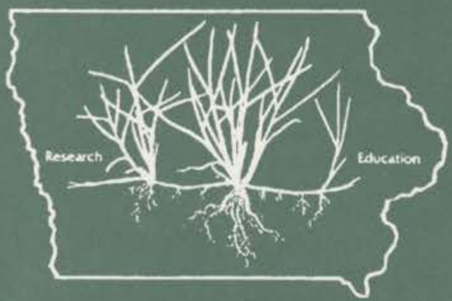

1988 Iowa Turfgrass Research Report

IOWA STATE UNIVERSITY
EXTENSION

FG-454 | July 1988

Introduction

The following research report is the eighth yearly publication of the results of turfgrass research projects performed at Iowa State University. The first was published for the 1981 field day, which was held June 18, of that year. The others were published in conjunction with the 1982, 1983, 1984, 1985, 1986 and 1987 field days.

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 ninth season. The research 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. Several new studies were initiated on this area in the 1985, 1986, and 1987 seasons and a map showing the location of these studies can be found in this report.

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.

We would also like to acknowledge Kenneth Diesburg, Richard Moore, Young Joo, Michael Burt, Zachary Reicher, Jim Walser, Pat Emge, Pat Gradoville, Mary Boyle, Paul Dayton, and all the others employed at the field research area in the past year for their efforts in building the program.

In December of 1987, Ken Diesburg, who had managed the activities at the turfgrass research areas for nearly five years, graduated and left that position. Richard Moore, who had worked at the research areas in a part-time capacity for three years, took over the position in March of 1988. The 1988 season will involve considerable renovation of older studies and the initiation of new projects. Those who attend the 1988 Field Day will notice that a number of old projects have been eliminated and that preparation of new sites is well underway.

A special thanks goes to Betty Hempe for her work on typing this publication.

Edited by Nick Christians, professor, turfgrass science; Michael Agnew, assistant professor, turfgrass extension; and Elaine Edwards, extension communication specialist.

