15104 1EC	0.38	9	9	9	8	6	6	1	99
23. MON-15104 1EC	0.50	9	9	9	8	7	7	1	99
24. MON-15104 1EC	0.75	9	9	9	8	6	6	0	100
25. MON-15175 0.25G	0.25	9	9	9	8	7	6	0	100
26. MON-15175 0.25G	0.38	9	9	9	8	7	6	1	99
27. MON-15175 0.25G	0.50	9	9	9	7	6	6	1	99
28. MON-15111 0.27G (30-3-10)	0.375	9	9	9	8	7	6	2	97
29. MON-15112 0.35G (30-3-10)	0.5	9	9	9	8	8	7	0	100
30. Team 2G	3.0	9	5	6	6	5	4	38	46
LSD (0.05)		0.4	0.5	0.2	0.7	1.1	1.1	32	45

1989 -- Postemergence Annual Grass Control

G.T. Spear and N.E. Christians

The 1989 postemergence annual grass control study was located at the Iowa State University Horticulture Research Station near Ames, on a Nassau Kentucky bluegrass turf established September 22, 1988. The soil is a Nicolett (fine-loamy, mixed mesic, Aquic Hapludoll) soil with a pH of 7.5, 26 lb/A phosphorus (P), 198 lb/A potassium (K), and 2.3% organic matter.

The area was seeded with crabgrass at a rate of 1 lb seed/1000 ft^2 on September 22, 1988, and again on April 21, 1989.

The treatments included American Hoechst's Acclaim and experimental products -- HOE 360 and HRAV 01129. Acclaim also was used in combination with PRE-M, Trimec, PRE-M + Trimec, Team, and Turflon Amine. Other treatments included Monsanto's experimental products Mon 15104, Mon 15111, Mon 15112, Mon 15151, and Mon 15175; BASF's Basagran and BAS 514 OOH + BAS 090; and Fermenta's MSMA + Dacthal.

Liquid treatments were applied to 25 ft^2 plots in three replications on June 16, 1989, in the equivalent of 2.75 gal water/1000 ft^2. Granular treatments were applied with a hand-held shaker. Repeat applications of BAS 514 OOH + BAS 090 (Treatments 6 - 9) were made July 14, 1989.

Phytotoxicity data were recorded several times throughout the season (Table 21). The lower ratings on the last three dates were taken by research technician Richard Moore and are based on a quality scale where 9 = the best possible turf quality. The greatest damage was observed at each date on grass treated with the Acclaim 1EC at the higher rate (Treatment 11) and on the HOE-360 14H at the highest rate (Treatment 15). The MSMA + Dacthal 6F plots showed significant phytotoxicity on June 22, 1989, but recovered by the next reading, June 27, 1989.

The 1989 growing season was drier than usual for the second straight year. The area was irrigated to keep the bluegrass from going dormant. In spite of the irrigation, the severe drought in the spring and summer resulted in delayed germination of crabgrass and resulted in smaller crabgrass plants than usual for the time of year. The crabgrass counts were made August 16, 1989. Many treatments provided excellent season-long crabgrass control (Table 22). These included all of the BAS 514 OOH + BAS 090 treatments; Pre-M + Trimec; Acclaim + Pre-M; Acclaim + Pre-M + Turflon Amine; Acclaim + Pre-M + Trimec; MON 15104, MON 15175, MON 15151, MON 15111, and MON 15112 at all rates; Basagran + Oil Concentrate at the higher rate; and MSMA + Dacthal 6F.

Some treatments in the study provided unacceptable crabgrass control. These included Acclaim 1EC at both rates; HOE-360 14H at all rates; Basagran and Basagran + Oil Concentrate at the lower rate; Acclaim + Team at the higher rate; and Acclaim + Pre-M + Trimec (Treatment 39). The unacceptable control of Mon 15104 at 0.75 lb ai/A (Treatment 27) was likely due to an error in application or preparation of treatments.

Table 21. The 1989 postemergence annual grass control study.

Treatment	Rate (lb ai/A)	Phytotoxicity 6/22	6/27	7/3	7/8	7/13	7/21	7/26	8/4
1. Control	----	9	9	9	9	9	8	7	7
2. BAS 514 OOH 50 WP + BAS 090 02S	0.75 + 2 pt/A	9	9	9	9	9	8	6	6
3. BAS 514 OOH 50 WP + BAS 090 02S	1.0 + 2 pt/A	9	9	9	9	9	8	7	7
4. BAS 514 OOH 50 WP + BAS 090 02S	1.5 + 2 pt/A	9	9	9	9	9	8	7	7
5. BAS 514 OOH 50 WP + BAS 090 02S	0.75 + 2 pt/A								
+ [Repeat appl]	+ [1.0 + 2 pt/A]	8	9	9	9	9	8	6	6
6. BAS 514 OOH 50 WP + BAS 090 02S	1.0 + 2 pt/A								
+ [Repeat appl]	+ [1.0 + 2 pt/A]	9	9	9	9	9	9	6	7
7. BAS 514 OOH 50 WP + BAS 090 02S	1.5 + 2 pt/A								
+ [Repeat appl]	+ [0.5 + 2 pt/A]	9	9	9	9	9	8	6	7
8. BAS 514 OOH 50 WP + BAS 090 02S	0.75 + 2 pt/A								
+ [Repeat appl]	[0.75 + 2 pt/A]	9	9	9	9	9	8	7	7
9. BAS 514 OOH 50 WP + BAS 090 02S	1.0 + 2 pt/A								
+ [Repeat appl]	[0.75 + 2 pt/A]	9	9	9	9	9	8	7	7
10. Acclaim 1EC	0.18	7	7	7	8	6	8	7	7
11. Acclaim 1EC	0.25	5	5	5	5	6	7	6	6
12. HOE-360 14H 0.46 EC	0.06	7	8	9	9	9	8	7	6
13. HOE-360 14H 0.46 EC	0.09	6	5	7	8	7	7	6	6
14. HOE-360 14H 0.46 EC	0.125	6	6	6	6	5	7	6	6
15. HOE-360 14H 0.46 EC	0.18	4	4	4	4	4	6	5	4
16. HRAV 01129 50 WDG	0.18	8	9	9	9	9	8	7	7
17. PRE-M 60DG + Trimec	1.5 + 3.5 pt/A	9	9	9	9	9	8	6	7
18. Acclaim 1EC + PRE-M 60DG	0.12 + 1.5								
+ [Preceding Trimec appl]	+ [3.5 pt/A]	6	9	9	9	9	8	6	7
19. Acclaim 1EC + PRE-M 60DG	0.12 + 1.5	6	6	9	8	8	8	7	6
20. Acclaim 1EC + PRE-M 60DG	0.12 + 1.5								
+ Turflon Amine	+ 2.5 pt/A	6	9	9	9	8	8	7	7
21. Acclaim 1EC + PRE-M 60DG	0.12 + 1.5								
+ Trimec	+ 3.5 pt/A	8	9	9	9	9	8	7	7
22. Acclaim 1EC + Turflon Amine	0.25 + 2.5 pt/A	9	9	9	9	9	8	7	6
23. MON 15151 1EC	0.38	9	9	9	9	6	8	7	7
24. MON 15151 1EC	0.50	9	9	9	9	9	8	7	7
25. MON 15104 1EC	0.38	9	9	9	9	9	9	7	8

Table 21. The 1989 postemergence annual grass control study. (continued)

Treatment	Rate (lb ai/A)	Phytotoxicity 6/22	6/27	7/3	7/8	7/13	7/21	7/26	8/4
26. MON 15104 1EC	0.50	9	9	9	9	9	8	6	7
27. MON 15104 1EC	0.75	9	9	9	9	9	8	7	7
28. MON 15175 0.25G	0.38	9	9	9	9	9	8	6	6
29. MON 15175 0.25G	0.50	9	9	9	9	9	9	8	8
30. MON 15111 0.27G (30-3-10)	0.38	9	9	9	9	9	8	8	8
31. MON 15112 0.35G (30-3-10)	0.50	9	9	9	9	9	9	8	8
32. MON 15112 0.35G (30-3-10)	0.75	9	9	9	9	9	8	7	7
33. Basagran	1.0	9	9	9	9	9	8	7	7
34. Basagran + Oil Concentrate	1.0 + 1 qt/A	9	9	9	9	8	8	7	7
35. Basagran + Oil Concentrate	2.0 + 1 qt/A	8	9	9	9	9	8	7	8
36. MSMA + Dacthal 6F	2.0 + 10.5	5	9	9	9	9	9	7	7
37. Acclaim 1EC + Team 10% Sprayable	0.08 + 2	8	6	7	7	8	8	7	7
38. Acclaim 1EC + Team 10% Sprayable	0.12 + 2	8	8	9	9	9	8	6	7
39. Acclaim 1EC + Pre-M 60DG (Trimec applied 4 days before Acclaim treatment)	0.12 + 1.5 (3.5 pt/A)	8	9	9	9	9	8	6	6
LSD		2.1	1.5	0.8	0.9	1.7	0.9	1.1	1.0

Table 22. The 1989 postemergence annual grass control study.

Treatment	Rate (lb ai/A)	Crabgrass counts per plot	Percent Control
1. Control	----	58	0
2. BAS 514 OOH 50 WP + BAS 090 02S	0.75 + 2 pt/A	1	98
3. BAS 514 OOH 50 WP + BAS 090 02S	1.0 + 2 pt/A	0	100
4. BAS 514 OOH 50 WP + BAS 090 02S	1.5 + 2 pt/A	0	100
5. BAS 514 OOH 50 WP + BAS 090 02S + [Repeat appl]	0.75 + 2 pt/A + [1.0 + 2 pt/A]	0	100
6. BAS 514 OOH 50 WP + BAS 090 02S + [Repeat appl]	1.0 + 2 pt/A + [1.0 + 2 pt/A]	0	100
7. BAS 514 OOH 50 WP + BAS 090 02S + [Repeat appl]	1.5 + 2 pt/A + [0.5 + 2 pt/A]	0	100
8. BAS 514 OOH 50 WP + BAS 090 02S + [Repeat appl]	0.75 + 2 pt/A [0.75 + 2 pt/A]	0	100
9. BAS 514 OOH 50 WP + BAS 090 02S + [Repeat appl]	1.0 + 2 pt/A [0.75 + 2 pt/A]	0	100
10. Acclaim 1EC	0.18	67	0
11. Acclaim 1EC	0.25	53	9
12. HOE-360 14H 0.46 EC	0.06	31	46
13. HOE-360 14H 0.46 EC	0.09	52	10
14. HOE-360 14H 0.46 EC	0.125	71	0
15. HOE-360 14H 0.46 EC	0.18	71	0
16. HRAV 01129 50 WDG	0.18	28	52
17. PRE-M 60DG + Trimec	1.5 + 3.5 pt/A	10	83
18. Acclaim 1EC + PRE-M 60DG + [Preceding Trimec appl]	0.12 + 1.5 + [3.5 pt/A]	12	79
19. Acclaim 1EC + PRE-M 60DG	0.12 + 1.5	3	95
20. Acclaim 1EC + PRE-M 60DG + Turflon Amine	0.12 + 1.5 + 2.5 pt/A	6	90
21. Acclaim 1EC + PRE-M 60DG + Trimec	0.12 + 1.5 + 3.5 pt/A	3	95
22. Acclaim 1EC + Turflon Amine	0.25 + 2.5 pt/A	18	69
23. MON 15151 1EC	0.38	0	100
24. MON 15151 1EC	0.50	0	100
25. MON 15104 1EC	0.38	1	98

Table 22. The 1989 postemergence annual grass control study. (continued)

Treatment	Rate (lb ai/A)	Crabgrass counts per plot	Percent Control
26. MON 15104 1EC	0.50	1	98
27. MON 15104 1EC	0.75	46	21
28. MON 15175 0.25G	0.38	1	98
29. MON 15175 0.25G	0.50	0	100
30. MON 15111 0.27G (30-3-10)	0.38	0	100
31. MON 15112 0.35G (30-3-10)	0.50	0	100
32. MON 15112 0.35G (30-3-10)	0.75	0	100
33. Basagran	1.0	47	19
34. Basagran + Oil Concentrate	1.0 + 1 qt/A	45	22
35. Basagran + Oil Concentrate	2.0 + 1 qt/A	3	95
36. MSMA + Dacthal 6F	2.0 + 10.5	2	97
37. Acclaim 1EC + Team 10% Sprayable	0.08 + 2	14	76
38. Acclaim 1EC + Team 10% Sprayable	0.12 + 2	33	43
39. Acclaim 1EC + Pre-M 60DG (Trimec applied 4 days before Acclaim treatment)	0.12 + 1.5 (3.5 pt/A)	54	7
LSD		24	41

Sod Rooting on Soil Treated With Preemergence Herbicide

R.G. Roe and N.E. Christians

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

Treatments (Table 23) were applied on May 31, 1989, to the surface of the freshly prepared soil with the use of a backpack carbon dioxide sprayer for the liquid materials, and a shaker box for the granular material. Following herbicide applications, a Kentucky bluegrass turf was cut to a 5/8 in depth and laid in the standard fashion. Sod pieces were transplanted into wooden frames, three frames per plot. The frames had 18-mesh fiberglass screen bottoms and were constructed of 1 in by 2 in pine boards with inside dimensions of 12 in by 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 (Figure 7). 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 frame, centered carefully over it to assure that the lifting force was vertical. The force at the point of root breakage from the soil was measured by the use of a hydraulic pressure gauge. Rooting measurements were used as an indication of sod establishment. The first frames were lifted after 10 days, the second after 20 days, and the last after 30 days.

Visual quality ratings were recorded at 20 and 30 days. Quality was rated on a scale of 1 to 9; with 9 = best, 5 = acceptable, and 1 = dead turf. An analysis of variance was performed on all data.

All treatments reduced sod rooting as compared to the untreated control 10 days after treatment (Table 24). BAS 514 OOH at 2 lb ai/A was the most restrictive treatment and the Ronstar 2G at 3 lb ai/A was numerically the least restrictive. There were no significant differences in quality among herbicide treated plots at 10 days. Twenty days after treatment, the Ronstar 2G no longer reduced rooting as compared to the control. All other treatments still reduced root development at 20 days, with the 2 lb ai/A BAS 514 OOH treatment still providing the greatest reduction.

By the 30th day, the grass on plots treated with the Ronstar 2G had a numerically greater pulling pressure than the control. All treatments, with the exception of the BAS 514 OOH at 1 lb ai/A, were still observed to significantly reduce rooting as compared to the control. Grass on plots treated with Team 2G showed the greatest restriction of rooting at 30 days.

Noticeable differences in turf quality began to appear two weeks after treatment and ratings were made at 20 and 30 days (Table 25). Plots treated with BAS 514 OOH at 2 lb ai/A, Mon 15151 1EC at 0.5 lb ai/A, and Team 2G at 2 lb ai/A received unacceptable quality ratings at both 20 and 30 days following treatment.

Table 23. Treatments used in sod rooting trial.

Treatment	Rate (lb ai/A)	Material/ plot	ml H_2O/ plot
1. Control	....	....	...
2. BAS 514 OOH 50WP	0.5	0.26 g	260
3. BAS 514 OOH 50WP	1.0	0.52 g	260
4. BAS 514 OOH 50WP	2.0	1.04 g	260
5. MON 15151 1EC	0.38	0.83 ml	260
6. MON 15151 1EC	0.50	1.09 ml	260
7. Team 2G	2.0	26.05 g	...
8. Ronstar 2G	3.0	39.08 g	...

Table 24. The effects of the herbicides on rooting of Kentucky bluegrass sod measured in pounds per square inch (PSI) needed to break the roots from the soil.

Treatment	Rate (lb ai/A)	Pulling pressure (PSI) 10 days	20 days	30 days
1. Control	....	345.0	526.6	550.0
2. BAS 514 OOH 50WP	0.5	110.0	270.0	233.3
3. BAS 514 OOH 50WP	1.0	153.3	270.0	316.6
4. BAS 514 OOH 50WP	2.0	90.0	156.6	116.6
5. MON 15151 1EC	0.38	110.0	206.6	280.0
6. MON 15151 1EC	0.5	130.0	176.6	213.3
7. Team 2G	2.0	146.6	173.3	106.6
8. Ronstar 2G	3.0	156.6	403.3	600.0
LSD 0.05		85.5	148.7	247.3

Table 25. Evaluation of Kentucky bluegrass sod injury taken 20 days and 30 days after sod laying.

Treatment	Rate (lb ai/A)	Quality ratings 20 days	30 days
1. Control	....	7.6	8.0
2. BAS 514 OOH 50WP	0.5	6.0	5.3
3. BAS 514 OOH 50WP	1.0	6.0	6.0
4. BAS 514 OOH 50WP	2.0	3.6	4.0
5. MON 15151 1EC	0.38	5.6	5.3
6. MON 15151 1EC	0.5	4.0	4.6
7. Team 2G	2.0	3.6	4.0
8. Ronstar 2G	3.0	7.3	7.3
LSD 0.05		2.1	2.0

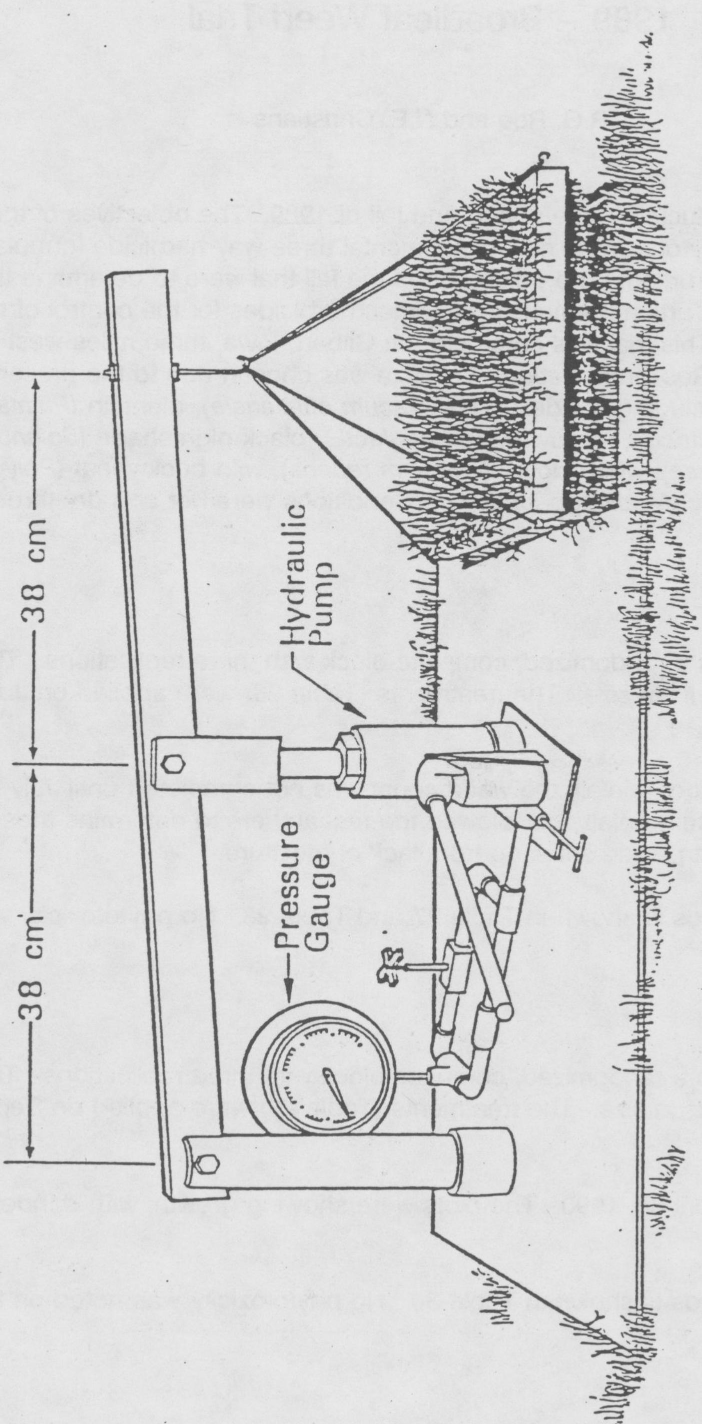


Figure 7. Hydraulic pump apparatus lifting wooden frames.

1989 -- Broadleaf Weed Trial

R.G. Roe and N.E. Christians

This was a two-part trial conducted in the spring and fall of 1989. The objectives of the spring trial were to determine the efficacy of several new experimental three-way herbicide formulations for turf weed control vs Trimec and Turflon. The objectives of the fall trial were to determine the efficacy of fall applications of Confront, Turflon II Amine, and Trimec herbicides for the control of broadleaf weeds in cool-season turfgrasses. This trial was conducted in Gilbert, Iowa, three miles west of the Iowa State University Horticulture Research Station. This site was chosen due to the presence of a wide variety of broadleaf weeds including dandelion (*Taraxacum officianale*), plantain (*Plantago major*), violet (*Viola* spp *L.*), oxalis (*Oxalis stricta*), mallow (*Malva neglecta*), black nightshade (*Solanum nigrum*), Canada thistle (*Cirsium arvense*), white clover (*Trifolium repens*), wild buckwheat (*Polygonum convolvulus*), and black medic (*Medicago lupulina*). Conditions were hot and dry throughout the growing season.

<u>Spring Application</u>:

The experimental design was a randomized, complete-block with three replications. The individual plots were 10 ft by 10 ft, 100 ft^2 in size. The treatments (Table 26) were applied on June 6 with a CO_2 backpack sprayer.

Due to extreme heat and lack of rainfall, the weed count was not completed until July 21. The weed count was taken two days after rainfall, this allowed the researchers to determine those weeds killed by herbicide action rather than those suffering from lack of moisture.

A complete count of the weeds is shown in Table 27 and Table 28. No phytotoxicity was noted on the Kentucky bluegrass.

<u>Fall Application</u>:

The experimental design was a randomized, complete-block with three replications. The individual plots were 10 ft x 10 ft, 100 ft^2 in size. The treatments (Table 29) were applied on September 28 with a CO_2 backpack sprayer.

Weed data were taken on April 30, 1990. The plots were showing growth, with dandelions, violets, and plantain present.

A complete count of the weeds is shown in Table 30. No phytotoxicity was noted on the Kentucky bluegrass.

<u>Findings</u>:

The spring/early summer application showed a significant reduction in dandelions for all treatments. Treatments 2 and 6 showed a reduction in violets while oxalis was reduced by Treatment 6. Fall application showed a significant reduction in dandelions for Treatments 5 through 9 only, with XRM-5085 at 2.0 pt/A showing the best response. Violets showed the most response to Treatments 4, 6, and 7.

Table 26. Spring/early summer application.

Treatment		Rate (lb ai/A)	Material/ plot	Ml/ H_2O/yr
1. Control		----	----	---
2. Mix A	Formula 40 (2,4-D)	0.83	1.9 ml	1135
	XRM-3724 (Triclopyr)	0.083	0.24 ml	
	XRM-3972 (Clopyralid)	0.042	0.12 ml	
3. Mix B	Formula 40 (2,4-D)	1.25	2.9 ml	1135
	XRM-3724 (Triclopyr)	0.125	0.36 ml	
	SRM-3972 (Clopyralid)	0.063	0.18 ml	
4. Mix C	Formula 40 (2,4-D)	1.67	3.82 ml	1135
	XRM-3724 (Triclopyr)	0.17	0.49 ml	
	SRM-3972 (Clopyralid)	0.083	0.24 ml	
5. Mix D	XRM-5085 (Confront)	2/3 pt/A	0.72 ml	1135
	Formula 40 (2,4-D)	1.0	2.29 ml	
6. Turflon II Amine		3 pt/A	3.24 ml	1135
7. Trimec		4 pt/A	4.32 ml	1135

Total spray: 3 gal/100 ft^2.

Table 27. Spring/early summer application.

Treatment		Rate (lb ai/A)	Dandelion	Plantain	Violets	Oxalis	Mallow
1. Control		----	194.66	12.00	85.33	160.00	1.33
2. Mix A	Formula 40 (2,4-D)	0.83	13.33	0.00	31.33	125.33	0.33
	XRM-3724 (Triclopyr)	0.083					
	XRM-3972 (Clopyralid)	0.042					
3. Mix B	Formula 40 (2,4-D)	1.25	5.00	0.33	84.00	97.66	0.00
	XRM-3724 (Triclopyr)	0.125					
	SRM-3972 (Clopyralid)	0.063					
4. Mix C	Formula 40 (2,4-D)	1.67	2.33	0.00	83.00	136.00	0.00
	XRM-3724 (Triclopyr)	0.17					
	SRM-3972 (Clopyralid)	0.083					
5. Mix D	XRM-5085 (Confront)	2/3 pt/A	6.66	0.33	64.33	135.00	5.00
	Formula 40 (2,4-D)	1.0					
6. Turflon II Amine		3 pt/A	45.33	0.00	32.00	19.00	0.33
7. Trimec		4 pt/A	4.33	0.00	60.33	124.66	0.66
LSD 0.05			74.28	NS	NS	NS	NS

Total spray: 3 gal/100 ft^2.

Table 28. Spring/early summer application.

Treatment		Black Night Shade	Canada Thistle	White Clover	Wild Buckwheat	Black Medic
1. Control		1.33	4.00	2.66	9.33	2.00
2. Mix A	Formula 40 (2,4-D) XRM-3724 (Triclopyr) XRM-3972 (Clopyralid)	0.00	1.66	0.00	0.00	0.00
3. Mix B	Formula 40 (2,4-D) XRM-3724 (Triclopyr) SRM-3972 (Clopyralid)	0.00	0.66	0.00	0.00	0.00
4. Mix C	Formula 40 (2,4-D) XRM-3724 (Triclopyr) SRM-3972 (Clopyralid)	0.00	0.00	0.00	0.00	0.00
5. Mix D	XRM-5085 (Confront) Formula 40 (2,4-D)	0.33	0.00	0.00	0.00	0.00
6. Turflon II Amine		0.00	0.33	0.00	0.00	0.00
7. Trimec		0.00	1.00	0.00	0.00	0.00
LSD 0.05		NS	NS	NS	NS	NS

Table 29. Fall application.

Treatment	Rate (lb ai/A)	Material/ plot	Ml/ H_2O/plot
1. Control	----	----	----
2. Turflon II Amine	2.0 pt/A	2.16 ml	1135
3. Turflon II Amine	2.5 pt/A	2.7 ml	1135
4. Turflon II Amine	3.0 pt/A	3.24 ml	1135
5. XRM-5085	1.0 pt/A	1.08 ml	1135
6. XRM-5085	1.5 pt/A	1.62 ml	1135
7. XRM-5085	2.0 pt/A	2.16 ml	1135
8. Trimec	3.0 pt/A	3.24 ml	1135
9. Trimec	4.0 pt/A	4.32 ml	1135

Total spray: 3 gal/100 ft^2.

Table 30. Fall application.

Treatment	Rate (lb ai/A)	Dandelion	Violets	Plantain
1. Control	----	230.00	47.00	0.33
2. Turflon II Amine	2.0 pt/A	218.00	20.66	0.00
3. Turflon II Amine	2.5 pt/A	163.33	17.66	0.00
4. Turflon II Amine	3.0 pt/A	203.33	6.00	0.00
5. XRM-5085	1.0 pt/A	66.66	16.33	1.00
6. XRM-5085	1.5 pt/A	22.66	6.33	0.33
7. XRM-5085	2.0 pt/A	6.00	3.33	0.33
8. Trimec	3.0 pt/A	57.00	9.33	0.00
9. Trimec	4.0 pt/A	23.66	84.33	0.00
LSD		147.54	NS	NS

Total spray: 3 gal/100 ft^2.

Chlorsulfuron and Ethofumesate Effects on the Germination of Four Cool-season Turfgrasses

R.W. Moore, N.E. Christians, and M.G. Burt

Two selective herbicides were evaluated for their effects on the germination of four species of cool-season turfgrasses. Treatments included a control, Chlorsulfuron (a selective control for tall fescue in Kentucky bluegrass and fine fescue), and Ethofumesate (a selective control for *Poa annua* in perennial ryegrass and Kentucky bluegrass). Activated charcoal was also included to evaluate its ability to neutralize Chlorsulfuron.

This study was initiated in the fall of 1988 at the Iowa State University Horticulture Research Station near Ames, Iowa. The soil on the site is an Aquic Hapludoll, fine-loamy, mixed-mesic, Nicolett soil, with a pH of 7.8, 13.0 ppm phosphorus (P), 70.0 ppm potassium (K), and 2.3% organic matter.

Treatments included a control, Chlorsulfuron at 0.18 lb ai/A, Chlorsulfuron repeated at the same rate with activated charcoal added at 300 lb/A, and Ethofumesate at 0.75 lb ai/A. The treatments were applied on September 13, 1988. Each treatment was applied in 3.0 gal water/1000 ft^2.

Delayed seeding dates were used to test residual effects of the treatments. The first seeding took place on September 13, at the time of herbicide and charcoal treatment. The second seeding took place on October 3, 20 days after the initial treatment. The third seeding took place on October 24, 40 days after treatment.

Four turfgrass species were used in this study. Julia Kentucky bluegrass was seeded at 1.5 lb/1000 ft^2, Commander perennial ryegrass at 6.0 lb/1000 ft^2, Shade Master creeping red fescue at 4.0 lb/1000 ft^2, and Cimmeron tall fescue at 8.0 lb/1000 ft^2.

This study was conducted in a split-block design in which the four treatments were randomized within each of the three seeding dates. The four species were randomized within each treatment. The study was replicated three times. Each treatment plot measured 10 ft by 10 ft, while each species plot within each treatment measured 2.5 ft by 3.33 ft.

Data collected were a visual percent cover of each species plot at the end of each month during the growing season. The months included September, October, and November, 1988, and April, May, and June, 1989. Fresh clipping yields of each species were taken at the termination of the study in late June 1989.

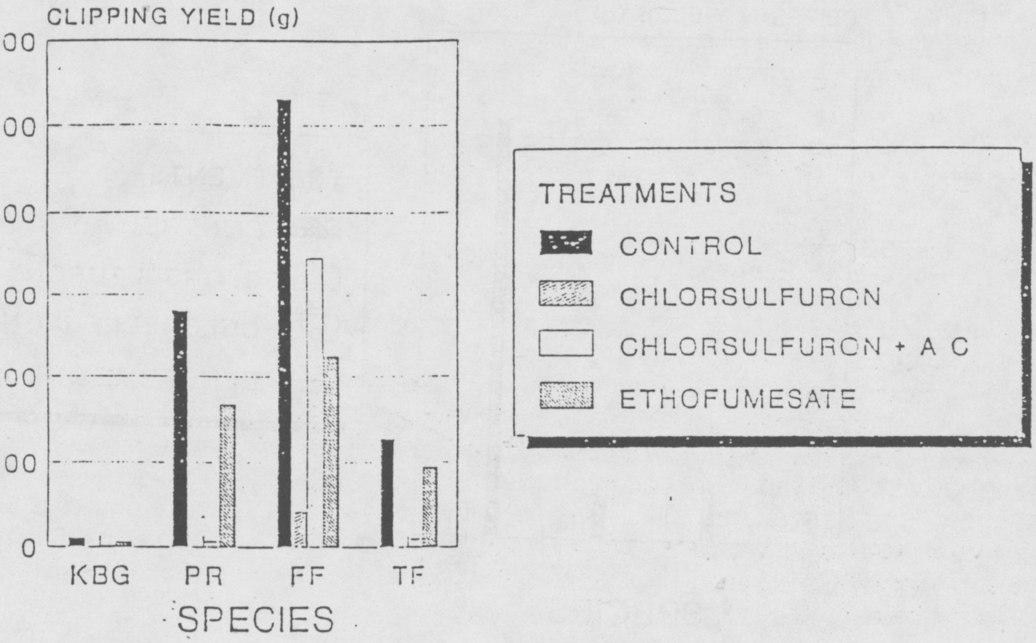
June clipping yield data taken from plots seeded on September 13, 1988, demonstrated that Chlorsulfuron inhibited seed germination in three of the four species. The fine fescue exhibited some tolerance and produced about 50 g of clippings as compared to over 500 g in the control plot. Activated charcoal reduced the effects of Chlorsulfuron. The fine fescue plot that received Chlorsulfuron and charcoal produced more than 300 g of clippings compared to the plots that received Chlorsulfuron alone which produced approximately 50 g. Ethofumesate did not inhibit germination as much as the other treatments, except in the case of Kentucky bluegrass, which produced only about 10 g of clippings. Tall fescue treated with Ethofumesate produced about 90 g, perennial ryegrass about 175 g, and fine fescue over 200 g (Figure 8).

June clipping yields taken from plots seeded on October 3, 1988, suggest that Chlorsulfuron continued to inhibit germination of all four species for several weeks after treatments. The fine fescue still showed some tolerance by yielding about 2 g of clippings as compared to the control that produced 66 g. Activated charcoal displayed some neutralizing ability of the Chlorsulfuron in three of the species but none at all for the Kentucky bluegrass. The fine fescue demonstrated the greatest clipping yield of all treated species when treated with Chlorsulfuron and activated charcoal. All species germinated in the Ethofumesate treated plots. Perennial ryegrass was the least affected of all species by this treatment (Figure 9).

June clipping yields taken from plots seeded on October 24, 1988, had very little overall germination in all plots including the control. In the Chlorsulfuron treated plot, only the fine fescue showed any growth. In the Ethofumesate treated plot, all species except the tall fescue were very close to the control. The tall fescue plot had 10 times more clippings collected in the control plot as compared to the Ethofumesate treated plot (Figure 10).

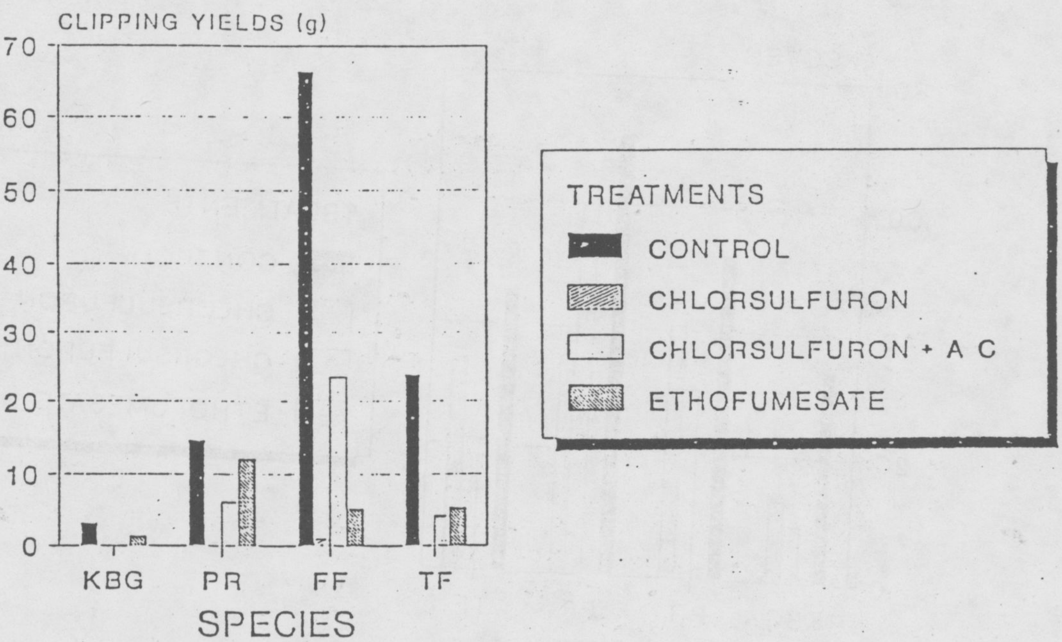
Percent cover data taken in June and averaged over all three seeding dates demonstrated that the Chlorsulfuron treated plots had the least cover (Figure 11). Kentucky bluegrass, perennial ryegrass, and tall fescue had a percent cover of less than 5% while the fine fescue reached a 30% cover on the Chlorsulfuron treated plot. Activated charcoal had some neutralizing effect on the Chlorsulfuron for all species. Ethofumesate had less effect than Chlorsulfuron and Chlorsulfuron + activated charcoal on perennial ryegrass, tall fescue, and Kentucky bluegrass. In the fine fescue, the Ethofumesate treated plots had over 35% cover as compared to over 70% cover in the control and 30% cover in the Chlorsulfuron treated plot.

The hot, dry weather occurred in September and October could have influenced the germination of each species, especially the Kentucky bluegrass. This is suggested by the reduced clipping yield in the control plot (Figures 8, 9, and 10). The fine fescue showed the highest tolerance to the herbicides when seeded at the time of treatment. The Chlorsulfuron treatment reduced clipping yields in all species. Ethofumesate reduced percent cover and clipping yields but not as severely as Chlorsulfuron. The data suggest that Chlorsulfuron has a longer residual than Ethofumesate and that activated charcoal can be used successfully in neutralizing Chlorsulfuron.



A C = ACTIVATED CHARCOAL
KBG=KENTUCKY BLUEGRASS & FF=FINE FESCUE
PR= PERENNIAL RYEGRASS & TF=TALL FESCUE
LSD 0.05 For Comparison of Treatments = 150
LSD 0.05 For Comparison of Species = 67

Figure 8. Seeded at time of treatments. (June data).



A C = ACTIVATED CHARCOAL
KBG=KENTUCKY BLUEGRASS & FF=FINE FESCUE
PR=PERENNIAL RYEGRASS & TF=TALL FESCUE
LSD 0.05 For Comparison of Treatments = 18
LSD 0.05 For Comparison of Species = 12

Figure 9. Seeded 20 days after treatment. (June data).

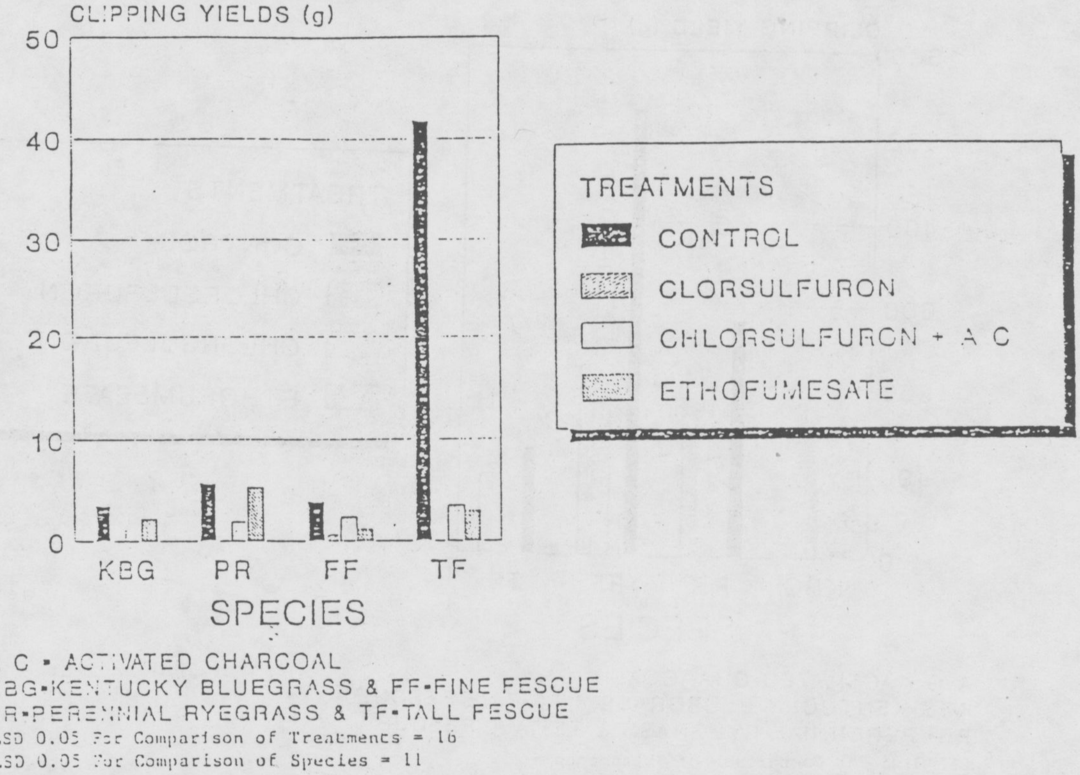


Figure 10. Seeded 40 days after treatment. (June data).

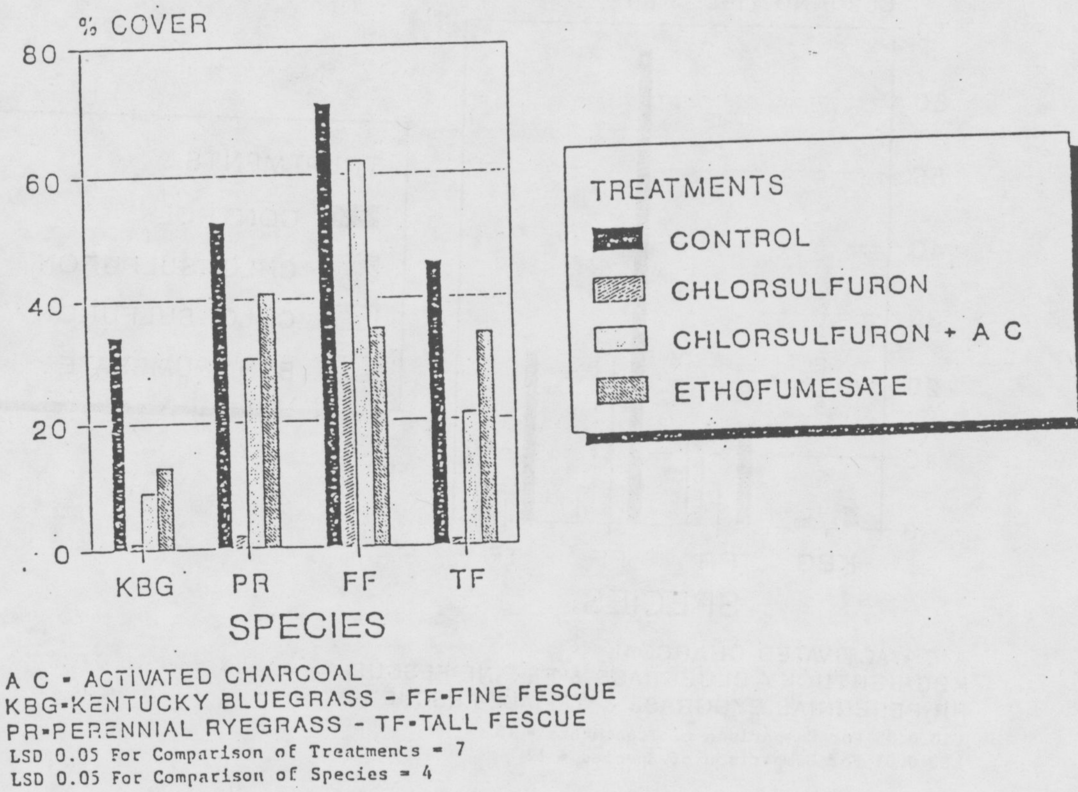


Figure 11. Percent cover of species by treatment. (June data).