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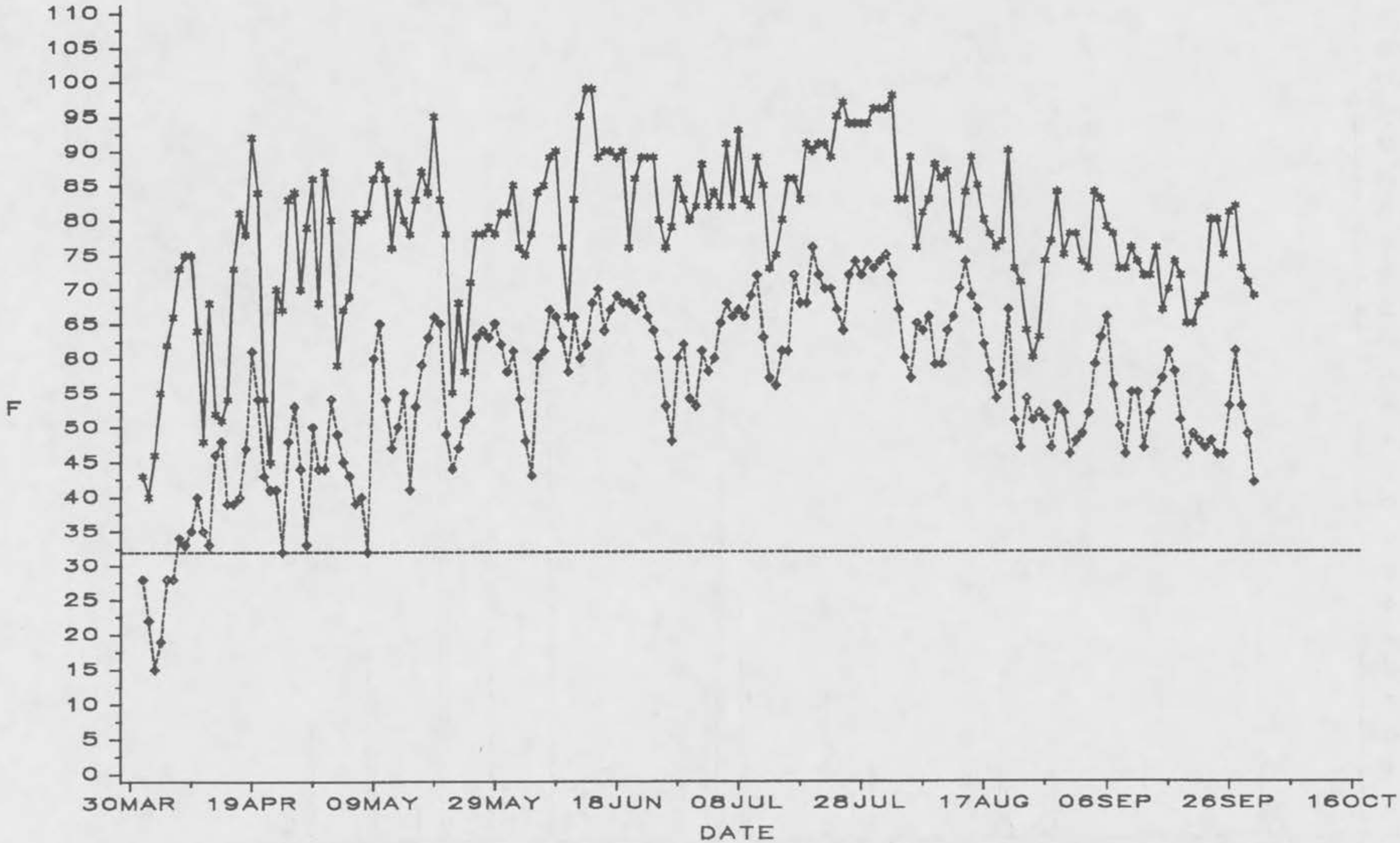
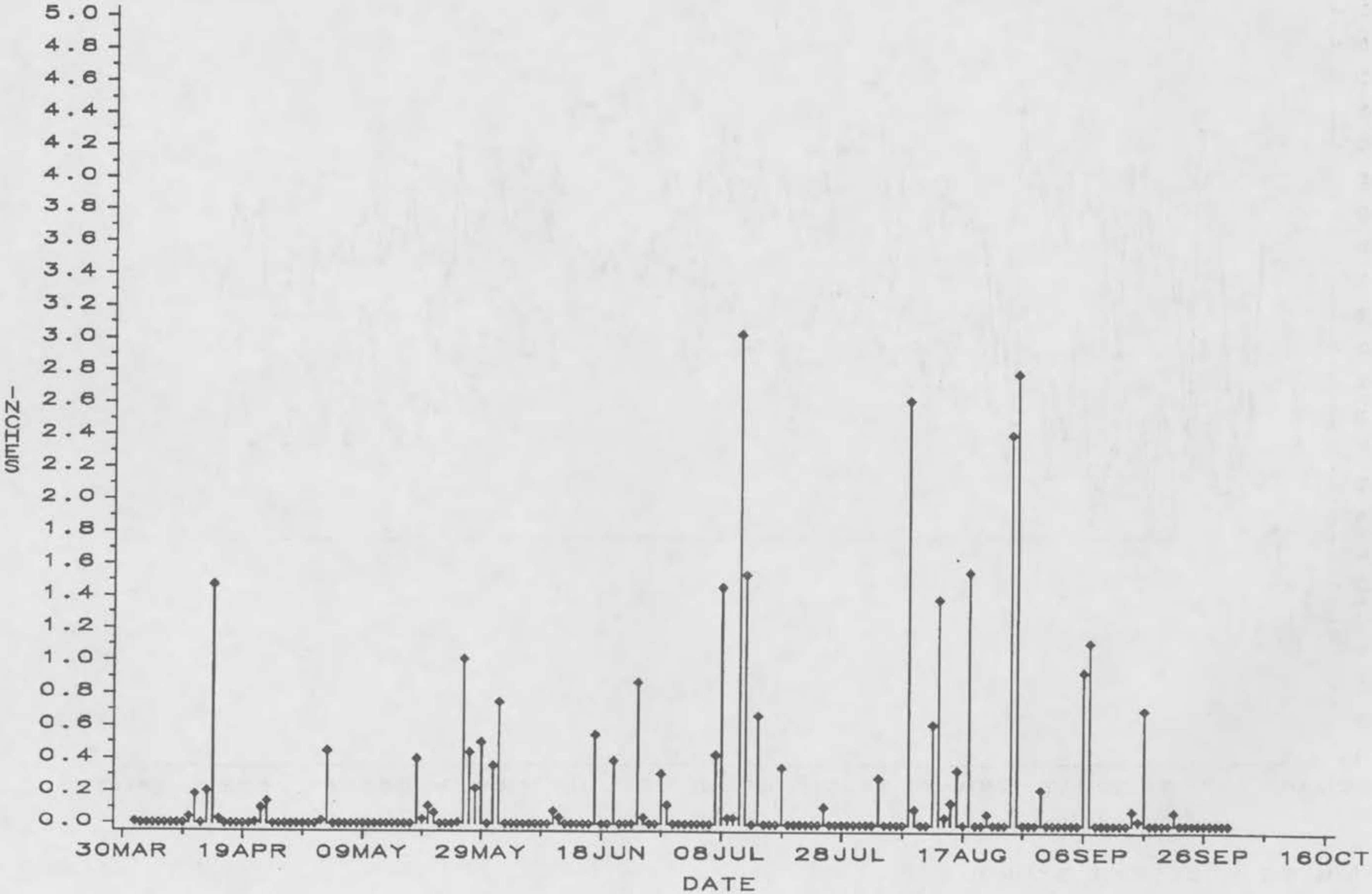
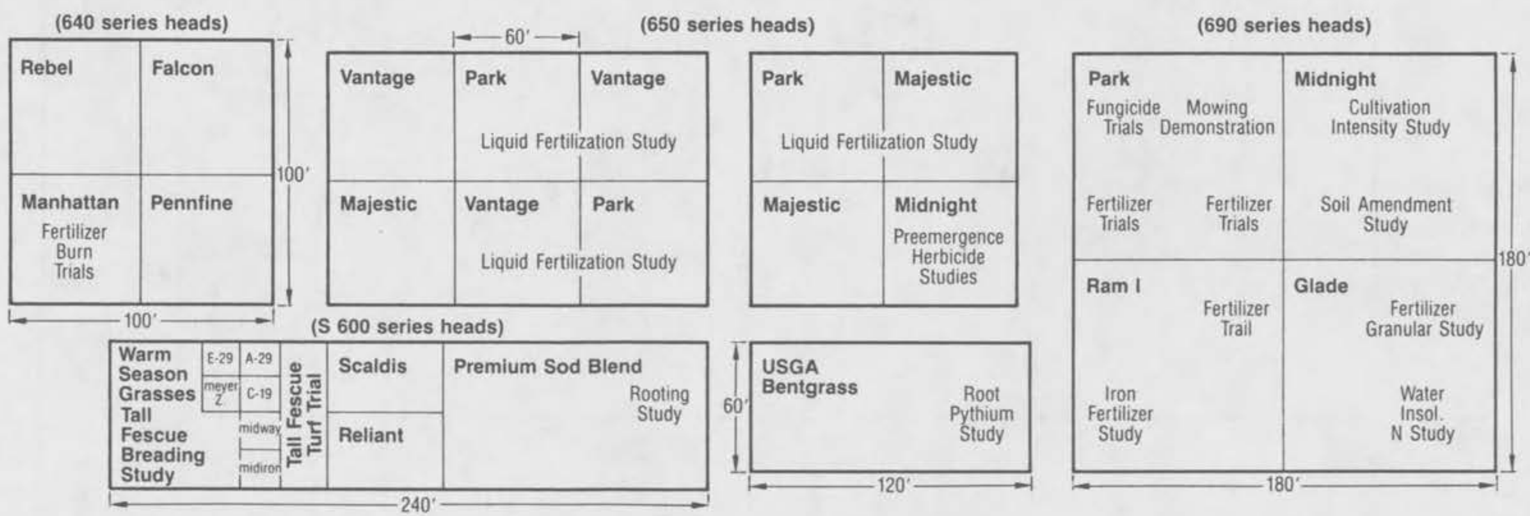