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

R.W. Moore and N.E. Christians

Four nitrogen (N) 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/wk 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 31). 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 .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 taking 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 one application (Figure 12, Table 32) demonstrated slower growth and lower quality ratings at the start of the study, as compared to the grass that received the other treatments, but showed higher and more consistent ratings from mid-summer into fall. The grass treated with IBDU at the same 4 lb rate demonstrated the highest ratings early, but slowly declined throughout the season. Plots treated with sulfur coated urea demonstrated similar ratings as the IBDU except in the mid-summer when it demonstrated slightly better quality ratings; while both rated lower than Agriform. Agriform resulted in lower clipping yields (Figure 13, Table 33) than the other N sources. Differences in clipping yields of the three treatments were greater earlier in the season but were not significantly different from mid-summer through fall.

Agriform at the split application rate (Figure 14, Table 34) demonstrated similar clipping yield data to the other treatments. However, these ratings were somewhat lower overall than the other treatments. Visual quality ratings (Figure 15, Table 35) of the Agriform treated grass again started out with very low ratings. By mid-summer the Agriform treated grass had reached acceptable ratings and remained more stable than the other treatments, which demonstrated variable visual quality and clipping yield data.

The Agriform treated grass demonstrated slow spring greenup and little early-summer growth as compared to the other treatments. The low amount of water soluble N and the 8 to 9 month release period of a portion of the resin coated urea is the probable cause of the lower ratings. Some of this N would not be available until late in the season or the following spring. From mid-summer to fall, more consistent visual quality and clipping yields suggest better overall growth as compared to IBDU, sulfur coated urea, and urea. An addition of more water-soluble N to the Agriform formula, could possibly increase the early season response of the grass.

Table 31. Treatments for the 1989 Sierra Corporation Agriform study.

Treatments		Total lbs 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						6.25 g
(standard)[2]	46-0-0	4	.75	April	24.0 g	Apr & May
			.75	May	24.0 g	August
			1.0	August	32.0 g	Sept

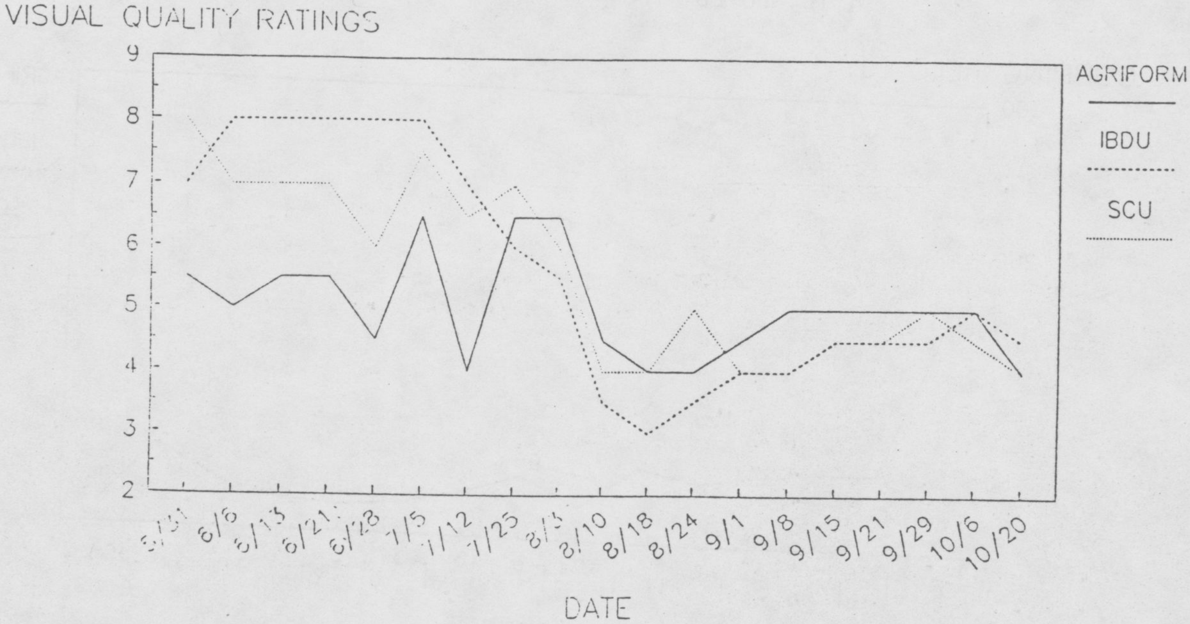
[1] Balanced urea program matches split applications of Agriform.

[2] Standard urea program for midwest conditions.

Potassium sulfate will be applied to Treatments 3 to 8 at a rate equivalent to that provided in plots 1 and 2.

SIERRA CORP AGRIFORM STUDY

4 lb. N/1000 sq.ft.-ONE APPLICATION



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

FIGURE 12

SIERRA CORP AGRIFORM STUDY

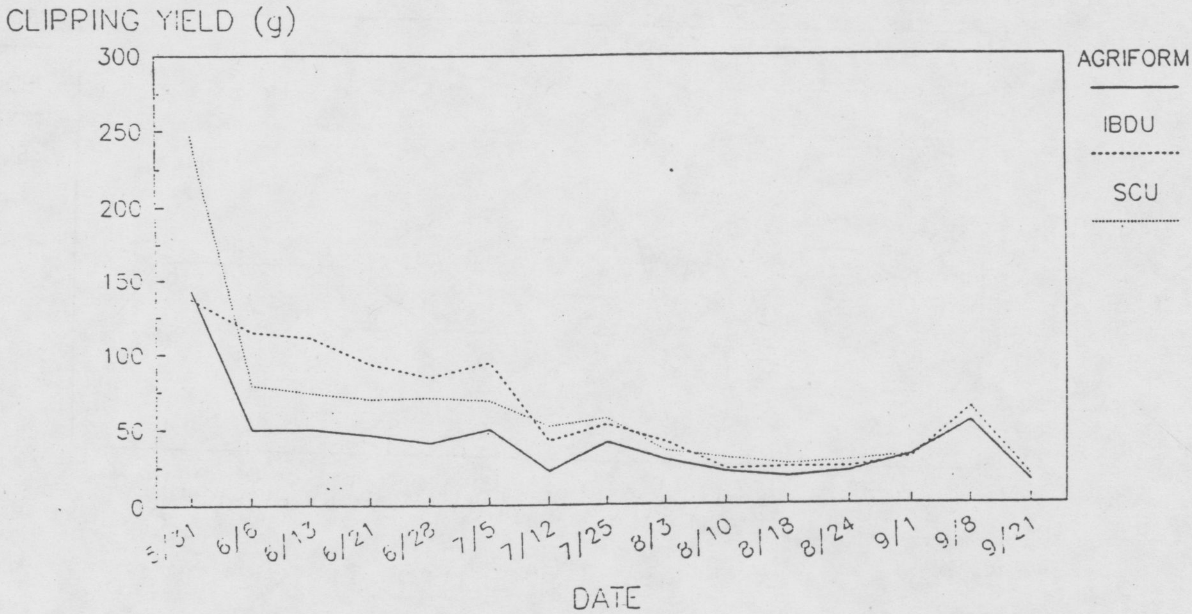
4 lb. N/1000 sq.ft.-ONE APPLICATION
WEEKLY QUALITY RATINGS

	AGRIFORM	IBDU	SCU
5/31	5.5	7.0	8.0
6/6	5.0	8.0	7.0
6/13	5.5	8.0	7.0
6/21	5.5	8.0	7.0
6/28	4.5	8.0	6.0
7/5	6.5	8.0	7.5
7/12	4.0	7.0	6.5
7/25	6.5	6.0	7.0
8/3	6.5	5.5	6.0
8/10	4.5	3.5	4.0
8/18	4.0	3.0	4.0
8/24	4.0	3.5	5.0
9/1	4.5	4.0	4.0
9/8	5.0	4.0	4.0
9/15	5.0	4.5	4.5
9/21	5.0	4.5	4.5
9/29	5.0	4.5	5.0
10/6	5.0	5.0	4.5
10/20	4.0	4.5	4.0

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

TABLE 32

SIERRA CORP AGRIFORM STUDY
4 lb. N/1000 sq.ft.-ONE APPLICATION



CLIPPING YIELDS ARE IN GRAMS PER
14 sq.ft. OF PLOT

FIGURE 13

SIERRA CORP AGRIFORM STUDY
4 lb. N/1000 sq.ft.-ONE APPLICATION
WEEKLY CLIPPING YIELD (g)

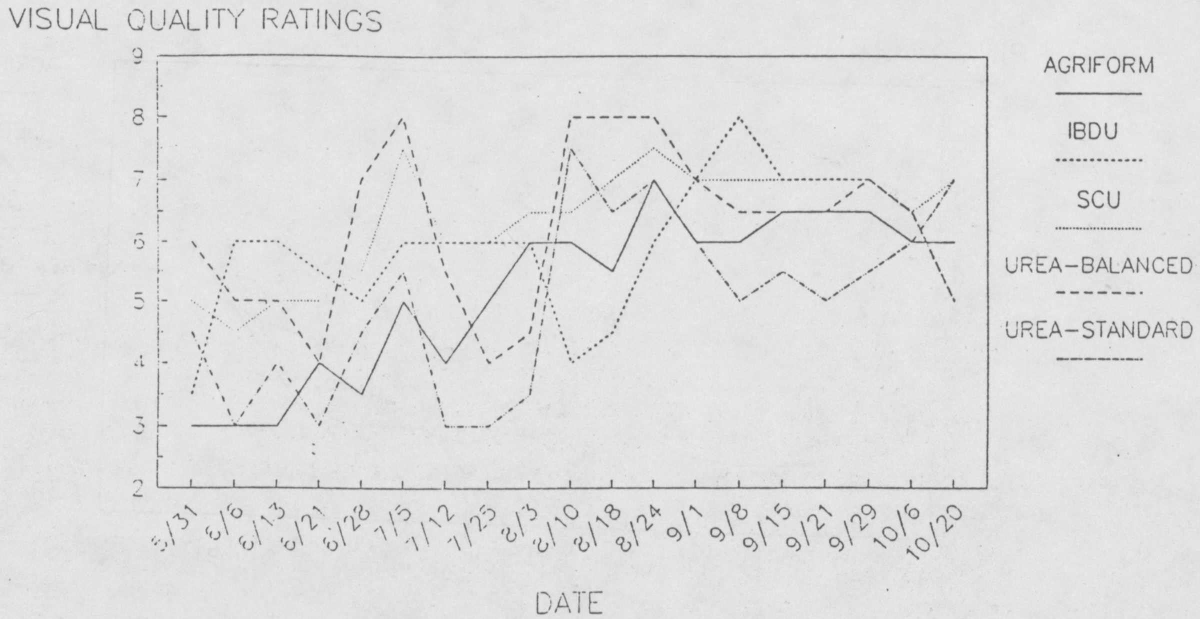
	AGRIFORM	IBDU	SCU
5/31	143	137	247
6/6	50	115	79
6/13	50	111	74
6/21	46	93	70
6/28	41	84	71
7/5	50	94	69
7/12	22	42	52
7/25	41	53	57
8/3	29	41	35
8/10	21	23	30
8/18	18	24	26
8/24	21	24	28
9/1	32	30	32
9/8	54	63	63
9/21	14	18	18

CLIPPING YIELDS ARE IN GRAMS PER
14 sq.ft. OF PLOT

TABLE 33

SIERRA CORP AGRIFORM STUDY

4 lb./1000 sq.ft. IN SPLIT APPLICATIONS.



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

FIGURE 14

SIERRA CORP AGRIFORM STUDY

4 lb./1000 sq.ft. IN SPLIT APPLICATIONS.

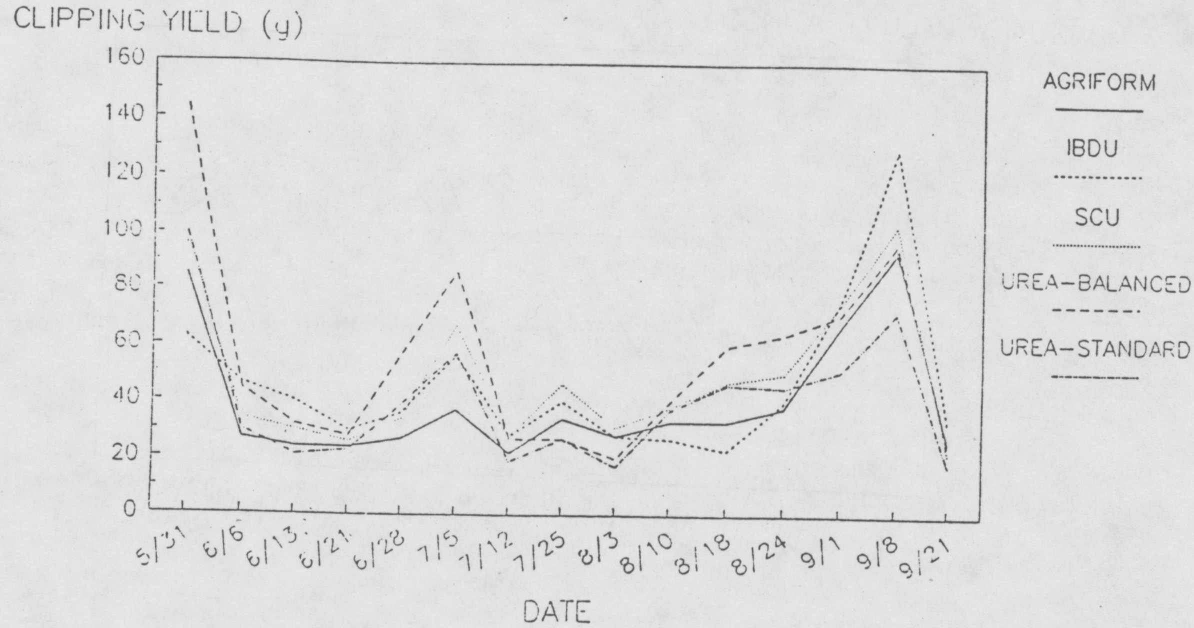
WEEKLY QUALITY RATINGS

	AGRIFORM	IBDU	SCU	UREA-BALANCED	UREA-STANDARD
5/31	3.0	3.5	5.0	6.0	4.5
6/6	3.0	6.0	4.5	5.0	3.0
6/13	3.0	6.0	5.0	5.0	4.0
6/21	4.0	5.5	5.0	4.0	3.0
6/28	3.5	5.0	5.5	7.0	4.5
7/5	5.0	6.0	7.5	8.0	5.5
7/12	4.0	6.0	6.0	5.5	3.0
7/25	5.0	6.0	6.0	4.0	3.0
8/3	6.0	6.0	6.5	4.5	3.5
8/10	6.0	4.0	6.5	8.0	7.5
8/18	5.5	4.5	7.0	8.0	6.5
8/24	7.0	6.0	7.5	8.0	7.0
9/1	6.0	7.0	7.0	7.0	6.0
9/8	6.0	8.0	7.0	6.5	5.0
9/15	6.5	7.0	7.0	6.5	5.5
9/21	6.5	7.0	7.0	6.5	5.0
9/29	6.5	7.0	7.0	7.0	5.5
10/6	6.0	6.5	6.5	6.5	6.0
10/20	6.0	5.0	7.0	5.0	7.0

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

TABLE 34

SIERRA CORP AGRIFORM STUDY
4 lb./1000 sq.ft. IN SPLIT APPLICATIONS.



CLIPPING YIELDS ARE IN GRAMS PER
14 sq.ft. OF PLOT

FIGURE 15

SIERRA CORP AGRIFORM STUDY
4 lb./1000 sq.ft. IN SPLIT APPLICATIONS.
WEEKLY CLIPPING YIELD (G)

	AGRIFORM	IBDU	SCU	UREA-BALANCED	UREA-STANDARD
5/31	85	63	96	144	100
6/6	27	46	34	44	30
6/13	24	40	30	32	21
6/21	24	30	26	28	23
6/28	27	36	34	57	39
7/5	37	56	67	86	57
7/12	22	28	28	27	19
7/25	34	40	46	27	27
8/3	28	28	31	20	17
8/10	33	27	38	40	37
8/18	33	23	47	60	46
8/24	38	40	50	64	45
9/1	67	76	75	71	51
9/8	94	130	104	97	72
9/21	26	32	22	24	18

CLIPPING YIELDS ARE IN GRAMS PER
14 sq.ft. OF PLOT

TABLE 35

Natural Organic Trial

M.L. Agnew

In the spring of 1989, a natural organic nitrogen (N) trial was established on a four-year-old Park Kentucky bluegrass (*Poa pratensis*) stand. The grass was mowed weekly with clippings removed, dried, and recorded. Irrigation was applied at a rate of 1 in of water/wk. Rainfall was scarce, therefore, the area exhibited signs of environmental stress throughout the summer. Due to a lack of irrigation water, no water was applied after September 1, 1989.

The purpose of this study was to compare eight 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, 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 are 5 ft by 10 ft.

Data collected during the summer of 1989 included visual quality and clipping yields. 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 is equal to a straw-brown turfgrass stand. Due to limited water, 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 the 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 per 17.5 ft^2.

Table 36 shows the clipping yield data for 1989. Statistical differences were observed only during the early part of the study. As expected, plots fertilized with urea produced the most clippings. Plots fertilized with Natures Preference produced the least amount of clippings. In addition, Natures Preference had an adverse effect on plant growth, as noted by a depressed overall clipping yield total. All other organic N products performed similarly to each other.

Table 37 shows the visual quality ratings for 1989. Urea, fine grade Sustane, and Ringer 6-1-3 had the best overall rating. Only the control and Natures Preference had an overall rating below the acceptable level of 6. Natures Preference performance did not fall off until mid-July, after which it performed poorly.

The response to individual fertilizers following application varied greatly. For example, urea treated plots responded quickly and gradually lost color. Plots fertilized with natural organic fertilizer sources were slower to green-up, but maintained color for longer periods. This provided continuous quality while maintaining a slower growth rate. In addition, the quality difference between urea and the natural organic fertilizers is not great enough to outweigh the lower amount of clippings produced by the natural organics.

Finally, all the fertilizer sources were evaluated as to their spreadability. Except for the ISU experimental and Natures Preference, all fertilizer sources were easy to spread. The ISU Experimental was applied in a powder form and great care was needed when applying to prevent the loss of material. The size of Natures' Preference granules was very irregular, making fertilizer application difficult.

This study will continue for two more years. Thatch development and nitrate levels will be collected at termination.

Table 36. Natural Organic Fertilizer Trial - Clipping Yields.

Fertilizer Source(a)	Date 5/23	6/01	6/06	6/13	6/21	6/28	7/06	7/11	7/19	7/27	8/01	8/10	8/16	8/23	8/30	9/10	9/15	9/21	10/20	CYT(d)
BIOTURF	31.6(b)	34.8	14.3	11.1	12.5	20.3	13.2	15.5	13.0	10.6	13.1	14.0	12.7	10.4	26.6	15.0	13.0	5.1	4.6	329.2
SUST MED	29.4	24.6	9.7	7.4	11.5	10.8	6.5	10.1	10.4	8.7	9.6	8.0	12.2	8.2	17.8	30.5	8.1	4.1	4.3	231.8
SUST FIN	30.2	36.6	12.4	8.4	10.4	15.6	10.5	12.4	12.0	8.3	12.8	13.0	12.3	13.1	26.6	43.3	10.7	5.3	5.0	298.9
ISU EXP	29.9	33.2	16.0	12.0	11.0	17.8	13.0	12.3	10.7	9.5	10.2	9.1	12.4	10.1	26.2	53.0	12.3	5.3	4.2	308.2
MILORG	23.4	31.6	11.6	6.7	9.3	8.1	7.7	10.0	10.9	9.4	11.8	11.7	11.4	11.0	26.0	44.9	9.9	5.4	5.2	266.0
NAT. PREF	27.7	19.1	8.9	4.4	8.1	5.9	4.4	6.9	4.8	4.5	6.0	6.3	6.8	5.6	9.8	15.9	5.2	2.0	2.1	154.5
UREA	47.3	51.0	19.9	10.3	20.3	28.1	17.7	14.7	13.0	9.2	11.9	11.0	12.0	16.6	35.3	47.6	10.9	4.4	6.0	387.2
RING 10	22.1	24.5	13.0	8.3	12.2	19.7	12.6	12.2	11.0	9.7	10.3	9.0	11.3	9.4	22.8	47.6	11.7	4.9	3.8	276.2
RING 6	31.9	30.3	12.7	10.7	12.0	27.9	11.6	12.9	11.5	8.1	13.5	13.0	14.1	10.2	27.4	49.7	12.7	5.3	5.3	320.9
CONTROL	30.3	20.2	7.0	5.8	11.4	7.7	4.6	7.5	7.4	8.9	8.2	9.4	8.9	8.0	11.1	24.1	8.0	4.0	3.1	195.5
LSD .05	NS	*(c)	6.7	4.7	NS	14.8	6.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

(a) Analysis of fertilizers includes Bioturf = 10-4-4, Sustane medium 5-2-4, Sustane fine 5-2-4, ISU EXP = 10% Nitrogen, Milorganite 6-2-0, Natures Preference 5-3-5, Ringer 10-2-6, Ringer 6-1-3, Urea 46-0-0.
(b) Clipping yields are reported as grams dry weight/17.5 ft^2.
(c) * indicates a significance level of 0.10.
(d) CYT = Clipping Yield Total for 1989.

Table 37. Natural Organic Trial - Visual Quality Ratings.

Fertilizer Source(a)	Date 5/21	5/26	6/2	6/11	6/19	6/23	6/30	7/11	7/18	7/28	8/4	8/14	8/18	8/24	9/1	9/12	9/17	9/25	10/6	10/20	11/7	VM(c)
BIOTURF	6.3	6.0	7.0	6.7	6.3	6.7	7.0	6.7	6.7	6.7	6.0	6.7	6.3	6.7	8.0	7.3	7.7	5.7	7.0	6.3	7.3	6.7
SUST MED	7.0	6.7	7.3	6.0	6.3	6.3	6.3	7.0	6.3	6.0	5.0	5.3	6.0	6.0	7.0	6.3	7.0	5.3	6.0	5.7	6.3	6.3
SUST FIN	7.0	6.7	7.7	7.3	7.0	7.7	8.0	7.3	7.0	6.3	6.0	6.7	6.7	7.0	8.3	7.3	7.3	6.3	7.3	6.7	7.7	7.1
ISU EXP	6.3	6.3	8.0	7.7	7.0	7.0	6.7	7.0	6.3	6.0	6.0	6.0	6.3	6.3	7.7	7.3	7.7	6.0	6.7	5.7	7.7	6.7
MILORG	6.7	6.7	7.3	7.3	6.3	6.0	6.3	6.7	7.0	5.7	5.7	6.0	6.0	6.7	7.0	7.0	7.3	6.0	6.7	6.0	7.0	6.5
NAT.PREF	6.7	6.3	7.0	6.0	5.3	7.0	7.0	7.0	5.0	6.0	5.3	5.3	5.7	5.7	5.0	4.3	4.0	4.0	4.7	4.3	4.3	5.5
UREA	8.0	9.0	9.0	8.0	8.3	7.3	7.7	7.3	7.3	6.7	6.3	6.3	6.3	7.3	8.3	7.7	8.3	6.0	6.7	6.7	9.0	7.5
RING 10	5.7	6.0	7.7	7.0	7.0	5.7	6.3	6.0	7.0	5.3	5.3	5.3	6.0	6.7	8.0	7.3	8.0	6.0	6.3	6.3	7.3	6.5
RING 6	6.7	7.0	7.7	6.7	7.0	7.3	7.7	7.7	6.7	6.7	6.3	6.3	7.0	7.0	8.0	7.7	8.0	6.0	6.3	6.0	7.7	7.0
CONTROL	6.3	5.7	5.0	5.3	4.7	5.7	5.3	6.3	5.7	6.0	6.0	5.7	6.7	6.0	5.0	4.7	5.0	5.0	4.7	4.7	4.7	5.4
LSD .05	0.9	1.0	.07	0.2	1.0	1.7	1.4	1.4	0.8	1.5	1.3	1.3	1.1	1.3	1.8	1.6	1.6	1.4	1.5	1.4	1.1	0.7

(a) Analysis of fertilizers includes Bioturf = 10-4-4, Sustane medium 5-2-4, Sustane fine 5-2-4, ISU EXP = 10% Nitrogen, Milorganite 6-2-0, Natures Preference 5-3-5, Ringer 10-2-6, Ringer 6-1-3, Urea 46-0-0.
(b) 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.
(c) VM = average quality rating for 1989

Liquid Fertilizer Trial

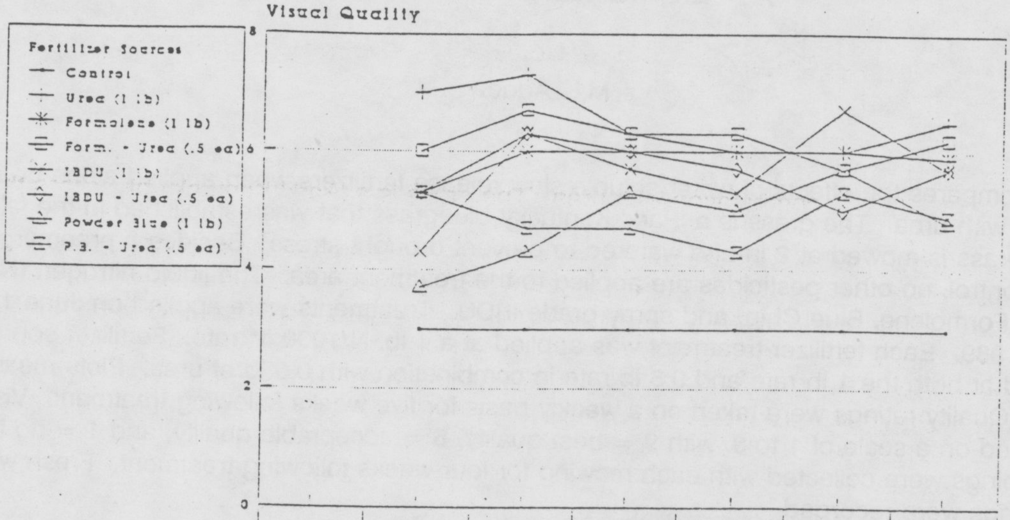
M.L. Agnew

This study compares the effects of water soluble slow release fertilizers when applied alone or in combination with urea. The grass is a 'Park' Kentucky bluegrass that was established in the fall of 1987. The grass is mowed at 2 in and watered to prevent drought stress. Besides a preemergence crabgrass control, no other pesticides are applied to the treatment area. The liquid nitrogen (N) sources are Formolene, Blue Chip, and spray grade IBDU. Treatments were applied on June 13 and August 24, 1989. Each fertilizer treatment was applied at a 1 lb. N/1000 ft^2 rate. Fertilizer sources were applied at both the 1 lb rate and 0.5 lb rate in combination with 0.5 lb of urea. Plots measured 5 ft by 5 ft. Quality ratings were taken on a weekly basis for five weeks following treatment. Visual quality is rated on a scale of 1 to 9, with 9 = best quality, 6 = acceptable quality, and 1 = no live grass. Clippings were collected with each mowing for four weeks following treatment. Fresh weights of the clippings were recorded.

The quality data for the first fertilizer treatment is included in Figure 16. Urea and formolene plus urea were the only treatment to have an acceptable overall quality. This data is reflective of a treatment applied prior to the onset of stress. The quality data for the second fertilizer treatment is included in Figure 17. Only Powder Blue, IBDU + urea, and the control had overall quality levels less than the acceptable level. The response of the second treatment is reflective of good growing conditions until mid-September. All irrigation at the research site was terminated at this time.

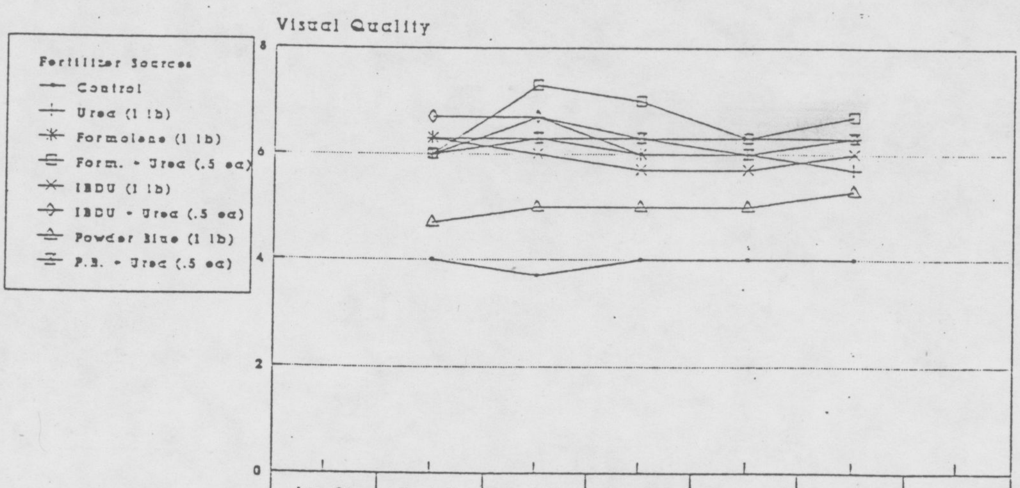
The clipping data for the first fertilizer treatment is included in Figure 18. Treatment differences were not evident during this period. Fertilizer source did not compensate for environmental stress. Under more optimal weather conditions, clipping yield differences were evident (Figure 19). Overall, the IBDU treatments produced the most clippings followed by the Formolene treatments and Powder Blue + urea.

Figure 16. Effects on visual quality. (Fertilizer application on June 13, 1989.)



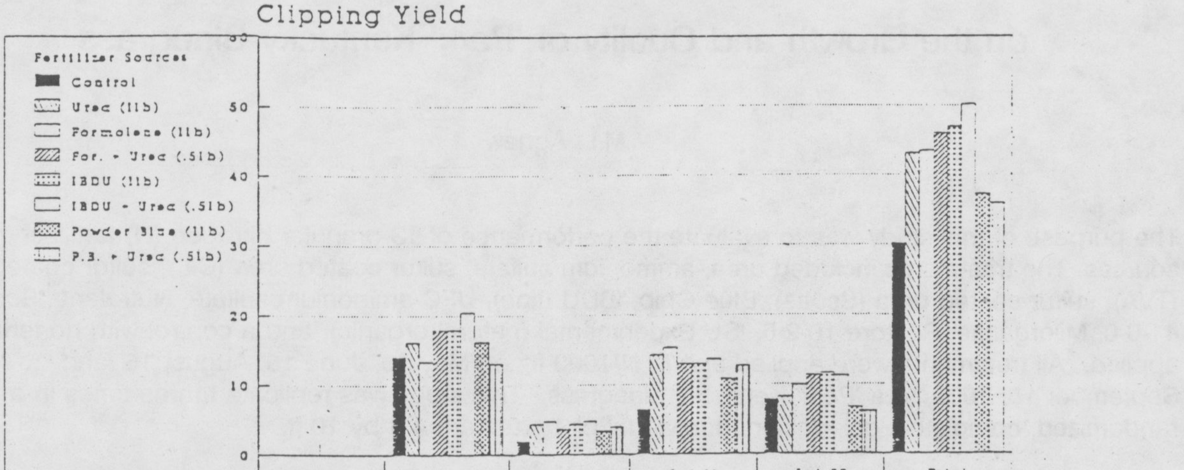
	Jun 13	Jun 21	Jun 29	Jul 07	Jul 11	Jul 26	Mean
Control		3	3	3	3	3	3
Urea (1 lb)		7	7.3	6.3	6	6	6.5
Formolene (1 lb)		5.3	6	6	6	6	5.9
Form. + Urea (.5 ea)		6	6.7	6.3	6.3	5.7	6.2
IBDU (1 lb)		4.3	6.3	5.7	5.3	6.7	5.7
IBDU + Urea (.5 ea)		5.3	6.3	6	5.7	5	5.7
Powder Blue (1 lb)		3.7	4.3	5.3	5	5.7	4.8
P.B. + Urea (.5 ea)		5.3	4.7	4.7	4.3	5.3	4.9
LSD (0.05)		1.1	1.1	2.0	1.4	1.7	1.1

Figure 17. Effects on visual quality. (Fertilizer application on August 24, 1989.)



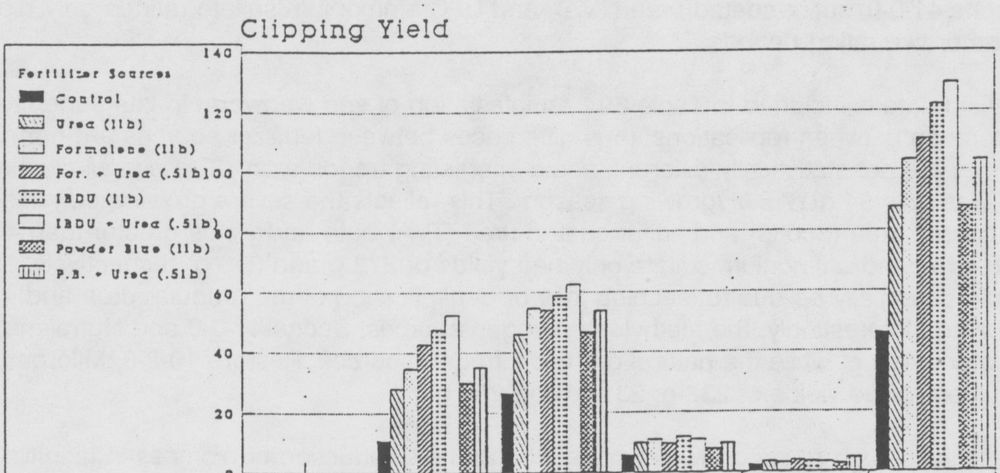
	Aug 24	Sept 01	Sept 08	Sept 15	Sept 21	Sept 29	Mean
Control		4	3.7	4	4	4	3.9
Urea (1 lb)		6	6.7	6	6	5.7	6.1
Formolene (1 lb)		6.3	6.3	6	6	6.3	6.2
Form. + Urea (.5 ea)		6	7.3	7	6.3	6.7	6.7
IBDU (1 lb)		6.3	6	5.7	5.7	6	5.9
IBDU + Urea (.5 ea)		6.7	6.7	6.3	6.3	6.3	6.5
Powder Blue (1 lb)		4.7	5	5	5	5.3	5.0
P.B. + Urea (.5 ea)		6	6.3	6.3	6	6.3	6.2
LSD (0.05)		1.2	0.9	1.1	1.1	1.3	0.6

Figure 18. Effects on clipping yields. (Fertilizer application on June 13, 1989.)



	Jun 13	Jun 30	Jul 7	Jul 11	Jul 20	Total
Control		14.1	2	6.4	7.8	30.2
Urea (1lb)		16.2	4.4	14.3	8.2	43.1
Formolene (1lb)		13.4	4.3	15.4	9.9	43.5
For. + Urea (.5lb)		18	3.7	13	11.3	46
IBDU (1lb)		18	4.4	13	11.6	47
IBDU + Urea (.5lb)		20.5	4.3	13.7	11.2	50.2
Powder Blue (1lb)		16.3	3.4	10.8	6.7	37.2
P.B. + Urea (.5lb)		13.1	4	12.7	6.1	36.9
LSD (0.05)		N.S.	N.S.	1.5	N.S.	N.S.

Figure 19. Effects on clipping yields. (Fertilizer application on August 24, 1989.)



	Aug 24	Aug 30	Sep 10	Sep 16	Sep 21	Total
Control		11.1	26.7	6.9	2.5	46.2
Urea (1lb)		28.2	46.2	9.9	3.4	87.7
Formolene (1lb)		34.8	54.7	11	3.1	103.6
For. + Urea (.5lb)		42.8	54.1	9.7	4	110.6
IBDU (1lb)		47.8	59	11.8	3.5	122.1
IBDU + Urea (.5lb)		52.5	62.3	10.9	3.3	129.4
Powder Blue (1lb)		30.2	46.9	8	2.8	87.8
P.B. + Urea (.5lb)		35.1	54	9.7	4.8	103.6
LSD (0.05)		8.3	11.0	4.0	N.S.	10.9

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

M.L. Agnew

The purpose of this study was to evaluate the performance of 13 granular nitrogen (N) 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 are 4 ft by 10 ft.

All plots were mowed at a 2 in height with all clippings removed. The research plots were irrigated a minimum of 1.5 in water/growing week until September 1. No additional irrigation was applied after September 1 due to a lack of irrigation water at the research station.

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 turf. Clipping yields were obtained at each mowing by collecting all leaf tissue above 2 in within a 1.75 ft by 10 ft (17.5 ft^2) area. Clippings were dried and weights recorded.

The visual quality data is included in Table 38. None of the fertilizer sources exhibited an average quality less than 6. Sulfur coated urea (Scotts), Scotts 41-0-0, IBDU, sulfur coated urea (CIL), sulfur coated urea (TVA), Nutralene, Urea, ammonium sulfate, UFC ammonium sulfate, and ISU experimental all had an average quality rating greater than 7. The only fertilizer sources to maintain a 6 rating or better on each date was IBDU (fine) and sulfur coated urea (Scotts). Sulfur coated urea (CIL), Nutralene, Scotts 41-0-0, sulfur coated urea (TVA), and UFC ammonium sulfate ratings only dipped below 6 on one or two rating periods.

The clipping yield data is included in Table 39. An infestation of sod webworm in late June created a significant difference between replications, thus differences between fertilizer sources are nonexistent. While differences are not statistically different, some interesting trends exist. The overall clipping yield of the control was only 54 g/17.5 ft^2/growing season. This reflects the severe growing conditions of 1989. Sulfur coated urea (Scotts) and sulfur coated urea (TVA) both had yields greater than 400 g. In comparison, urea and ammonium sulfate only had yields of 272 g and 319 g, respectively. This difference could potentially be due to leaching loss or denitrification of the granular urea and ammonium sulfate. Interestingly, the methylene nitrogen sources, Scotts 41-0-0 and Nutralene, had yields of 237 g and 194 g, while the natural organic nitrogen sources, Restore 10-2-6, Milorganite, and the ISU Experimental had yields of 237 g, 231 g, and 259 g.

Environmental issues such as groundwater protection and the reduction of biomass in landfills are primary concerns of all turfgrass managers. One way to reduce clipping production is to select fertilizers that produce fewer clippings. In addition, it is also important to choose fertilizers that won't leach into the ground water on sandy turfgrass sites. The challenge to the turfgrass manager, however, is to maintain good quality, while reducing clipping production. Data presented here will help the turfgrass manager make that decision.

Table 38. Granular fertilizer trial visual quality ratings[a].

Fertilizer Source	5/21	5/26	6/02	6/14	6/19	6/23	6/30	7/11	7/18	7/28	8/04	8/11	8/18	8/24	9/01	9/11	9/17	9/25	10/6	10/20	11/7	VM[b]
Am. Sulphate	7.7	9.0	8.0	8.0	8.3	8.7	8.3	7.3	6.3	6.3	6.3	6.0	6.7	7.0	7.7	7.3	7.3	5.7	6.7	5.7	7.3	7.2
Blue Chip	6.3	7.0	6.3	5.3	6.7	6.3	6.3	6.3	6.0	6.3	6.0	6.3	6.0	6.7	7.0	7.0	7.7	6.0	7.0	6.3	7.0	6.5
SCU-CIL	8.0	8.7	7.3	7.7	8.0	8.3	8.3	7.3	7.0	7.3	7.3	7.3	7.0	7.0	8.0	7.7	8.3	6.3	7.3	6.3	8.0	7.6
SCU-TVA	8.0	8.7	7.7	7.7	8.0	7.7	7.0	6.7	6.3	7.0	6.7	7.0	6.7	7.0	7.7	8.0	8.3	6.7	7.0	7.0	8.0	7.4
SCU-Scotts	8.0	8.7	7.7	7.3	8.7	8.7	8.7	7.3	6.7	6.7	6.7	7.0	7.0	7.3	8.7	8.0	9.0	7.0	7.7	7.7	9.0	7.8
ISU Exp	7.7	8.7	7.7	7.0	7.7	8.0	8.0	5.7	5.3	7.0	6.3	6.7	6.7	6.7	8.3	7.3	8.7	6.7	6.7	6.3	8.3	7.2
Milorganite	6.3	7.3	5.3	6.0	5.7	6.0	6.3	7.0	6.3	6.3	6.3	6.0	7.0	6.3	7.7	7.3	7.7	6.7	7.3	6.3	7.3	6.6
Ringer 10%	6.0	6.7	6.0	6.7	6.7	6.7	7.0	6.7	6.0	6.3	6.3	6.3	7.3	6.7	8.0	7.7	8.7	6.7	7.3	6.3	6.7	6.8
Scotts 41%	8.0	9.0	8.0	8.0	8.7	8.3	8.3	7.0	7.0	7.0	6.7	7.0	6.7	6.7	8.3	7.3	8.3	6.3	7.0	7.0	8.3	7.6
Nutralene	7.7	9.0	7.7	7.3	8.3	7.7	7.7	7.7	7.0	7.0	6.7	6.7	6.7	7.0	8.0	7.3	7.7	6.3	7.3	6.0	8.0	7.4
IBDU	7.7	8.0	7.3	7.7	8.0	6.7	6.7	7.0	6.7	7.0	7.0	7.0	7.3	7.0	8.3	7.3	8.3	7.0	7.7	7.0	7.0	7.3
UFC-Am.Sul.	8.0	8.7	7.3	7.7	8.0	7.7	7.3	7.0	7.0	6.7	7.0	6.7	6.7	6.7	7.7	7.3	7.3	6.3	6.7	6.3	7.0	7.2
Urea	8.0	9.0	8.0	8.0	8.3	8.0	8.0	7.3	7.0	6.3	6.3	6.0	6.7	7.0	8.0	7.0	7.7	6.3	7.0	6.7	8.0	7.4
Control	4.0	4.7	4.0	4.0	4.0	4.0	4.3	4.3	4.3	5.0	4.7	5.0	5.7	6.0	4.7	4.7	3.0	4.3	5.3	4.0	4.0	4.5
LSD 0.05	0.7	1.0	0.8	0.7	1.1	1.2	1.2	1.3	1.0	0.8	0.9	0.8	1.4	1.0	1.5	1.0	1.5	1.4	1.4	1.5	1.4	0.7

[a] Visual quality is based on a scale of 9 to 1: 9 = dark-green, dense turfgrass, 6 = minimum acceptable quality, and 1 = straw brown turf.
[b] VM = average quality rating for 1989.