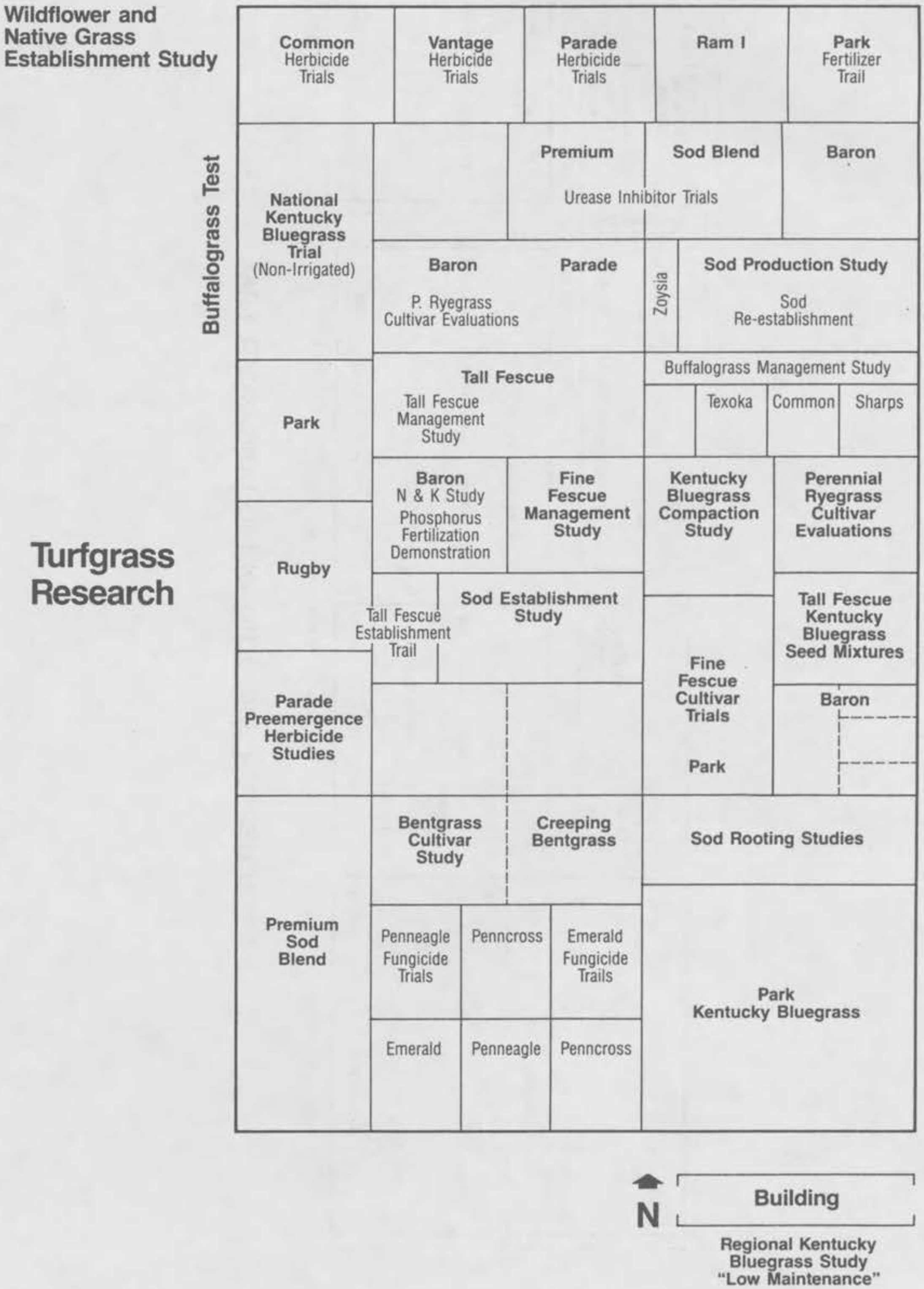
MAXIMUM EQUALS STAR SYMBOL
MINIMUM EQUALS DASHED LINE AND DIAMOND SYMBOL

RAINFALL 1987



1984 Expansion of the Turfgrass Research Area

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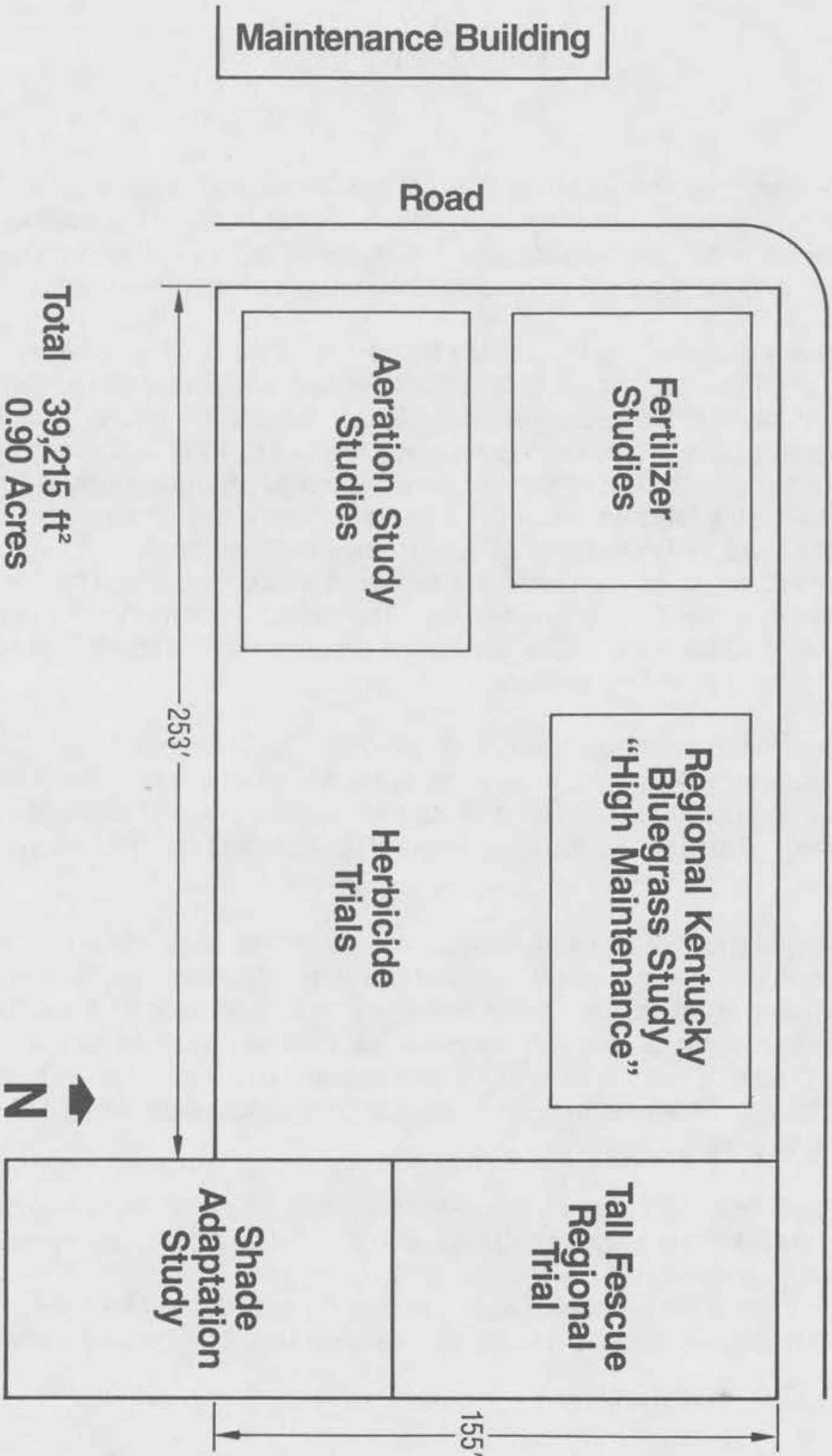
Building
Regional Kentucky Bluegrass Study "Low Maintenance"