Table 39. Clipping yields[a] for 13 granular fertilizer sources.

Fertilizer Source	5/11	5/22	5/31	6/06	6/12	6/20	6/27	7/05	7/10	7/18	7/24	7/31	8/07	8/22	8/29	9/05	9/12	9/19	10/20	CYT[b]
Am. Sulphate	33.9	24.4	36.1	20.1	15.9	12.9	25.1	19.9	13.2	12.0	5.8	10.4	10.1	10.0	26.0	18.1	14.2	5.7	5.2	318.7
Blue Chip	10.3	15.2	11.0	7.5	8.1	5.1	7.5	6.2	6.7	8.2	4.4	5.4	8.4	5.7	13.2	10.4	8.9	3.2	2.9	148.4
SCU-CIL	28.7	25.3	23.8	17.6	16.3	14.2	29.6	25.2	14.9	18.8	10.8	19.3	17.5	11.2	30.8	20.1	18.9	6.9	8.7	358.6
SCU-TVA	75.2	30.4	33.1	19.9	18.1	12.9	22.2	14.6	12.0	15.2	10.7	16.5	18.4	14.0	36.0	25.6	20.8	9.5	10.7	415.8
SCU-Scotts	64.6	37.4	36.0	23.4	16.9	12.3	28.9	21.3	15.2	16.7	9.5	15.2	18.1	12.7	42.6	28.3	23.3	10.5	11.8	444.5
ISU Exp	27.8	21.2	18.5	15.0	14.5	4.3	18.8	13.1	7.8	13.0	8.8	9.4	10.7	6.4	21.3	20.4	16.5	6.1	5.5	259.0
Milorganite	20.3	16.8	18.0	10.6	10.7	7.3	11.5	10.0	10.0	9.6	6.6	9.2	13.0	6.8	23.3	18.2	16.4	6.7	6.0	230.7
Ringer 10%	29.9	16.7	13.6	13.8	9.1	7.6	13.4	14.9	9.8	10.7	5.8	10.5	11.8	5.4	19.7	17.6	17.0	4.9	4.8	237.0
Scotts 41%	26.7	19.0	17.0	11.0	14.0	5.9	18.5	12.2	8.3	12.4	6.0	8.0	12.2	8.1	19.9	15.9	13.5	4.3	5.0	238.0
Nutralene	23.1	18.0	16.5	10.7	12.2	6.9	10.4	8.3	5.2	6.3	4.6	5.1	11.5	4.0	14.6	15.7	13.1	4.2	3.6	194.0
IBDU	48.3	20.7	26.6	13.3	13.8	9.7	13.1	16.9	13.1	15.4	9.4	15.2	17.7	10.1	18.4	19.8	18.1	8.1	7.2	314.8
UFC-Am.Sul.	51.4	22.5	18.8	12.4	14.2	11.1	19.2	17.2	9.7	15.6	7.7	10.8	14.4	9.7	28.0	17.3	16.2	6.2	4.9	307.5
Urea	30.5	24.5	23.4	12.2	12.0	9.6	17.9	15.9	8.3	9.5	6.1	11.7	11.3	7.9	25.6	20.6	13.9	5.1	5.9	271.8
Control	4.7	6.7	4.3	4.2	3.3	2.3	1.7	0.5	2.1	1.9	1.5	1.7	4.9	1.6	3.5	3.9	3.5	1.1	1.4	54.9
LSD(0.05)	54.5	18.8	18.3	9.6	10.0	10.7	17.8	18.9	12.3	14.7	8.1	12.9	11.5	9.0	25.7	17.2	10.8	6.8	7.4	268.3

[a] Clipping yields are reported as g dry weight/17.5 ft^2.
[b] CYT = Clipping yield total for 1989.

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

M.L. Agnew

This study compares the effects of core cultivation on the performance of four granular nitrogen (N) sources. The study was established on May 20, 1988, and is to continue through 1990. The turf is Park Kentucky bluegrass established in the fall of 1987. The grass is mowed weekly at 2 in and all clippings are removed. Irrigation was applied at a rate of 1.5 in/wk until September 1. No additional irrigation was applied after September 1 due a lack of irrigation water at the research station.

Treatments included five N treatments and two cultivation treatments. The fertilizer included milorganite, Blue Chip, Scotts methylene urea (41-0-0), ISU Experimental (natural organic), and a nonfertilized control. Cultivation treatments included core cultivation and noncultivated control. Treatments were applied on May 5 and August 15, 1989. Each fertilizer was applied immediately following each cultivation treatment.

This study was replicated three times in a randomized, complete-block design. Individual plot sizes are 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 9 = to dark-green, dense turfgrass, 6 = to minimum acceptable quality, and 1 = to straw turf. Clipping yields were collected on a weekly basis by removing all the leaf tissue above 2 in within a 21 in x 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 g/17.5 ft^2.

Visual quality data is presented in Table 40. There were no differences between cultivation treatments or fertilizer x cultivation interaction. The data presented in Table 40 is a total summary of each treatment. All fertilizer sources consistently had better quality than the untreated control (Figure 20). Scott's 41-0-0 fertilizer greened-up the quickest in the spring and maintained acceptable quality throughout the growing season. The ISU Experimental fertilizer performed similarly to the Scotts product. Milorganite and Blue Chip demonstrated 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. The ISU Experimental had the greatest total clipping production, followed by Scott's 41-0-0, Milorganite, and Blue Chip. All fertilizers had greater clipping production when compared to the nonfertilized control (Figure 21). Core cultivation had a negative effect on May 22 and June 20 (Figure 22). While this only showed up on two days, it indicates that cultivation before dry weather has an effect on clipping production.

Table 40. Fertilizer cultivation study visual quality[a] ratings.

Fertilizer		May		June		July						August			September			October				November			
Source	Coring	26	18	21	26	2	11	19	24	30	11	18	28	4	11	18	24	1	11	17	25	6	20	7	Mean	WWD
Blue CH	Y	6.3	7.6	7.7	7.3	7.7	6.7	7.0	6.3	6.7	5.7	5.3	5.3	5.7	6.0	5.7	6.0	6.0	6.3	6.3	6.0	5.7	6.0	7.0	13.3	3.3
BLUE CH	N	6.7	7.7	8.0	7.7	6.7	6.3	8.0	6.0	6.3	6.7	6.0	5.3	6.0	6.0	6.0	6.3	6.3	6.7	6.7	5.7	5.3	6.0	6.0	12.7	3.3
CONTROL	Y	4.0	4.3	4.3	4.3	4.0	3.7	4.0	3.7	3.7	3.3	3.7	3.7	5.0	5.3	6.0	6.0	4.3	4.0	3.3	3.7	6.3	4.0	6.7	10.7	2.3
CONTROL	N	4.0	4.7	4.0	4.7	4.0	4.3	4.0	3.7	3.7	3.3	3.7	3.7	4.7	4.7	5.3	5.7	4.0	4.0	3.7	4.0	5.7	3.3	6.0	10.0	2.7
ISU EXP	Y	7.3	7.3	8.3	8.7	8.3	8.0	8.3	7.0	7.3	7.0	6.7	6.0	6.7	6.7	6.7	7.0	7.7	7.7	8.0	7.0	6.0	7.0	5.7	13.0	2.7
ISU EXP	N	7.3	7.7	8.0	9.0	8.0	8.0	8.3	7.0	7.3	6.7	6.3	6.0	6.3	6.0	6.0	6.3	7.7	7.7	8.0	7.0	7.0	7.3	8.7	16.0	2.3.
MILORG	Y	7.0	7.0	7.0	8.3	7.0	6.7	7.3	6.3	6.3	6.0	5.7	5.0	5.7	5.7	6.0	6.3	6.7	7.3	7.7	6.7	6.7	7.3	8.3	15.3	2.7
MILORG	N	7.0	7.7	7.3	8.3	6.7	6.7	7.7	6.0	6.7	6.0	5.7	4.7	6.0	5.7	6.3	6.3	7.0	7.7	7.7	7.0	6.3	7.0	6.0	13.0	2.7
SCOTTS	Y	7.7	8.3	9.0	9.0	8.3	8.7	9.0	8.0	8.0	7.0	6.7	6.0	6.0	6.7	6.3	6.7	7.3	6.7	7.3	6.3	6.7	7.0	8.3	16.0	2.3
SCOTTS	N	7.7	8.3	8.7	9.0	9.3	8.7	8.3	8.0	7.3	7.0	6.7	6.3	6.3	6.3	6.3	7.0	7.0	7.0	7.0	6.7	6.7	7.3	8.0	15.7	2.7
LSD 00.5		0.4	0.6	0.5	0.6	0.7	0.8	0.8	0.8	0.7	0.9	0.9	1.2	0.7	0.7	0.7	0.5	1.0	0.7	0.6	0.7	1.0	0.9	2.2	2.2	0.7
		NS[b]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Quality based on the rate of 9 to 1: 9 = good quality, 6 = acceptable quality, and 1 = dead turf.
[b] NS = Non Significant.

Table 41. Fertilizer cultivation study clipping yields.

Fertilizer		May				June				July				August				September		Oct	
Source	Coring	5/11	5/22	5/31	6/06	6/12	6/20	6/27	7/05	7/10	7/18	7/24	7/31	8/07	8/22	8/27	9/05	9/12	9/19	10/20	Total
NONE	Y	2.4	8.5	3.7	4.3	2.5	1.2	1.4	0.5	0.6	1.3	0.8	0.9	3.2	1.7	2.3	2.0	2.3	0.7	1.4	41.6
NONE	N	4.8	11.7	5.3	3.5	3.8	2.4	3.2	0.9	1.2	1.4	0.8	1.4	4.1	2.0	2.7	3.5	2.6	0.9	1.4	57.6
MILORGANITE	Y	13.8	32.5	30.1	20.0	12.3	5.3	9.4	5.4	4.0	5.8	2.9	5.2	6.8	4.1	12.5	18.0	19.8	6.2	6.4	220.3
MILORGANITE	N	17.1	46.1	36.5	20.9	12.4	9.2	7.1	5.8	4.4	6.0	4.0	5.6	9.9	3.7	12.8	19.0	20.6	6.0	5.5	252.6
BLUE CHIP	Y	8.1	26.0	9.5	11.3	8.5	4.2	4.4	3.5	3.2	3.1	1.9	3.7	5.0	2.8	6.6	6.9	5.8	2.3	2.1	119.0
BLUE CHIP	N	12.8	40.2	22.1	13.4	7.1	6.1	6.1	4.0	3.7	5.2	3.0	4.6	6.3	3.7	9.5	8.0	9.3	3.2	3.2	171.7
SCOTTS 41-0-0	Y	26.3	51.6	34.5	20.8	14.7	7.1	12.3	7.4	5.5	6.5	3.5	7.4	7.8	4.3	13.3	11.6	14.0	4.6	5.7	259.0
SCOTTS 41-0-0	N	21.7	47.7	29.1	22.2	12.8	10.4	11.1	9.9	4.2	7.7	3.2	6.8	8.5	5.5	16.8	12.4	15.3	4.0	4.8	254.3
ISU EXP	Y	29.0	54.0	50.5	34.7	24.0	9.0	12.6	7.4	6.2	8.6	4.4	7.9	9.7	4.9	22.1	25.1	26.5	7.7	8.7	353.1
ISU EXP	N	26.8	49.8	43.8	23.7	14.9	11.2	9.8	7.1	4.4	5.1	2.9	6.4	7.7	5.5	19.1	21.3	23.7	8.5	6.2	298.1
LSD FERT (0.05)	Y	10.3	17.5	11.3	7.4	4.1	2.6	3.5	3.8	2.2	3.7	1.6	2.5	2.7	2.1	7.4	8.2	6.0	2.2	3.0	87.3
LSD CORE (0.05)		NS	NS	NS	NS	NS	1.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Figure 20. Fertilizer effects on visual quality.

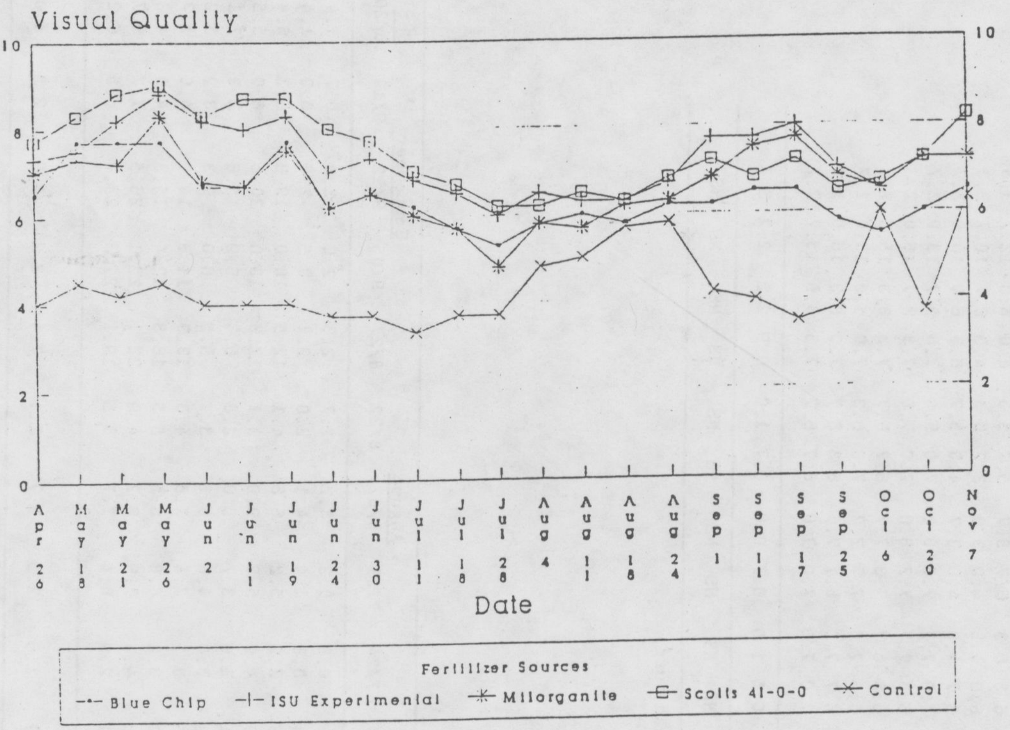


Figure 21. Fertilizer effects on clipping yield.

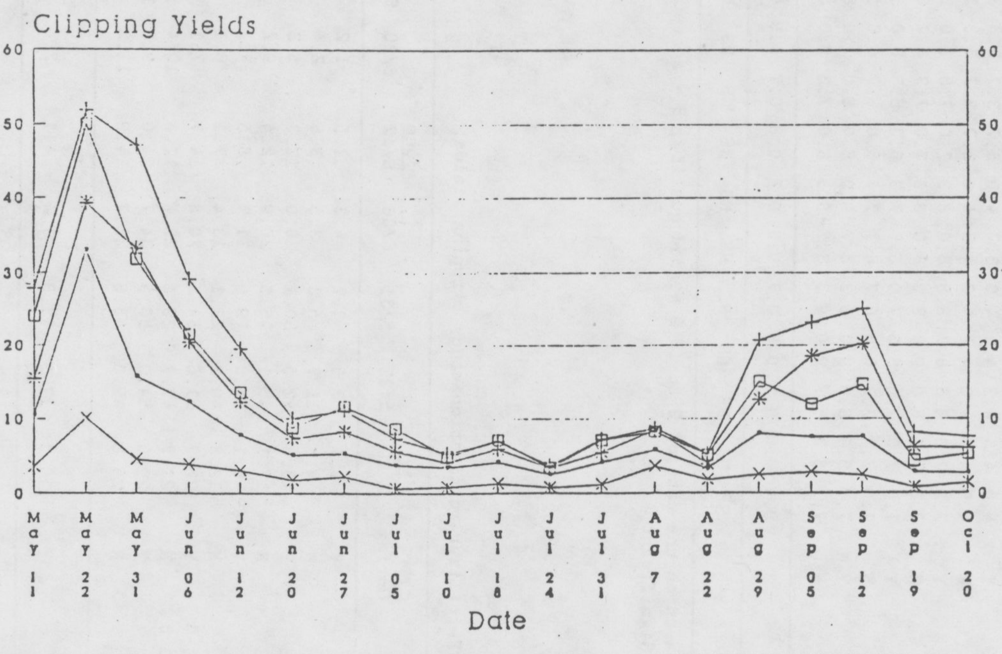
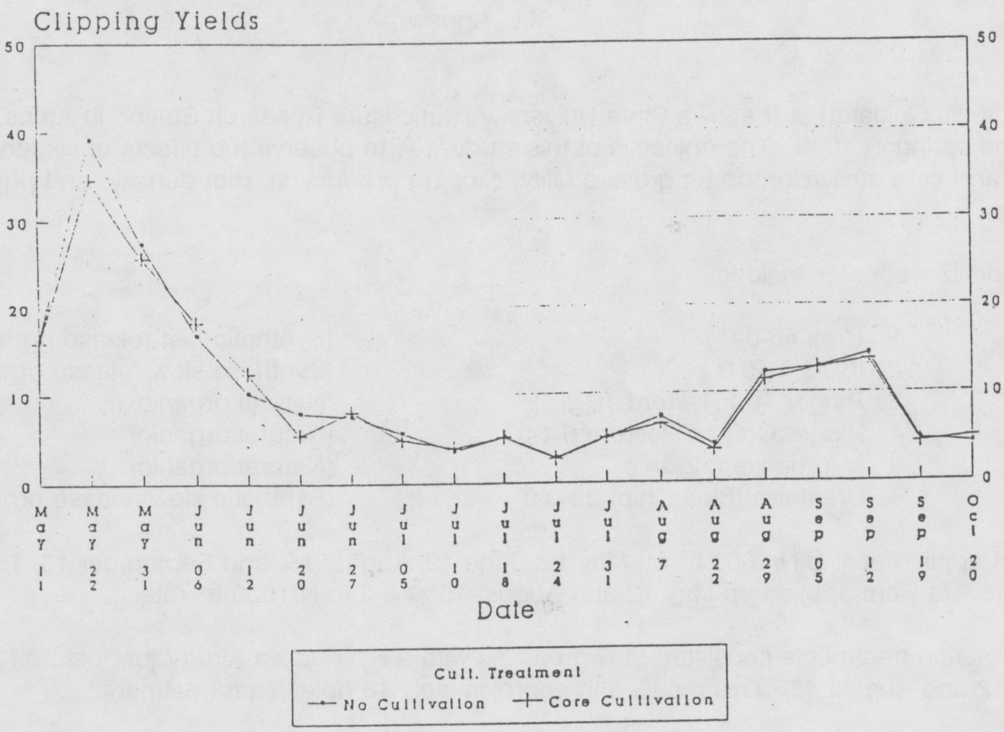


Figure 22. Cultivation effects on clipping yield.



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 Greens 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 12, June 12, August 15, and September 15, 1989. All other fertilizers were applied on May 12 and August 15 at a 2 lb N/1000 ft^2 rate.

Core cultivation treatments consisted of two passes with a Ryan Lawn-Aire IV just before fertilization on May 12 and August 15. This resulted in approximately 18 holes/sq ft/treatment.

Traffic stress was initiated on June 2 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 dry summer of 1989, the predominate traffic stress was wear.

SOIL PHYSICAL PROPERTIES

One undisturbed soil sample was collected from each plot on July 15 and October 15. Total porosity, air-filled porosity, and bulk density were determined on each sample. Penetrometer resistance was measured on the samples taken on October 15.