East Research Area



Results of High- and Low-Maintenance Kentucky Bluegrass Regional Cultivar Trials - 1987

N. E. Christians

The United States Department of Agriculture (USDA) has initiated several regional Kentucky bluegrass cultivar trials presently 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.

Three separate trials are underway at Iowa State University. One is a highmaintenance study established in 1981 that receives 4 lb N/1000 ft^2/yr and is irrigated as needed; another is a low-maintenance study established in 1980 that receives 1 lb N/1000 ft^2/yr in September and is not irrigated. The third 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 low-maintenance study is to observe the performance of the 84 cultivars under conditions similar to those that would be used in a park, school yard, or other low-maintenance areas. The objective of the third 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, 2 and 3 are the averages of ratings made on three replicated plots for the three studies. Yearly means of all the months data were taken are listed in the last column. The first cultivar received the highest average rating for the entire 1987 season. The cultivars are then 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. For example, the yearly means for the high-maintenance cultivars must exceed 0.7, the LSD for that column (Table 1). Midnight with a mean reading of 8.1 performed better than Cheri with a reading of 7.3. However, the performance of Midnight was statistically the same as Glade that had a yearly mean of 7.5.

Midnight, CEB VB 3965, PSU-173, Ram-1, and Glade were the best of the cultivars in the high-maintenance trial (Table 1). Midnight, Glade, and Ram I have consistently performed well over the past few years and can be considered to be among the best cultivars for Iowa conditions on high-maintenance sites, although it should be noted that Midnight greens-up late in the spring and has been observed to be quite susceptible to powdery mildew in the shade.

This is the first year that data are reported for the nonirrigated high-maintenance trial and much of the differences in ratings may be due to establishment differences. This study will continue for several years. True differences due to variations in adaptation to this management regime will become more apparent over the next few years.

K3-162-1, Kenblue, S. D. Common, S-21, and Argyle were the top rated cultivars in the low-maintenance trial (Table 3). Many cultivars that ranked in the upper 25 positions in 1986 have been ranked much lower in dryer years. In choosing cultivars for low maintenance conditions, data from several years should be considered.

In most years, cultivars that performed well under high-maintenance conditions did not do as well under low-maintenance conditions. Conversely, many of the poorer cultivars in high-maintenance areas were the best in the low-maintenance study. This trend can be observed by studying tables 1 and 3.

Table 1. The 1987 quality ratings for the high-maintenance regional Kentucky bluegrass test established in the fall 1981.

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
1.	Midnight	7.7	8.7	8.7	8.7	8.3	6.3	8.1
2.	CEB VB 3965	8.0	8.3	8.0	7.7	8.3	7.7	8.0
3.	PSU - 173	7.3	8.0	7.7	7.3	8.0	7.7	7.7
4.	Ram - 1	7.7	7.7	7.3	7.3	7.7	7.7	7.6
5.	Glade	6.7	7.7	7.7	8.3	7.7	7.0	7.5
6.	Enmundi	7.7	8.0	7.3	7.7	8.0	6.0	7.4
7.	WW Ag 478	8.0	6.3	7.0	7.3	8.3	7.3	7.4
8.	AZO	7.7	7.3	8.3	8.3	6.7	6.3	7.4
9.	AZO - 6A	7.3	7.3	7.3	7.0	7.7	7.7	7.4
10.	Cheri	7.3	7.7	7.0	7.3	7.7	7.0	7.3
11.	PSU - 150	6.7	7.7	8.3	8.0	7.0	6.0	7.3
12.	Holiday	7.3	7.0	7.0	7.7	7.7	7.3	7.3
13.	Merit	7.7	7.3	8.0	8.0	7.0	6.0	7.3
14.	AZO - 6	6.7	7.0	7.3	8.0	7.3	7.3	7.3
15.	Bristol	7.0	7.3	7.3	7.7	7.3	7.0	7.3
16.	N535	7.3	7.0	6.7	6.7	8.0	7.7	7.2
17.	BA - 61 - 91	7.3	7.3	7.3	7.3	7.7	6.0	7.2
18.	Adelphi	6.3	7.3	6.3	7.3	7.7	7.3	7.1
19.	243	7.7	6.7	7.3	7.3	7.0	6.3	7.1
20.	PSU - 190	7.3	6.0	7.7	7.0	7.3	7.0	7.1
21.	Aspen	7.3	7.0	7.3	6.7	7.3	6.7	7.1
22.	Vanessa	7.7	6.7	7.0	6.7	7.7	7.0	7.1
23.	I - 13	6.7	7.3	7.7	8.0	6.3	6.3	7.1
24.	Mona	7.3	6.7	6.7	6.7	8.0	7.0	7.1
25.	Viola	7.0	7.0	7.3	7.0	7.7	6.3	7.1
26.	Enoble	7.0	7.7	7.0	7.7	7.0	6.3	7.1
27.	Merion	7.0	7.0	7.3	7.0	8.0	6.3	7.1
28.	Eclipse	6.7	7.3	7.0	7.7	7.0	6.7	7.1
29.	Kimono	7.0	6.0	7.0	7.3	7.3	7.3	7.0
30.	WW Ag 480	7.0	8.0	7.0	6.7	7.0	6.3	7.0
31.	Mosa	7.3	8.0	6.7	6.0	7.3	6.7	7.0
32.	Mer pp 300	7.3	7.7	7.0	7.3	7.0	5.7	7.0
33.	Nugget	7.0	6.3	7.3	7.0	6.3	7.3	6.9
34.	Banff	7.3	6.3	7.0	6.7	7.7	6.7	6.9
35.	MLM - 18011	7.7	7.3	5.7	6.7	7.3	7.0	6.9
36.	WW Ag 480	6.7	6.0	6.3	6.7	7.7	8.0	6.9
37.	Cello	7.0	7.3	6.7	6.7	7.7	6.3	6.9
38.	Majesty	6.7	6.3	7.3	7.3	6.3	7.3	6.9
39.	H - 7	7.0	6.7	6.7	7.0	7.0	7.0	6.9
40.	Mer pp 43	6.7	6.7	6.7	7.0	7.7	6.7	6.9
41.	Admiral	6.3	6.0	7.0	7.3	7.7	7.0	6.9
42.	Birka	7.0	6.7	6.7	7.3	7.0	6.3	6.8
43.	Baron	6.7	7.3	6.7	7.3	6.7	6.3	6.8
44.	Plush	7.0	7.0	6.7	6.7	6.7	7.0	6.8
45.	Parade	6.3	7.0	6.3	6.3	7.3	7.3	6.8
46.	Columbia	6.7	6.0	6.3	7.7	7.3	7.0	6.8
47.	Sydsport	6.3	7.7	6.3	7.0	7.0	6.3	6.8