Fertilizer source and traffic stress had no effect on soil physical properties (Tables 42 and 43). A treatment difference was noted between cultivation treatments in October. Total porosity and air-filled porosity of the cultivated plots were 43.6 and 22.0%, respectively, whereas total porosity and air-filled porosity of the noncultivated plots were 44.9 and 20.8%, respectively. None of the samples demonstrated air-filled porosities at less than a 15% level, the condition at which plants have difficulty growing.

PLANT GROWTH CHARACTERISTICS

Visual quality ratings and clipping yield samples were collected on a weekly basis. Shoot density, thatch development, and root density samples were collected on July 17. All plots were rated on a visual scale of 9 to 1. A rating of 9 is equal to a dark green, dense turfgrass, whereas a rating of 1 is equal to 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 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 bags and dried. Weights were recorded as g/17.5 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. 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 Figures 23a , 23b, and 23c. Urea, Restore 10-2-6, and Restore 6-1-3 demonstrated the best overall quality. These three fertilizer sources maintained an acceptable quality throughout the year.

The effect of fertilizer source on clipping yields is presented in Figures 24a and 24b. The urea, IBDU, Restore 10-2-6, Milorganite, Restore 6-1-3, and Blue Chip had total yields of 125.1 g, 96.8 g, 134.1 g, 103.3 g, 135.3 g, and 96.3 g, respectively. The treatments with higher yields corresponded to the better quality ratings. In spring, this response was much greater for urea than any other fertilizer source. In fall, this response was greater for Restore 10-2-6 and Restore 6-1-3.

There were no effects of fertilizer on either shoot density or thatch development (Table 44). Only one application of fertilizer was applied prior to the sampling date. Therefore, no differences were expected.

There were no effects of fertilizer on root density in the upper three soil zones (Figure 25). However, minor differences did occur at the 10% level in the 15 to 20 cm soil zone. Milorganite had the greatest root mass followed by Restore 10-2-6 and Blue Chip.

<u>Core cultivation</u>:

There was little or no effect of core cultivation on visual quality (Tables 45, 46, and 47), clipping yields (Tables 48, 49, and 50), or root density (Table 51). Core cultivation significantly reduced shoot density (Figure 26). This decrease is likely due to removal of tillers during the cultivation process.

<u>Traffic Stress</u>:

Core cultivation had little effect on plant growth. However, traffic stress did adversely affect plant growth. Traffic reduced overall plant quality, and dramatically affected quality in June and October (Figure 27a and 27b). Traffic also decreased clipping yields (Figure 28a and 28b). Overall clipping yields were 124 g for non-traffic areas and 106 g for traffic areas. Furthermore, traffic reduced shoot density (Figure 29) and root density at the 15 to 20 cm soil depth (Table 51).

Table 42. The effects of fertilizer source, core cultivation, and traffic on soil physical properties, July, 1989.

Treatment Number	Core Cultivation	Traffic	Bulk Density	Total Porosity	Air-filled Porosity
1 UREA	YES	YES	1.34	51.4	26.6
2 UREA	YES	NO	1.37	57.1	30.3
3 UREA	NO	YES	1.29	62.1	31.6
4 UREA	NO	NO	1.38	50.4	25.4
5 IBDU	YES	YES	1.38	54.6	24.5
6 IBDU	YES	NO	1.42	52.2	27.4
7 IBDU	NO	YES	1.24	54.8	29.5
8 IBDU	NO	NO	1.42	55.6	30.2
9 RESTORE 10-2-6	YES	YES	1.40	52.5	27.0
10 RESTORE 10-2-6	YES	NO	1.31	50.9	26.4
11 RESTORE 10-2-6	NO	YES	1.42	49.4	25.7
12 RESTORE 10-2-6	NO	NO	1.40	50.7	25.7
13 MILORGANITE	YES	YES	1.37	50.6	26.7
14 MILORGANITE	YES	NO	1.40	49.9	25.9
15 MILORGANITE	NO	YES	1.37	51.3	26.5
16 MILORGANITE	NO	NO	1.29	51.9	28.2
17 RESTORE 6-1-3	YES	YES	1.44	49.2	24.4
18 RESTORE 6-1-3	YES	NO	1.36	50.2	25.4
19 RESTORE 6-1-3	NO	YES	1.34	50.4	27.5
20 RESTORE 6-1-3	NO	NO	1.36	54.4	28.5
21 BLUE CHIP	YES	YES	1.42	50.9	26.5
22 BLUE CHIP	YES	NO	1.38	54.5	28.5
23 BLUE CHIP	NO	YES	1.38	49.5	25.4
24 BLUE CHIP	NO	NO	1.31	50.9	26.3
$LSD_{(0.05)}$ FERT			NS	NS	NS
$LSD_{(0.05)}$ CORE			NS*	NS	NS
$LSD_{(0.05)}$ TRAFFIC			NS	NS	NS

*Significant at the 10% level.

Table 43. The effects of fertilizer source, core cultivation, and traffic on soil physical properties, October, 1989.

Treatment Number	Core Cultivation	Traffic	Bulk Density	Total Porosity	Air-filled Porosity	Penetration Resistance
1 UREA	YES	YES	1.31	44.0	21.3	3.08
2 UREA	YES	NO	1.35	44.7	20.9	3.33
3 UREA	NO	YES	1.23	44.4	22.8	3.00
4 UREA	NO	NO	1.34	43.2	20.3	3.50
5 IBDU	YES	YES	1.35	43.8	21.0	3.17
6 IBDU	YES	NO	1.30	42.9	20.9	3.00
7 IBDU	NO	YES	1.30	45.3	23.3	3.25
8 IBDU	NO	NO	1.38	45.9	21.3	3.17
9 RESTORE 10-2-6	YES	YES	1.30	44.1	21.5	2.91
10 RESTORE 10-2-6	YES	NO	1.29	45.0	22.0	3.08
11 RESTORE 10-2-6	NO	YES	1.23	43.6	22.2	2.58
12 RESTORE 10-2-6	NO	NO	1.33	45.2	21.7	3.33
13 MILORGANITE	YES	YES	1.33	42.2	26.7	3.17
14 MILORGANITE	YES	NO	1.29	43.7	20.7	2.67
15 MILORGANITE	NO	YES	1.38	46.7	23.0	2.67
16 MILORGANITE	NO	NO	1.28	45.0	21.5	3.00
17 RESTORE 6-1-3	YES	YES	1.33	42.6	19.9	3.25
18 RESTORE 6-1-3	YES	NO	1.31	43.0	20.2	2.92
19 RESTORE 6-1-3	NO	YES	1.33	44.7	21.4	2.92
20 RESTORE 6-1-3	NO	NO	1.31	44.6	21.6	3.42
21 BLUE CHIP	YES	YES	1.30	43.5	20.7	2.92
22 BLUE CHIP	YES	NO	1.30	44.2	21.1	2.83
23 BLUE CHIP	NO	YES	1.28	45.3	23.3	2.92
24 BLUE CHIP	NO	NO	1.31	45.1	21.2	3.00
$LSD_{(0.05)}$ FERT			NS	NS	NS	NS
$LSD_{(0.05)}$ CORE			NS	1.2	NS*	NS
$LSD_{(0.05)}$ TRAFFIC			NS	NS	NS	NS

*Significant at the 10% level.

Table 44. The effect of fertilizer source, core cultivation, and traffic stress on shoot density and thatch depth.

Treatment Number	Core Cultivation	Traffic Stress	Shoot Density	Thatch Depth (mm)
1 UREA	YES	YES	62.9	14.7
2 UREA	YES	NO	56.9	14.6
3 UREA	NO	YES	70.3	12.1
4 UREA	NO	NO	63.7	12.9
5 IBDU	YES	YES	55.1	13.7
6 IBDU	YES	NO	57.3	12.2
7 IBDU	NO	YES	67.7	11.3
8 IBDU	NO	NO	72.0	11.8
9 RESTORE 10-2-6	YES	YES	59.3	13.7
10 RESTORE 10-2-6	YES	NO	68.8	14.7
11 RESTORE 10-2-6	NO	YES	51.7	12.3
12 RESTORE 10-2-6	NO	NO	75.4	13.6
13 MILORGANITE	YES	YES	55.2	15.4
14 MILORGANITE	YES	NO	67.8	15.2
15 MILORGANITE	NO	YES	66.1	14.4
16 MILORGANITE	NO	NO	73.7	11.1
17 RESTORE 6-1-3	YES	YES	63.7	12.8
18 RESTORE 6-1-3	YES	NO	73.7	14.6
19 RESTORE 6-1-3	NO	YES	74.3	14.2
20 RESTORE 6-1-3	NO	NO	76.8	11.6
21 BLUE CHIP	YES	YES	62.8	14.7
22 BLUE CHIP	YES	NO	70.2	16.2
23 BLUE CHIP	NO	YES	60.8	15.5
24 BLUE CHIP	NO	NO	62.1	14.0
$LSD_{(0.05)}$ FERT			NS	NS
$LSD_{(0.05)}$ CORE			5.0	1.1
$LSD_{(0.05)}$ TRAFFIC			5.0	NS

Table 45. Effects of fertilizer, core cultivation, and traffic on plant quality from May 21 to June 30, 1989.

Treatment Number	May 21	May 26	June 2	June 11	June 19	June 23	June 30
1	8.3	9.0	8.7	6.7	6.7	7.0	6.7
2	8.0	9.0	9.0	7.7	7.3	8.0	7.7
3	8.0	9.0	9.0	7.0	6.0	6.3	6.3
4	8.0	9.0	9.0	8.0	7.0	7.3	7.3
5	5.7	5.0	5.0	4.0	4.0	4.3	5.0
6	5.3	5.0	5.0	5.3	5.0	6.3	6.3
7	6.3	5.7	5.7	5.0	3.7	3.7	4.7
8	6.0	5.7	5.7	5.3	4.3	5.3	6.0
9	6.3	6.0	7.7	7.0	6.3	7.0	7.0
10	6.3	6.0	7.7	7.7	7.3	7.7	7.7
11	6.3	6.0	8.0	6.7	5.3	6.3	6.3
12	6.3	6.0	8.0	7.3	6.7	7.3	7.3
13	6.3	5.7	7.3	6.0	5.3	5.3	5.7
14	5.7	5.7	7.3	6.7	6.0	6.7	6.7
15	6.0	5.7	7.0	6.0	5.0	6.0	6.7
16	6.3	5.7	7.0	6.3	5.7	6.7	6.3
17	6.3	6.0	8.0	6.0	6.0	6.7	6.7
18	6.0	6.0	8.0	7.3	7.0	7.7	7.7
19	6.7	6.3	8.0	6.7	6.3	6.7	6.7
20	6.3	6.3	8.0	7.3	7.3	8.0	7.7
21	6.7	5.7	6.7	5.3	3.7	5.7	5.3
22	6.7	5.7	6.7	5.3	4.0	5.7	5.3
23	7.0	6.3	6.7	4.7	4.0	5.3	5.7
24	6.7	6.0	6.7	5.0	4.3	6.0	6.0
$LSD_{(0.05)\ FERT}$	0.6	0.4	0.3	0.5	0.5	0.6	0.6
$LSD_{(0.05)\ CORE}$	NS	0.2	NS	NS	NS	NS	NS
$LSD_{(0.05)\ TRAFFIC}$	NS	NS	NS	0.3	0.3	0.4	0.3

Table 46. Effects of fertilizer, core cultivation, and traffic on plant quality from July 11 to August 24, 1989.

Treatment Number	July 11	July 18	July 28	Aug 4	Aug 14	Aug 18	Aug 24
1	6.7	6.7	6.7	6.7	6.3	6.3	7.0
2	7.0	6.3	6.0	6.0	6.3	6.3	7.0
3	6.7	6.3	6.3	6.0	6.3	6.0	7.3
4	7.0	6.3	6.0	6.0	6.3	6.0	6.3
5	6.3	6.0	6.7	7.0	6.0	6.3	6.7
6	7.0	6.7	6.3	7.0	6.7	7.0	6.7
7	6.0	5.7	6.7	6.3	7.0	6.3	6.3
8	6.0	6.0	6.3	6.3	6.0	6.3	6.3
9	7.7	6.7	7.0	7.0	6.3	6.7	6.3
10	7.7	7.0	6.0	6.7	6.3	6.3	7.0
11	6.0	6.3	6.7	6.3	6.7	6.0	6.3
12	7.0	6.7	6.0	6.3	6.7	6.3	6.3
13	6.7	5.7	6.7	6.7	6.7	6.3	6.3
14	7.0	6.3	6.0	6.3	6.7	6.7	6.3
15	6.3	6.0	6.7	6.3	6.3	6.0	6.0
16	6.3	6.7	6.3	6.0	6.0	6.7	6.0
17	6.7	6.0	6.7	6.7	6.7	6.7	6.3
18	7.7	7.0	6.7	7.0	6.3	7.0	6.3
19	7.0	6.7	7.3	7.3	6.3	6.7	6.7
20	7.3	6.7	6.3	7.3	6.3	7.0	7.3
21	6.3	6.0	6.7	6.3	5.7	6.0	5.7
22	6.3	6.0	5.7	5.7	5.3	6.3	6.0
23	5.7	6.0	6.3	5.7	6.0	6.3	6.3
24	6.7	6.3	6.3	6.0	6.0	6.3	6.7
$LSD_{(0.05)}$ FERT	0.5	NS	NS	0.6	0.4	NS	NS
$LSD_{(0.05)}$ CORE	0.3	NS	NS	NS	NS	NS	NS
$LSD_{(0.05)}$ TRAFFIC	0.3	NS	0.3	NS	NS	NS	NS

Table 47. Effects of fertilizer, core cultivation, and traffic on plant quality from September 1 to November 7, 1989.

Treatment Source	Sept 1	Sept 12	Sept 17	Sept 25	Oct 6	Oct 20	Nov 7	Average
1	7.0	7.0	7.0	5.3	6.0	6.0	6.7	6.9
2	8.3	7.7	7.3	7.3	7.7	9.0	7.0	7.4
3	7.0	7.0	7.3	5.7	5.7	6.3	6.0	6.8
4	8.0	7.3	7.0	7.0	7.0	7.7	8.3	7.2
5	7.0	7.3	8.0	5.7	6.0	5.7	5.7	5.9
6	7.3	7.3	7.3	7.0	7.0	7.3	8.0	6.5
7	6.7	7.3	6.7	5.3	5.7	5.3	5.3	5.8
8	6.3	7.0	6.3	6.3	7.0	6.7	7.7	6.1
9	8.0	8.0	7.7	5.3	5.0	5.3	5.0	6.6
10	8.0	7.3	7.3	7.3	7.7	7.3	7.0	7.1
11	7.0	7.3	8.0	5.3	5.7	5.3	5.0	6.3
12	7.3	7.3	7.7	7.0	7.7	6.7	7.3	6.9
13	6.7	6.7	7.0	5.7	5.3	4.7	5.3	6.1
14	7.3	7.0	7.3	7.0	7.3	7.0	7.7	6.7
15	6.7	6.7	7.0	5.7	6.0	5.0	5.3	6.1
16	6.7	6.7	7.0	7.0	7.0	6.3	7.0	6.5
17	7.3	7.3	7.7	6.7	6.7	5.7	5.7	6.5
18	8.0	7.7	7.7	8.0	7.7	7.3	7.7	7.2
19	7.3	7.7	7.7	6.0	5.0	5.0	5.0	6.6
20	8.0	7.3	7.3	7.3	7.3	6.7	7.7	7.2
21	6.0	5.7	5.7	5.3	5.3	5.0	4.7	5.7
22	6.0	5.7	6.7	6.7	6.0	5.7	6.3	5.9
23	6.3	5.7	6.0	5.0	5.3	4.7	4.3	0.7
24	6.7	6.3	6.7	6.3	6.3	6.0	6.7	6.2
$LSD_{(0.05)}$ FERT	0.6	0.5	0.6	0.5	0.5	NS	0.6	0.5
$LSD_{(0.05)}$ CORE	NS	NS	NS	NS	NS	NS	NS	NS
$LSD_{(0.05)}$ TRAFFIC	0.3	NS	NS	0.3	0.3	0.3	0.3	0.2

Table 48. Effects of fertilizer, core cultivation, and traffic on clipping yield from May 23 to July 6, 1989.

Treatment Number	May 23	June 1	June 6	June 13	June 21	June 28	July 6
1	11.9	22.7	8.1	5.4	6.8	5.7	5.1
2	11.7	27.8	10.6	5.4	6.1	4.2	4.9
3	12.1	24.2	9.3	4.4	6.6	6.9	4.8
4	14.6	24.2	10.8	4.9	5.8	4.4	5.0
5	5.6	8.1	3.1	2.2	3.3	2.7	4.1
6	6.2	8.4	2.7	2.3	2.5	3.6	2.7
7	6.8	8.5	3.3	3.8	3.7	5.2	4.2
8	7.7	8.0	2.7	5.8	2.8	3.1	3.8
9	6.5	13.7	6.4	4.9	6.5	8.7	5.6
10	10.3	16.3	7.3	4.5	4.9	4.8	5.8
11	8.7	17.1	8.1	4.2	8.8	9.7	9.1
12	8.9	16.6	7.6	3.8	5.6	6.7	7.1
13	6.3	10.9	4.8	4.7	5.3	5.4	4.9
14	7.4	11.0	4.6	5.4	3.7	3.3	4.3
15	8.5	11.0	4.9	3.9	5.1	5.9	5.2
16	10.2	12.8	4.9	3.9	3.7	3.1	3.9
17	6.6	20.7	9.2	4.6	7.9	10.9	8.1
18	6.9	21.5	8.3	3.8	5.8	4.9	7.7
19	6.9	16.0	8.4	5.8	7.7	7.9	5.3
20	6.5	15.8	8.0	4.2	3.1	4.0	3.9
21	10.0	16.9	5.2	6.3	5.7	5.1	4.2
22	10.2	15.3	4.8	3.4	4.2	1.8	2.7
23	8.0	11.9	3.7	3.2	5.4	3.8	3.6
24	11.9	13.1	4.9	4.9	4.1	2.0	2.3
$LSD_{(0.05)}$ FERT	3.0	5.2	1.9	1.2	2.9	2.4	2.4
$LSD_{(0.05)}$ CORE	NS	NS	NS	NS	NS	NS	NS
$LSD_{(0.05)}$ TRAFFIC	NS	NS	NS	NS	NS	1.1	1.4

Table 49. Effects of fertilizer, core cultivation, and traffic on clipping yield from July 11 to August 24, 1989.

Treatment Number	July 11	July 20	July 27	Aug 1	Aug 9	Aug 16	Aug 24
1	3.8	3.9	2.6	3.4	4.8	5.0	9.2
2	3.8	4.7	2.8	3.1	3.6	3.4	10.1
3	4.7	4.5	3.3	4.0	4.5	4.8	9.1
4	4.1	4.8	4.2	4.5	4.6	4.7	9.2
5	4.2	5.6	4.1	6.7	5.9	7.1	9.2
6	3.1	6.5	3.3	4.6	5.1	5.6	10.1
7	3.7	7.5	4.8	6.6	6.7	8.4	11.4
8	3.8	5.0	3.5	3.8	3.7	5.6	8.2
9	5.6	6.2	3.7	5.2	5.3	6.1	7.3
10	4.7	5.9	3.9	4.5	4.7	5.2	6.5
11	8.5	8.1	4.1	5.7	6.8	6.3	10.5
12	5.0	8.5	4.5	4.2	4.9	5.7	9.4
13	4.8	5.6	3.7	4.7	5.1	4.4	6.1
14	3.6	5.2	2.9	2.7	4.7	4.3	7.1
15	5.9	6.4	3.3	4.1	5.6	6.1	6.7
16	3.7	6.0	3.8	3.9	4.0	4.8	6.7
17	7.4	5.9	5.6	6.6	5.4	6.4	9.4
18	5.8	7.4	5.4	5.1	5.0	4.9	8.8
19	8.7	7.4	4.8	4.2	6.2	5.8	7.9
20	7.8	5.2	3.8	3.7	4.2	3.9	5.5
21	5.1	5.4	3.9	5.0	5.5	5.7	9.7
22	3.5	3.6	2.9	2.7	3.8	3.8	7.2
23	4.2	5.3	3.9	4.0	6.1	4.9	9.6
24	2.5	3.8	3.4	3.0	3.8	4.4	7.5
$LSD_{(0.05)}$ FERT	1.8	2.6	NS	NS	NS	NS	NS
$LSD_{(0.05)}$ CORE	NS	NS	NS	NS	NS	NS	NS
$LSD_{(0.05)}$ TRAFFIC	1.1	NS	NS	1.0	0.7	NS	NS

Table 50. Effects of fertilizer, core cultivation, and traffic on clipping yield from September 10 to October 20, 1989.