Table 1. (continued)

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
48.	225	6.3	6.3	6.7	7.7	7.3	6.7	6.8
49.	Barblue	7.3	6.3	7.0	5.7	7.3	7.3	6.8
50.	Welcome	6.0	6.0	7.0	7.3	7.3	6.7	6.7
51.	Apart	6.7	6.0	7.3	6.7	7.3	6.3	6.7
52.	SH - 2	6.0	7.0	6.3	7.0	6.7	7.0	6.7
53.	Escort	6.7	5.0	6.3	7.0	7.7	7.3	6.7
54.	K1 - 152	6.3	6.7	6.7	6.7	7.3	6.7	6.7
55.	Fylking	7.3	6.3	6.0	6.0	6.7	7.0	6.6
56.	239	7.0	6.0	6.3	7.0	6.3	7.0	6.6
57.	Trenton	6.3	6.7	6.3	6.3	7.0	7.0	6.6
58.	Rugby	6.7	6.0	6.3	7.0	6.7	7.0	6.6
59.	Dormie	6.7	6.0	6.0	6.7	7.7	6.3	6.6
60.	Touchdown	6.3	6.0	6.7	7.3	7.3	6.0	6.6
61.	Harmony	7.0	6.7	5.3	6.3	7.7	6.7	6.6
62.	Bonnieblue	7.0	6.0	6.3	7.0	6.7	6.3	6.6
63.	Charlotte	6.3	5.3	6.0	7.0	8.0	7.0	6.6
64.	NJ 735	6.0	5.3	7.0	7.0	7.0	7.0	6.6
65.	Bayside	6.0	6.0	6.7	6.7	7.0	7.3	6.6
66.	K3 - 178	6.7	5.7	5.7	6.7	7.3	7.3	6.6
67.	Bono	6.7	6.0	6.7	7.3	6.7	5.7	6.5
68.	Monopoly	6.0	6.0	6.3	6.3	6.7	7.0	6.4
69.	Wabash	6.0	6.3	6.7	6.7	6.7	6.3	6.4
70.	American	6.3	6.3	6.7	6.3	7.0	6.0	6.4
71.	Shasta	6.0	6.0	6.0	6.7	7.0	7.0	6.4
72.	A - 34	6.3	6.0	6.0	6.3	7.0	6.7	6.4
73.	S - 21	5.7	5.7	6.7	7.0	6.7	6.0	6.3
74.	Geronimo	6.3	6.0	6.3	6.7	6.3	6.3	6.3
75.	Kenblue	5.3	5.3	6.3	7.7	6.3	7.0	6.3
76.	Argyle	5.7	6.0	6.3	6.7	6.3	7.0	6.3
77.	S. D. Common	5.3	5.7	7.0	7.3	6.7	6.0	6.3
78.	K3 - 179	6.0	5.7	6.3	6.7	7.0	6.3	6.3
79.	Vantage	5.7	6.3	6.7	6.3	6.7	5.7	6.2
80.	P 141 (Mystic)	5.7	5.3	6.7	7.0	7.3	5.3	6.2
81.	Piedmont	5.7	5.7	6.3	6.3	5.7	5.7	5.9
82.	K3 - 162	5.3	5.0	5.7	6.0	7.3	5.3	5.8
83.	SV - 01617	6.3	4.3	5.0	5.3	7.0	6.3	5.7
84.	Lovegreen	5.7	4.7	5.7	6.0	6.3	5.0	5.6
	LSD 0.05	1.1	1.4	1.4	1.3	1.2	1.4	0.7

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

Table 2. The 1987 quality ratings for the nonirrigated, high-maintenance regional Kentucky bluegrass trial established in the fall 1985.