Treatment Number	Sept 10	Sept 15	Sept 22	Oct 20	Average
1	15.2	3.5	1.3	3.0	121.5
2	12.7	4.5	1.1	2.2	122.8
3	17.8	4.3	1.8	3.3	130.3
4	11.3	4.8	1.9	2.2	125.9
5	17.6	6.0	1.6	4.6	101.2
6	10.8	5.1	0.8	2.7	86.1
7	18.9	6.5	2.7	4.1	116.9
8	10.7	5.3	0.9	1.9	83.1
9	23.9	6.7	2.4	4.1	129.1
10	19.7	9.4	2.3	2.5	123.3
11	27.0	7.3	3.1	4.2	157.4
12	16.0	7.6	1.8	2.7	126.8
13	20.2	5.0	2.2	3.2	107.2
14	13.3	5.9	1.4	2.0	92.5
15	21.6	4.3	2.7	3.1	114.5
16	14.6	5.4	1.9	1.7	99.1
17	25.9	8.3	2.3	5.5	156.7
18	20.6	10.1	1.4	3.5	138.0
19	25.7	7.4	2.5	4.1	141.1
20	17.6	7.2	1.4	2.6	105.5
21	16.2	4.4	1.5	3.0	118.1
22	7.9	3.4	1.2	1.4	83.9
23	14.3	3.5	0.9	1.9	98.2
24	7.7	3.4	1.0	1.2	84.9
$LSD_{(0.05)\ FERT}$	5.0	1.4	0.8	NS	NS*
$LSD_{(0.05)\ CORE}$	NS	NS	NS	NS	NS
$LSD_{(0.05)\ TRAFFIC}$	2.9	NS	0.5	0.9	NS*

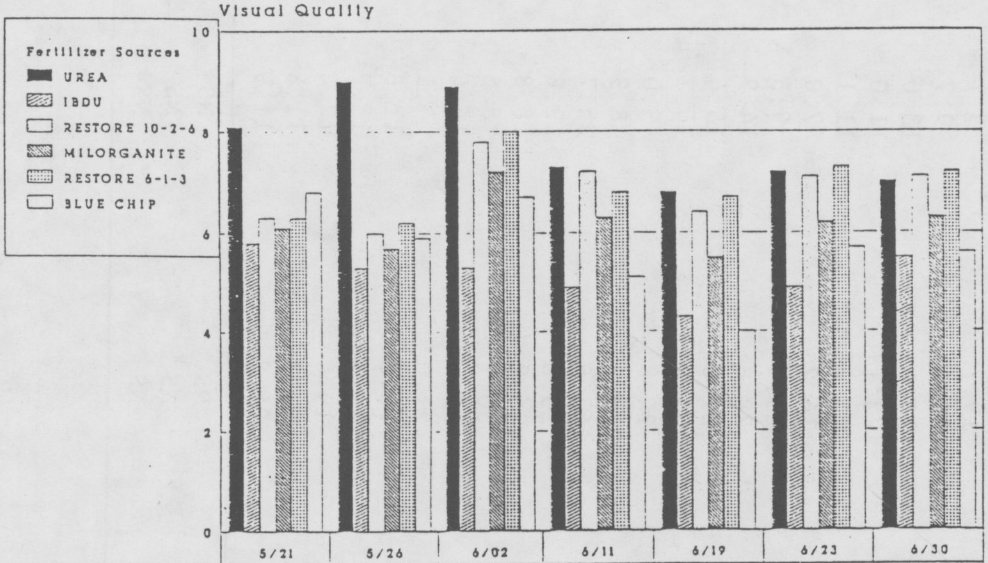
*Significant at the 10% level.

Table 51. The effects of fertilizer source, core cultivation, and traffic on root distribution.

Fertilizer Source	Core Cultivation	Traffic Stress	Root weight (by depth [cm]) 0 - 5	5 - 10	10 - 15	15 - 20
UREA	YES	YES	113.1	45.3	21.4	11.0
UREA	YES	NO	129.6	56.1	19.7	5.1
UREA	NO	YES	140.6	47.6	38.4	9.7
UREA	NO	NO	119.2	54.7	24.4	13.0
IBDU	YES	YES	127.7	47.0	23.1	11.0
IBDU	YES	NO	91.4	41.1	25.3	11.1
IBDU	NO	YES	109.1	58.8	16.2	7.0
IBDU	NO	NO	130.9	55.2	23.3	9.5
RESTORE 10-2-6	YES	YES	135.0	68.2	28.8	14.9
RESTORE 10-2-6	YES	NO	111.0	35.4	27.6	15.4
RESTORE 10-2-6	NO	YES	93.3	50.4	23.9	14.7
RESTORE 10-2-6	NO	NO	112.0	47.3	24.8	9.0
MILORGANITE	YES	YES	86.1	50.2	25.9	8.9
MILORGANITE	YES	NO	104.6	43.9	42.6	25.7
MILORGANITE	NO	YES	113.9	40.6	25.0	12.8
MILORGANITE	NO	NO	120.4	47.6	26.2	18.8
RESTORE 6-1-3	YES	YES	134.0	53.8	30.1	8.5
RESTORE 6-1-3	YES	NO	153.9	40.4	39.4	16.4
RESTORE 6-1-3	NO	YES	124.9	39.9	21.0	4.1
RESTORE 6-1-3	NO	NO	101.1	45.7	16.3	11.6
BLUE CHIP	YES	YES	70.6	39.7	21.0	13.7
BLUE CHIP	YES	NO	117.8	39.9	19.4	12.4
BLUE CHIP	NO	YES	111.9	38.3	27.3	11.8
BLUE CHIP	NO	NO	117.0	37.4	21.8	11.9
LSD 0.05 Fertilizer			NS	NS	NS	NS*
LSD 0.05 Core			NS	NS	NS	NS
LSD 0.05 Traffic			NS	NS	NS	NS*

* Significant at a 10% level.

Figure 23a. Fertilizer effects on visual quality.

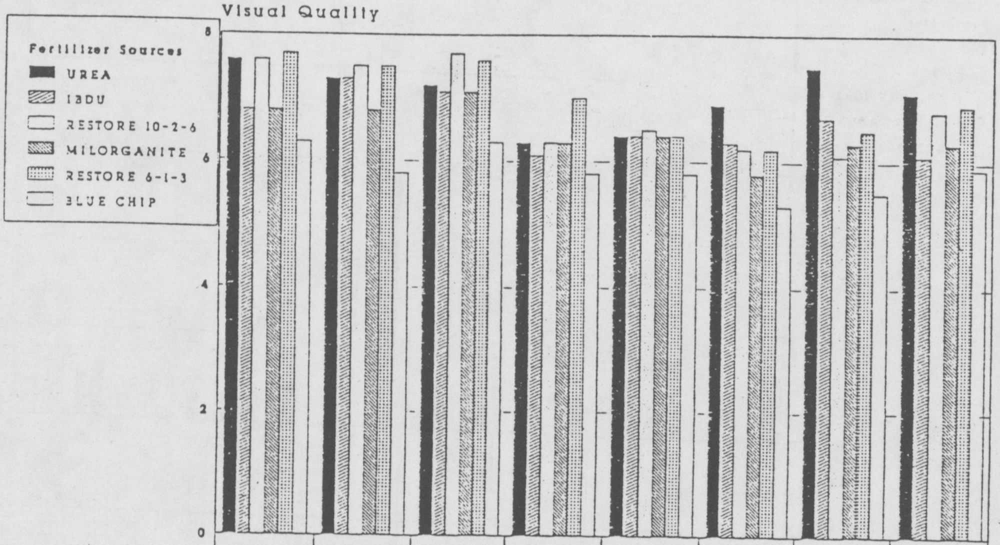


	5/21	5/26	6/02	6/11	6/19	6/23	6/30
UREA	8.1	9	8.9	7.3	6.8	7.2	7
IBDU	5.8	5.3	5.3	4.9	4.3	4.9	5.5
RESTORE 10-2-6	6.3	6	7.8	7.2	6.4	7.1	7.1
MILORGANITE	6.1	5.7	7.2	6.3	5.5	6.2	6.3
RESTORE 6-1-3	6.3	6.2	8	6.8	6.7	7.3	7.2
BLUE CHIP	6.8	5.9	6.7	5.1	4	5.7	5.6
LSD (0.05)	0.6	0.4	0.3	0.5	0.5	0.7	0.5

Figure 23b. Fertilizer effects on visual quality.

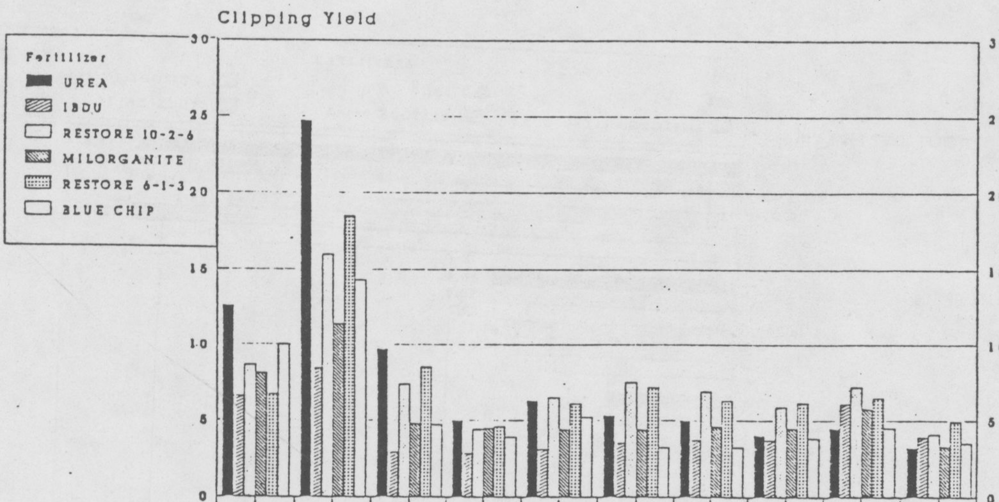
	7/11	7/18	7/28	8/04	8/14	8/18	8/24
UREA	6.8	6.4	6.3	6.2	6.3	6.2	6.9
IBDU	6.3	6.1	6.5	6.7	6.4	6.5	6.5
RESTORE 10-2-6	7.1	6.7	6.4	6.6	6.5	6.3	6.5
MILORGANITE	6.6	6.2	6.4	6.3	6.4	6.4	6.2
RESTORE 6-1-3	7.2	6.6	6.8	7.1	6.4	6.8	6.7
BLUE CHIP	6.3	6.1	6.3	5.9	5.8	6.3	6.1
LSD (0.05)	0.5	N.S.	N.S.	0.6	0.4	N.S.	N.S.

Figure 23c. Fertilizer effects on visual quality.



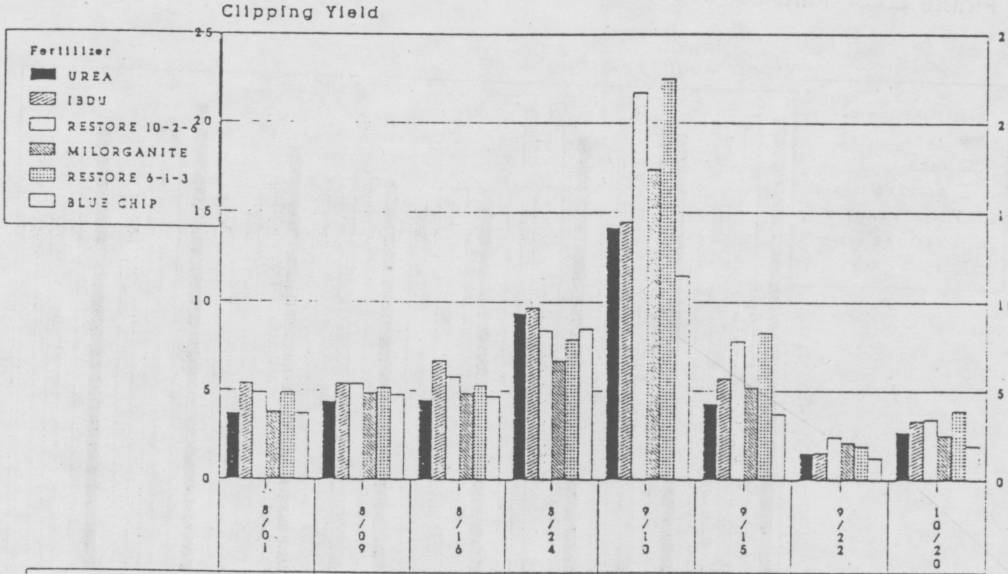
	9/01	9/12	9/17	9/25	10/06	10/20	11/07	Mean
UREA	7.6	7.3	7.2	6.3	6.4	6.9	7.5	7.1
IBDU	6.8	7.3	7.1	6.1	6.4	6.3	6.7	6.1
RESTORE 10-2-6	7.6	7.5	7.7	6.3	6.5	6.2	6.1	6.8
MILORGANITE	6.8	6.8	7.1	6.3	6.4	5.8	6.3	6.3
RESTORE 6-1-3	7.7	7.5	7.6	7	6.4	6.2	6.5	6.7
BLUE CHIP	6.3	5.8	6.3	5.8	5.8	5.3	5.5	5.7
LSD (0.05)	0.6	0.5	0.6	0.6	N.S.	0.6	0.5	0.3

Figure 24a. Fertilizer effects on clipping yields.



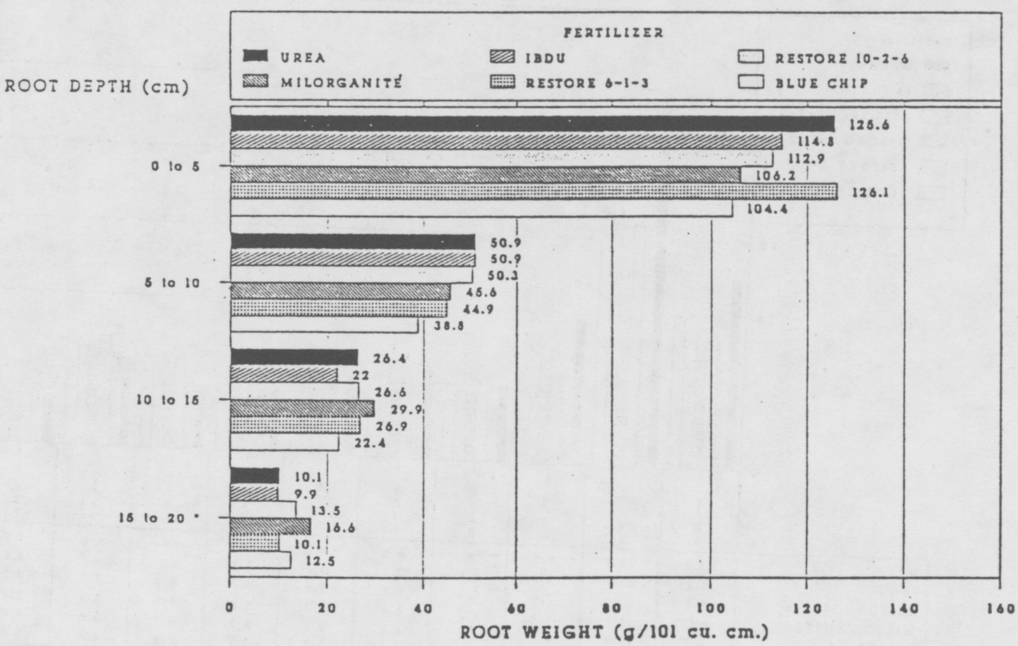
	5/23	6/01	6/06	6/13	6/21	6/28	7/06	7/11	7/20	7/27
UREA	12.6	24.7	9.7	5	6.3	5.3	5	4	4.5	3.2
IBDU	6.6	8.37	2.9	2.8	3.1	3.5	3.7	3.7	6.1	3.9
RESTORE 10-2-6	8.6	16	7.4	4.4	6.5	7.5	6.9	5.9	7.2	4.1
MILORGANITE	8.11	11.4	4.8	4.5	4.4	4.4	4.6	4.5	5.8	3.3
RESTORE 6-1-3	6.7	18.5	8.5	4.6	6.1	7.2	6.3	6.2	6.5	4.9
BLUE CHIP	10	14.3	4.7	3.9	5.2	3.2	3.2	3.8	4.5	3.5
LSD (0.05)	3.1	5.2	1.9	1.2	1.9	2.4	2.4	1.8	N.S.	N.S.

Figure 24b. Fertilizer effects on clipping yields.



	8/01	8/09	8/16	8/24	9/10	9/15	9/22	10/20
UREA	3.7	4.4	4.5	9.4	14.2	4.3	1.5	2.7
IBDU	5.4	5.4	6.7	9.7	14.5	5.7	1.5	3.3
RESTORE 10-2-6	4.9	5.4	5.3	8.4	21.7	7.8	2.4	3.4
MILORGANITE	3.8	4.9	4.7	6.7	17.4	5.2	2.1	2.5
RESTORE 6-1-3	4.9	5.2	5.3	7.9	22.5	8.3	1.9	3.7
BLUE CHIP	3.7	4.8	4.7	8.5	11.5	3.7	1.2	1.9
LSD (0.05)	N.S.	N.S.	N.S.	N.S.	5.0	1.4	0.8	N.S.

Figure 25. Fertilizer effects on root weights.



*significant at a 0.10 level

Figure 26. Coring effects on shoot density and thatch development.

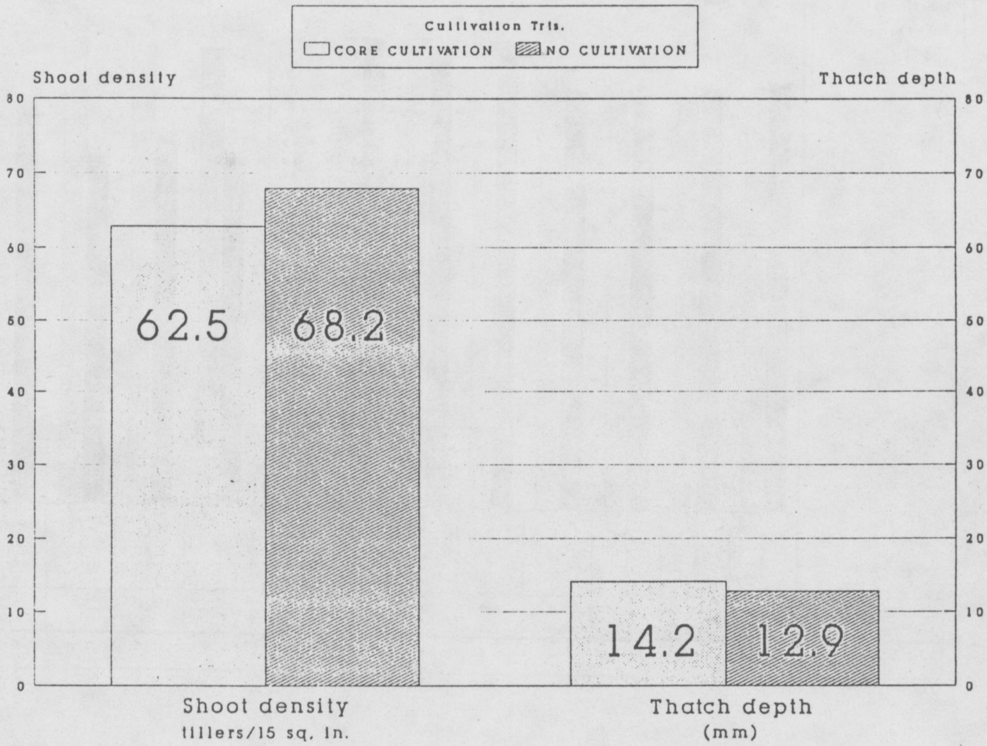
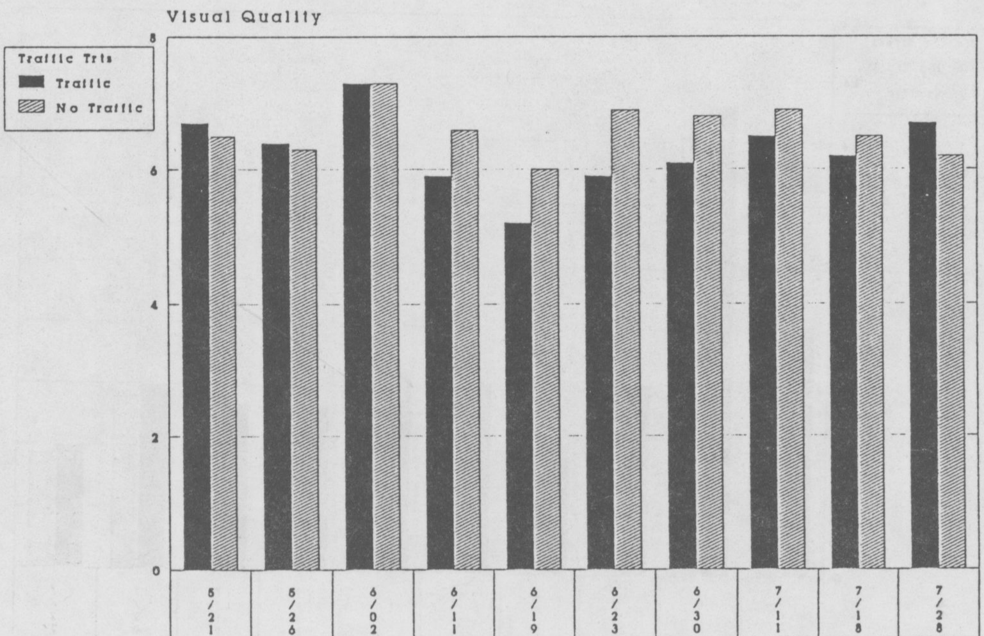
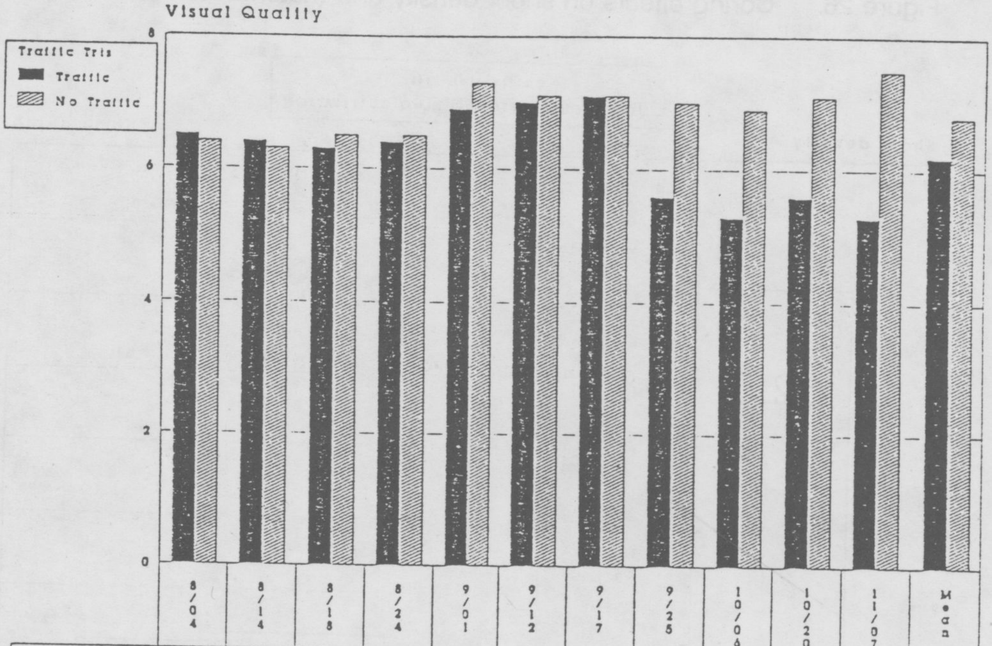


Figure 27a. Traffic effects on visual quality.