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
1.	Monopoly	7.0	5.0	7.3	6.0	6.7	6.3	6.4
2.	HV 97	5.7	5.3	7.3	6.7	7.0	6.3	6.4
3.	F-1872	6.7	6.3	6.3	5.3	6.7	6.7	6.3
4.	Mystic	6.7	6.3	7.0	7.0	5.0	5.0	6.2
5.	Trenton	7.0	5.3	5.3	6.0	7.0	6.3	6.2
6.	Blacksburg	6.7	4.3	6.7	6.7	6.0	6.7	6.2
7.	Parade	6.3	5.7	5.3	5.7	6.7	6.7	6.1
8.	Wabash	6.0	4.3	5.7	6.3	7.3	6.7	6.1
9.	Julia	6.7	5.3	6.0	5.3	6.3	6.7	6.1
10.	K3-178	7.0	5.7	5.7	5.3	6.7	6.3	6.1
11.	Park	5.3	5.3	7.0	5.3	6.7	6.3	6.0
12.	A-34	6.0	5.0	6.0	5.3	6.3	6.7	5.9
13.	Ba 72-492	6.7	4.7	6.3	5.7	6.7	5.3	5.9
14.	Ikone	6.0	5.0	6.7	5.0	6.7	6.3	5.9
15.	WW Ag 495	5.7	4.3	6.7	6.0	6.7	6.0	5.9
16.	NE 80-14	6.7	5.7	6.0	5.7	7.0	4.7	5.9
17.	Tendos	6.3	5.0	6.0	5.7	6.3	5.7	5.8
18.	Georgetown	6.3	5.0	5.7	5.3	6.0	6.7	5.8
19.	Conni	5.3	5.0	6.0	5.7	6.0	6.7	5.8
20.	BA 72-500	6.0	5.3	5.0	5.3	7.0	6.3	5.8
21.	NE 80-88	6.3	5.7	6.3	4.3	6.0	6.3	5.8
22.	Huntsville	4.3	6.3	5.7	5.0	7.0	6.3	5.8
23.	K1-152	5.7	5.0	5.7	5.3	6.7	6.7	5.8
24.	PST-CB1	6.0	6.0	6.0	5.0	5.7	6.0	5.8
25.	Classic	6.3	5.3	5.7	5.3	5.3	6.3	5.7
26.	Rugby	6.0	4.7	5.3	5.7	6.7	6.0	5.7
27.	P-104	5.0	4.3	5.7	5.3	6.3	7.0	5.6
28.	239	6.0	4.7	5.3	4.7	6.3	6.7	5.6
29.	Aquila	5.0	5.0	5.7	5.7	6.0	6.0	5.6
30.	South DAkota	5.3	5.0	7.0	5.0	6.7	4.3	5.6
31.	WW Ag 496	6.3	5.3	5.7	4.7	6.0	5.3	5.6
32.	NE 80-50	5.0	4.7	5.3	5.3	6.7	6.3	5.6
33.	NE 80-30	5.3	4.7	6.3	5.0	6.0	6.3	5.6
34.	WW Ag 491	6.0	5.0	5.3	5.3	5.7	5.7	5.5
35.	America	5.0	5.0	5.0	5.3	6.7	5.7	5.4
36.	Ba 69-82	5.3	4.3	5.3	5.0	6.7	5.7	5.4
37.	Loft's 1757	5.7	4.7	5.0	5.0	6.3	6.0	5.4
38.	Compact	4.7	3.0	5.7	5.0	7.0	6.3	5.3
39.	Joy	5.3	5.0	5.7	4.7	5.3	5.7	5.3
40.	Annika	6.0	3.3	5.0	5.3	6.3	5.7	5.3
41.	Kenblue	4.3	5.0	6.3	5.3	5.3	5.3	5.3
42.	Bristol	6.3	5.0	5.3	4.7	6.0	4.7	5.3
43.	BAR VB 534	5.0	5.0	5.3	5.3	5.3	5.7	5.3
44.	Cynthia	5.3	4.0	5.7	6.0	5.7	5.3	5.3
45.	Ba 73-540	5.3	4.7	5.0	4.7	6.0	6.0	5.3
46.	Eclipse	5.7	4.3	5.3	5.0	5.3	6.0	5.3
47.	Haga	5.3	4.7	5.0	5.0	5.3	6.0	5.2

Table 2. (continued)

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
48.	Somerset	5.0	4.0	5.0	4.7	6.3	6.3	5.2
49.	Ba 70-139	5.3	3.7	5.3	4.7	6.3	6.0	5.2
50.	Amazon	6.0	4.7	5.3	4.7	5.3	5.3	5.2
51.	Sydsport	5.3	4.3	5.0	4.3	5.3	6.0	5.1
52.	Victa	5.0	3.7	5.7	5.7	6.0	4.7	5.1
53.	Ba 73-626	4.7	4.3	5.0	5.3	5.7	5.7	5.1
54.	Cheri	5.7	4.3	4.7	5.0	5.3	5.3	5.1
55.	Midnight	6.0	4.3	4.7	4.7	5.7	5.0	5.1
56.	NE 80-110	5.3	4.0	5.0	5.0	5.3	5.3	5.0
57.	Barzan	4.3	4.7	4.7	4.3	5.3	6.3	4.9
58.	Able I	5.3	3.3	5.7	5.0	5.3	5.0	4.9
59.	Ba 72-441	4.7	3.3	4.7	5.3	5.7	6.0	4.9
60.	Asset	5.0	4.3	5.0	4.0	6.3	5.0	4.9
61.	Liberty	5.0	4.3	5.0	4.7	5.3	5.3	4.9
62.	Harmony	4.7	4.0	5.3	4.7	4.7	6.0	4.9
63.	Welcome	5.0	3.7	4.3	4.3	6.7	5.3	4.9
64.	WW Ag 468	5.7	4.3	5.3	4.7	5.0	4.7	4.9
65.	NE 80-55	4.7	3.7	4.7	4.3	6.7	5.3	4.9
66.	Gnome	5.0	4.7	4.7	4.3	5.0	5.0	4.8
67.	BAR VB 577	4.3	4.7	5.0	4.3	5.7	5.0	4.8
68.	Ram-1	4.7	3.7	4.3	4.3	6.0	5.0	4.7
69.	Challenger	4.7	4.7	4.3	4.0	5.3	5.0	4.7
70.	NE 80-47	4.3	3.7	4.7	4.3	6.0	5.0	4.7
71.	Ba 70-242	4.0	3.3	4.7	4.7	5.3	5.3	4.6
72.	Dawn	4.3	4.7	4.0	4.3	5.0	5.3	4.6
73.	Baron	4.3	4.3	4.7	4.7	4.7	4.3	4.5
74.	Nassau	4.3	3.7	4.0	3.7	5.3	5.3	4.4
75.	NE 80-48	4.7	3.3	4.0	4.0	5.0	5.7	4.4
76.	Aspen	4.3	4.0	4.0	4.3	4.3	5.0	4.3
77.	Merit	3.7	4.3	4.0	3.7	5.0	4.7	4.2
78.	Glade	3.7	2.7	4.0	4.3	5.3	4.3	4.1
79.	Merion	4.3	3.0	3.7	4.3	4.0	4.0	3.9
80.	Destiny	3.3	3.3	3.3	3.0	4.3	4.3	3.6
	LSD 0.05	1.5	1.4	1.5	.14	1.7	1.4	1.0

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

Table 3. The 1987 quality ratings for the low-maintenance regional Kentucky bluegrass test established in the fall 1980.

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
1.	K3 - 162	5.7	4.3	6.0	5.7	5.7	6.0	5.6
2.	Kenblue	3.7	4.3	6.0	6.0	6.0	6.3	5.4
3.	S. D. Common	4.7	4.0	6.0	5.7	6.0	6.0	5.4
4.	S - 21	4.7	4.0	5.7	5.3	5.7	5.7	5.2
5.	Argyle	4.7	4.7	5.7	4.7	5.0	5.3	5.0
6.	Piedmont	5.3	3.7	5.0	4.3	5.3	5.7	4.9
7.	PSU - 173	5.7	4.0	5.0	4.0	5.0	5.3	4.8
8.	Plush	5.0	4.3	4.7	3.3	5.7	5.7	4.8
9.	Flyking	5.0	4.3	4.3	3.3	5.3	5.7	4.7
10.	PSU - 190	5.7	4.7	4.3	3.3	4.7	4.7	4.6
11.	PSU - 15C	4.3	4.3	5.0	4.7	5.0	4.3	4.6
12.	Parade	4.3	4.0	4.0	4.3	5.3	5.7	4.6
13.	Vanessa	5.3	4.3	4.3	3.3	5.3	4.7	4.6
14.	Mosa	5.0	4.3	4.0	4.3	5.3	4.7	4.6
15.	Vantage	4.3	4.0	4.0	4.7	5.0	5.7	4.6
16.	Mer pp 43	5.7	4.0	4.0	3.7	5.3	4.7	4.6
17.	K3 - 179	4.0	4.3	4.7	4.3	5.3	5.0	4.6
18.	K3 - 178	6.0	4.7	4.3	3.3	4.7	4.7	4.6
19.	Wabash	6.3	3.7	3.7	3.0	5.3	5.0	4.5
20.	Touchdown	5.7	4.3	4.3	2.7	4.7	5.3	4.5
21.	A - 34	5.0	4.3	4.0	4.0	5.0	4.7	4.5
22.	BA - 61 - 91	5.7	4.0	4.3	3.7	4.3	5.0	4.5
23.	Kimono	5.3	4.3	4.3	3.0	5.0	4.7	4.4
24.	CEB VB 39	6.0	4.3	3.7	2.7	4.7	5.3	4.4
25.	Enoble	5.0	4.3	4.3	3.7	4.0	5.0	4.4
26.	NY 735	5.7	4.3	4.0	3.0	4.3	5.0	4.4
27.	Merion	5.7	4.0	4.0	3.3	4.3	5.0	4.4
28.	K1 - 152	4.7	3.7	4.0	4.3	4.3	5.7	4.4
29.	Monopoly	6.3	4.7	3.3	2.7	4.0	4.7	4.3
30.	Geronimo	6.0	4.0	4.3	3.0	4.0	4.3	4.3
31.	N 53 S	5.0	4.7	3.3	3.3	4.7	5.0	4.3
32.	Eclipse	5.3	4.0	4.3	3.0	4.0	5.0	4.3
33.	Harmony	4.7	4.0	3.0	3.0	4.7	5.7	4.2
34.	Majestic	4.7	4.3	3.7	3.3	4.3	5.0	4.2
35.	SH - 2	6.3	4.7	3.3	3.0	3.7	4.0	4.2
36.	Admiral	5.0	4.3	4.0	2.7	4.7	4.3	4.2
37.	Escort	4.7	4.7	3.7	2.3	4.7	5.3	4.2
38.	Barblue	4.7	4.0	3.7	3.7	4.3	4.7	4.2
39.	Birka	5.7	4.3	3.3	2.3	4.3	4.7	4.1
40.	SV - 01617	5.0	3.7	4.0	3.0	4.7	4.3	4.1
41.	MLM - 18011	4.7	3.7	3.3	3.3	4.3	5.3	4.1
42.	Shasta	5.3	4.0	3.3	2.3	4.7	5.0	4.1
43.	Apart	5.0	3.7	4.0	3.3	4.0	4.7	4.1
44.	Sydsport	6.0	4.7	4.0	2.7	4.0	3.3	4.1
45.	Victa	6.0	4.3	4.3	2.3	3.7	3.7	4.1
46.	Adelphi	5.3	3.7	3.3	3.0	3.7	5.0	4.0
47.	Cello	5.0	4.7	3.7	2.3	4.3	4.0	4.0

Table 3. (continued)