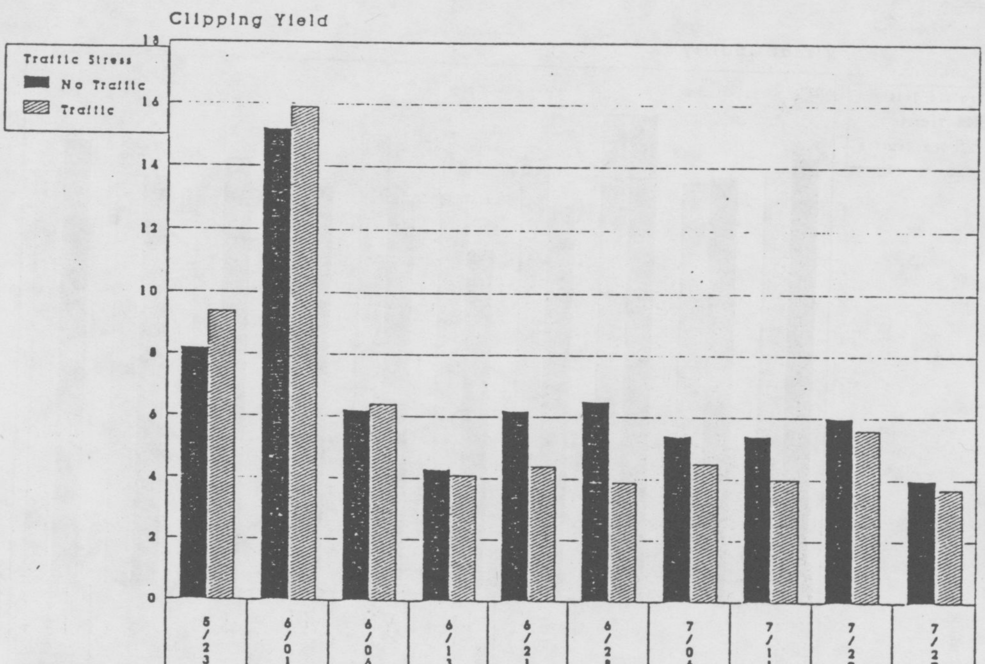
	5/21	5/26	6/02	6/11	6/19	6/23	6/30	7/11	7/18	7/28
Traffic	6.7	6.4	7.3	5.9	5.2	5.9	6.1	6.5	6.2	6.7
No Traffic	6.5	6.3	7.3	6.6	6	6.9	6.8	6.9	6.5	6.2
LSD (0.05)	N.S.	N.S.	N.S.	0.3	0.3	0.4	0.3	0.3	N.S.	0.3

Figure 27b. Traffic effects on visual quality.



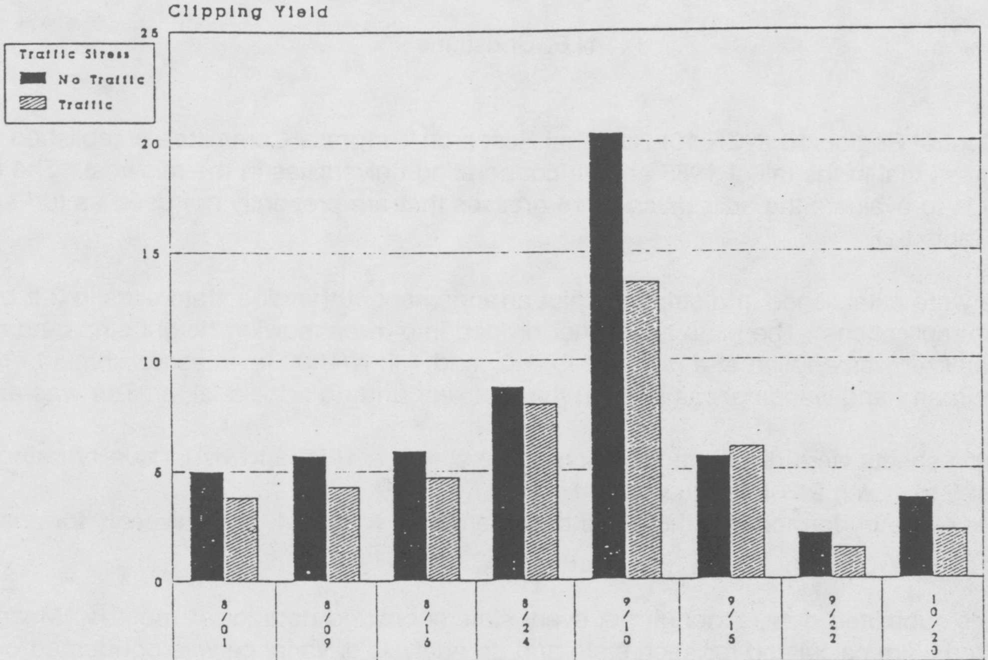
	8/04	8/14	8/18	8/24	9/01	9/12	9/17	9/25	10/06	10/20	11/07	Mean
Traffic	6.5	6.4	6.3	6.4	6.9	7	7.1	5.6	5.3	5.6	5.3	6.2
No Traffic	6.4	6.3	6.5	6.5	7.3	7.1	7.1	7	6.9	7.1	7.5	6.8
LSD (0.05)	N.S.	N.S.	N.S.	N.S.	0.3	N.S.	N.S.	0.3	0.3	0.3	0.3	0.2

Figure 28a. Traffic effects on clipping yields.



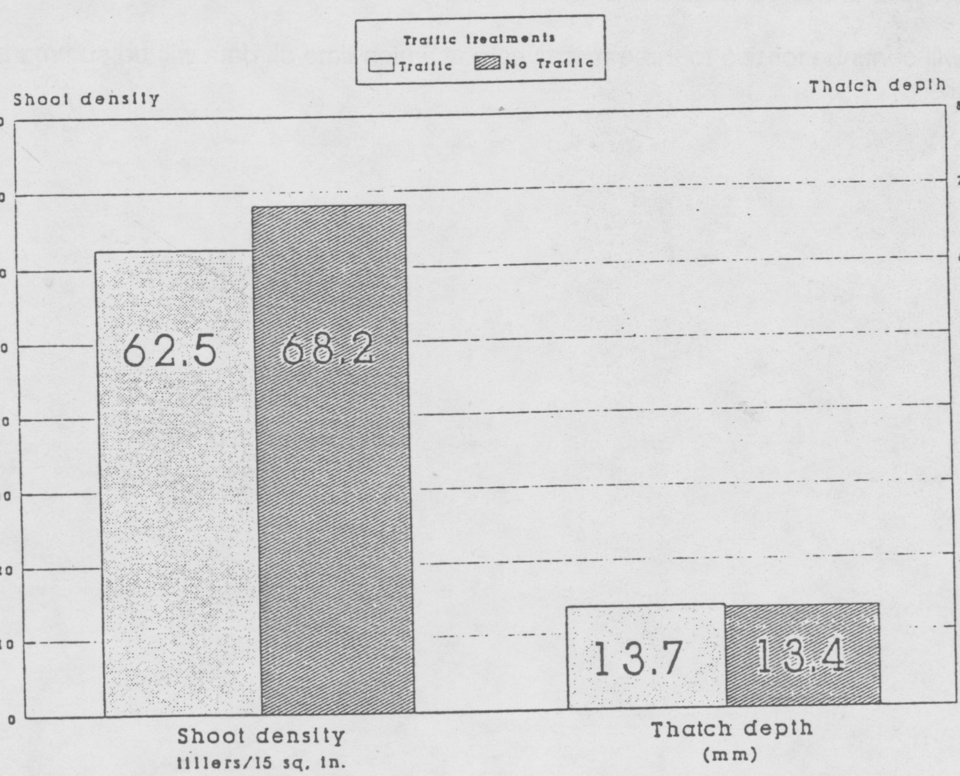
	5/23	6/01	6/06	6/13	6/21	6/28	7/06	7/11	7/20	7/27
No Traffic	8.2	15.2	6.2	4.3	6.2	6.5	5.4	5.4	6	4
Traffic	9.4	15.9	6.4	4.1	4.4	3.9	4.5	4	5.6	3.7
LSD (0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	1.1	1.4	1.1	N.S.	N.S.

Figure 28b. Traffic effects on clipping yields.



	8/01	8/09	8/16	8/24	9/10	9/15	9/22	10/20
No Traffic	5	5.7	5.9	8.8	20.4	5.6	2.1	3.7
Traffic	3.8	4.3	4.7	8	13.5	6	1.4	2.2
LSD (0.05)	1.0	0.7	N.S.	N.S.	2.9	N.S.	0.5	0.9

Figure 29. Traffic effects on shoot density and thatch development.



NCR-10 Regional Alternative Grass Trial

N.E. Christians

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 52).

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 now, 2 in, and 4 in. Fertilizer was applied at a rate of 2 lb P_20_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 1989 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 1989.

All nine states submitted data, although 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 1989 means.

Sheep fescue received the highest average rating for all state locations and all three mowing heights (Table 53). It was followed in order by Alta Tall Fescue and Exeter Colonial Bentgrass. The two Buffalograsses received the lowest ranking because of winter kill at several locations.

Quality ratings for the 16 grasses are listed by state in Table 54 and by state and mowing height in Table 55. The Buffalograsses survived the winter of 1988 in four of the nine states (these grasses were reestablished in the spring of 1990). Ruff crested wheatgrass also showed considerable damage or complete loss at several locations.

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

Table 52. Turfgrasses and seeding rates evaluated in the NCR-10 Regional Alternative Turfgrass Species Trial.

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

Species	Quality rating
Sheep Fescue	5.5
Alta Tall Fescue	5.3
Exeter Colonial Bentgrass	5.0
Reton Red Top	5.0
Durar Hard Fescue	4.6
Reubens Canada Bluegrass	4.4
Cover Sheep Fescue	4.1
Fairway Crested Wheatgrass	3.9
Colt *Poa trivialis*	3.6
Sodar Streambank Wheatgrass	3.2
Poa alpina	3.0
Ephraim Crested Wheatgrass	3.0
Bulbous Bluegrass	1.7
Ruff Crested Wheatgrass	1.5
Texoka Buffalograss	1.4
NE 84-315 Buffalograss	1.4
LSD 0.05	0.8

Table 54. Means of quality ratings for each species at the nine state locations.

	State								
Species	Iowa State	Kansas State	Michigan State	Ohio State	Purdue Univ	S. Ill Univ	Univ Ill	Univ MO	Univ WI
Fairway Crested Wheatgrass	5.8	4.4	3.0	4.1	3.8	2.5	3.9	4.8	2.8
Ephraim Crested Wheatgrass	4.9	3.7	2.2	3.5	2.7	1.5	3.0	3.4	2.3
Sodar Streambank Wheatgrass	5.2	2.8	2.8	3.1	3.1	2.0	3.7	4.3	1.8
Ruff Crested Wheatgrass	2.4	1.1	1.3	1.0	2.7	1.4	1.0	1.0	1.9
Reubens Canada Bluegrass	4.5	1.9	3.6	5.0	5.4	3.9	5.0	5.8	4.9
Durar Hard Fescue	6.4	3.5	3.9	4.2	4.6	4.1	4.2	6.1	4.5
Covar Sheet Fescue	5.3	3.5	3.5	4.0	4.0	3.4	4.3	5.3	3.8
Alta Tall Fescue	5.9	4.5	4.8	5.6	5.1	5.1	5.6	7.0	5.1
Sheep Fescue	6.8	2.8	5.0	5.7	5.5	5.6	5.3	6.4	6.4
Bulbous Bluegrass	2.6	1.5	1.5	1.1	2.1	1.4	1.5	1.5	1.6
Poa alpina	3.5	1.1	2.2	6.1	2.7	1.4	2.9	4.0	3.4
Reton Red Top	4.5	2.1	4.5	5.2	5.8	4.5	5.2	6.7	6.3
Colt *Poa trivialis*	2.0	1.0	3.0	5.1	3.9	2.4	4.4	5.1	6.0
Exeter Colonial Bluegrass	3.6	2.3	5.0	5.0	5.8	5.3	5.4	7.2	5.3
Texoka Buffalograss	1.0	2.1	1.1	1.2	2.0	1.0	2.1	1.0	1.1
NE 84-315 Buffalograss	1.0	1.5	1.1	1.2	2.2	1.0	2.1	1.0	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 55. The effect of mowing height on the quality of the alternative grass species at each of the nine states.

	State																										
	Iowa State University			Kansas State University			Michigan St. University			Ohio State 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	2" 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	5.0	6.1	6.3	3.4	4.6	5.4	3.2	3.1	2.7	4.3	3.8	4.1	3.3	3.9	4.3	2.3	2.5	2.8	3.6	4.3	3.9	3.3	4.8	6.3	2.7	2.7	2.9
Ephraim Crested Wheatgrass	4.2	4.9	5.7	2.8	3.6	4.7	2.3	2.1	2.2	3.4	3.2	4.0	2.5	2.9	2.7	1.3	1.4	1.7	2.9	2.9	3.1	2.7	3.5	4.1	2.1	2.4	2.5
Sodar Streambank Wheatgrass	4.5	5.2	5.8	2.1	2.7	3.7	2.9	3.1	2.4	2.5	2.7	4.1	3.0	3.2	3.1	1.8	2.1	2.2	3.6	3.9	3.7	3.3	4.1	5.4	1.8	1.9	1.6
Ruff Crested Wheatgrass	2.3	2.3	2.6	2.8	1.1	1.1	1.1	1.1	1.5	1.0	1.0	1.0	2.9	2.7	2.6	1.3	1.6	1.2	1.0	1.0	1.0	1.0	1.0	1.0	2.3	1.9	1.4
Reubens Canada Bluegrass	4.6	4.3	4.6	1.7	1.8	2.1	4.1	3.8	2.8	4.8	4.9	5.5	5.1	5.5	5.5	3.2	4.0	4.6	5.2	5.3	4.6	5.0	5.8	6.4	4.9	5.4	4.2
Durar Head Fescue	6.3	6.5	6.5	3.4	3.3	3.7	4.5	4.1	3.1	3.9	4.0	4.7	4.5	4.5	4.6	4.2	4.1	3.8	4.4	4.2	3.9	5.3	6.2	6.8	4.7	4.7	4.2
Covar Sheep Fescue	5.3	5.2	5.3	3.3	3.3	4.0	3.9	3.4	3.1	3.5	3.8	4.5	3.9	4.1	4.0	4.1	3.3	2.9	4.4	4.4	3.9	5.1	5.3	5.4	3.9	4.1	3.2
Alta Tall Fescue	5.5	5.9	6.3	3.6	4.9	5.1	5.9	4.9	3.8	6.3	5.8	4.7	4.8	5.6	4.9	4.8	5.3	5.2	4.7	4.9	4.1	6.6	7.1	7.3	5.1	5.6	4.7
Sheep Fescue	6.6	6.9	6.9	2.2	3.2	2.9	5.9	5.2	4.1	4.9	6.3	5.9	5.5	5.7	5.3	5.3	5.7	5.8	5.9	5.9	4.1	5.5	6.7	7.0	6.5	6.7	6.1
Bulbous Bluegrass	2.5	2.5	2.9	1.6	1.6	1.4	1.6	1.5	1.5	1.0	1.0	1.4	2.1	2.1	2.2	1.4	1.3	1.3	1.6	1.5	1.4	1.3	1.3	1.8	1.6	1.5	1.6
<u>Poa alpina</u>	3.5	3.5	3.5	1.1	1.2	1.2	2.2	2.2	2.3	6.6	6.2	5.5	2.6	2.7	2.9	1.5	1.4	1.3	3.1	2.8	2.8	4.0	4.0	4.0	3.8	3.8	2.6
Reton Red Top	4.5	4.3	4.8	1.9	1.9	2.3	5.4	4.7	3.5	5.0	4.9	5.6	5.3	6.1	6.0	4.2	4.8	4.7	5.4	5.9	4.4	6.0	7.0	7.1	6.3	6.6	5.9
Colt <u>Poa trivialis</u>	2.0	2.0	2.1	1.0	1.0	1.0	2.9	3.1	2.9	4.8	5.0	5.4	3.9	3.9	3.9	2.4	2.5	2.4	4.8	4.4	3.8	4.3	5.3	5.8	6.4	6.4	5.1
Exeter Colonial Bentgrass	3.3	3.4	4.2	2.4	2.2	2.3	6.3	5.0	3.9	4.6	5.0	5.5	5.6	6.1	5.9	5.1	5.4	5.5	5.7	5.9	4.6	6.9	7.3	7.4	5.8	5.6	4.5
Texoka Buffalograss	1.0	1.0	1.0	2.0	2.2	1.9	1.1	1.0	1.2	1.3	1.3	1.2	2.0	2.0	1.9	1.0	1.0	1.0	2.2	2.2	2.1	1.0	1.0	1.0	1.0	1.4	1.0
NE 84-315 Buffalograss	1.0	1.0	1.0	1.6	1.6	1.4	1.1	1.0	1.2	1.3	1.3	1.2	2.1	2.2	2.2	1.0	1.0	1.0	2.1	2.2	2.2	1.0	1.0	1.0	1.0	1.1	1.0

Introducing

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Dr. Clinton Hodges	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
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Mr. Roger Roe	Graduate Student and Research Associate. Horticulture Department M.S. (Christians/Agnew N.)
Mr. Grant Spear	Graduate Student and Research Associate. Horticulture Department M.S. (Christians).
Mr. Doug Struyk	Field Technician. Horticulture Department.

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322 East Florida Street
Post Office Box 684
Milwaukee, Wisconsin 53201

Milorganite
735 North Water Street
Milwaukee, Wisconsin 53200

Monsanto Company
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

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

Pickseed West Incorporated
Post Office Box 888
Tangent, Oregon 97389

Professional Turf Specialties Inc.
133 Kenyon Road
Champaign, Illinois 61820

Rhone-Poulenc Chemical Company
Black Horse Lane
Post Office Box 125
Monmouth Junction, NJ 08852

Ringer Corporation
9959 Valley View Road
Minneapolis, Minnesota 55344

O. M. Scott and Sons
14111 Scottslawn Road
Marysville, Ohio 43041

Ross Daniels Inc
1720 Fuller Road
West Des Moines, Iowa 50265

Spraying Systems Company
N Avenue at Schmale Road
Wheaton, Illinois 60187

Sustance Corporation
1107 Hazeltine Boulevard
Chaska, Minnesota 55318

Spring Valley Turf Products
1891 Spring Valley Road
Jackson, Wisconsin 53037

Terra Chemical Corporation
Box 218
Quimby, Iowa 51049

The Toro Company
Irrigation Division
Riverside, California 92500

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

UAP Special Products
Omaha, Nebraska 68100

* In preparing this information for the field day report, some companies may have inadvertently been missed. If your company has provided financial or material support for the research program, and is not mentioned above, please contact Nick Christians, Iowa State University, Department of Horticulture, Ames, Iowa 50011. Your company name will be added to future reports.