	Cultivar	May	June	July	Aug	Sept	Oct	Mean
48.	WW Ag 478	4.3	4.0	3.7	3.0	4.0	5.0	4.0
49.	Lovegreen	5.0	4.3	4.3	2.7	3.7	4.0	4.0
50.	Bayside	6.0	4.3	4.0	2.7	3.3	3.7	4.0
51.	RAM - 1	5.7	4.3	3.3	2.3	3.7	4.3	3.9
52.	243	5.7	4.0	3.3	3.0	3.7	3.7	3.9
53.	Enmundi	5.0	4.7	3.7	2.7	3.7	4.0	3.9
54.	Trenton	5.3	4.0	3.7	2.3	3.7	4.3	3.9
55.	Banff	4.7	4.0	3.7	3.0	4.0	4.3	3.9
56.	Dormie	5.0	3.7	3.7	3.0	4.3	4.0	3.9
57.	Holiday	4.7	4.0	3.3	2.3	4.3	4.7	3.9
58.	Welcome	4.3	3.3	3.7	3.3	4.3	4.7	3.9
59.	WW Ag 463	6.0	4.0	3.0	2.0	4.0	4.7	3.9
60.	Bono	5.3	5.0	3.7	2.3	3.7	3.7	3.9
61.	American	6.0	4.3	3.3	2.3	3.7	4.0	3.9
62.	Bonnieblue	5.0	4.0	3.7	3.3	3.3	4.0	3.9
63.	AZO - 6	5.0	4.0	3.0	2.3	4.3	4.7	3.9
64.	H - 7	5.3	3.3	3.7	3.0	4.0	4.0	3.9
65.	Mer pp 300	5.0	4.7	4.0	2.0	4.0	3.7	3.9
66.	Bristol	5.0	4.0	3.0	3.3	4.0	4.3	3.9
67.	225	5.7	4.0	3.3	2.7	4.0	3.7	3.9
68.	239	4.7	3.7	3.3	3.0	3.7	4.3	3.8
69.	Rugby	4.7	4.0	3.7	2.7	3.3	4.3	3.8
70.	Aspen	5.0	3.3	2.7	2.7	4.3	5.0	3.8
71.	I - 13	5.3	4.7	2.0	2.3	3.7	4.7	3.8
72.	Mona	5.3	4.7	3.0	2.0	3.7	4.0	3.8
73.	Cheri	5.7	4.0	3.7	2.3	3.3	3.3	3.7
74.	Baron	5.3	4.0	3.3	2.7	3.3	3.7	3.7
75.	Merit	4.7	4.0	3.0	2.3	4.0	4.0	3.7
76.	Charlotte	5.0	3.7	3.3	2.7	4.0	3.3	3.7
77.	AZO - 6A	4.0	4.0	3.7	3.0	3.7	4.0	3.7
78.	Columbia	4.0	4.0	3.0	2.7	4.3	4.0	3.7
79.	Nugget	4.0	4.0	3.3	2.7	3.7	3.7	3.6
80.	AZO	4.0	3.3	3.7	3.3	3.3	4.0	3.6
81.	WW Ag 480	5.7	3.7	3.0	2.0	3.3	3.3	3.5
82.	Midnight	4.3	3.7	3.3	2.3	4.0	3.3	3.5
83.	P 141 (Mystic)	4.7	4.3	3.0	2.3	3.7	3.0	3.5
84.	Glade	4.0	4.0	3.0	2.0	3.7	4.0	3.4
	LSD 0.05	1.6	N.S.	1.2	1.6	1.6	1.5	0.8

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

Regional Perennial Ryegrass Cultivar Evaluation

N. E. Christians and K. L. Diesburg

This is the fifth year of data from the trial established in the fall of 1982 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 each month of the growing season for turf quality and disease.

The trial is maintained at a 2-inch 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.

There are no statistical differences among the first 30 cultivars in Table 4. Notice that several of the top performers in 1987 are experimental numbered cultivars. 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.

Table 4. Turf quality[a] of perennial ryegrass cultivars in 1987.

Cultivar	Ratings[a] May	June	July	Aug	Sept	Oct	Mean
1. SWRC - 1	6.0	9.0	8.0	7.7	8.0	6.7	7.6
2. GT - II	6.3	8.7	7.7	7.3	8.0	7.3	7.6
3. BT - I	7.0	8.3	7.7	6.7	8.3	7.0	7.5
4. Palmer	8.0	8.7	7.0	7.0	7.0	6.7	7.4
5. 282	7.3	8.3	7.7	5.7	8.7	7.0	7.4
6. Prelude	6.7	7.3	6.3	7.3	8.7	7.3	7.3
7. Pennant	7.0	7.0	8.0	7.7	8.3	6.0	7.3
8. IA 728	7.0	7.7	7.7	7.3	8.3	5.7	7.3
9. Diplomat	6.0	8.7	8.0	7.0	7.3	6.3	7.2
10. Omega	7.3	8.0	7.0	7.7	7.0	6.3	7.2
11. Gator	7.0	8.3	7.3	6.3	7.7	6.7	7.2
12. HR - 1	7.3	7.0	6.0	6.7	9.0	6.7	7.1
13. Derby	6.3	7.7	7.3	7.3	7.7	6.0	7.1
14. Yorktown II	5.0	8.0	7.3	7.0	8.7	6.0	7.0
15. HE 168	5.3	7.3	8.3	7.3	8.0	5.7	7.0
16. Blazer	6.3	8.0	7.3	6.7	7.3	6.3	7.0
17. LP 702	5.3	7.7	8.3	6.0	7.7	6.7	6.9
18. LP 210	6.3	7.7	7.0	6.0	8.0	6.3	6.9
19. Manhattan II	5.7	8.3	7.0	5.3	8.3	6.7	6.9
20. Pennfine	7.7	7.0	7.3	6.7	7.0	5.3	6.8
21. Ranger	6.0	7.7	5.7	6.3	8.0	6.3	6.7
22. Fiesta	7.7	7.7	5.7	5.3	7.3	6.3	6.7
23. WWE 19	7.0	8.0	6.7	6.3	6.7	5.3	6.7
24. Birdie	7.7	7.3	6.3	5.3	7.3	6.0	6.7
25. HE 178	7.3	8.0	6.3	4.7	7.7	5.7	6.6
26 Manhattan	6.7	8.3	6.3	5.7	7.0	5.3	6.6
27. 2ED	6.3	7.0	6.7	6.0	8.0	5.3	6.6
28. Premier	7.0	6.7	6.0	6.3	7.3	6.0	6.6
29. M 382	5.7	8.0	6.3	5.7	7.7	6.0	6.6
30. Delray	6.7	7.0	6.7	6.0	8.0	5.0	6.6
31. Dasher	6.7	7.3	5.3	7.0	7.3	5.3	6.5
32. Gigil	6.3	7.7	6.3	5.7	7.7	5.3	6.5
33. NK 79307	5.7	7.3	6.3	6.7	7.0	5.3	6.4
34. Regal	7.0	6.0	6.3	7.0	6.7	5.7	6.4
35. Cockade	6.0	8.0	6.3	5.7	7.3	4.7	6.3
36. Cupido	6.0	7.7	6.7	6.0	6.3	5.3	6.3
37. Acclaim	6.3	7.0	6.0	4.3	7.3	6.0	6.2
38. Citation	7.0	6.0	5.0	5.3	7.3	6.7	6.2
39. Crown	7.0	7.0	5.3	4.7	7.0	5.3	6.1
40. 2 EE	5.3	6.3	6.0	6.0	7.3	5.3	6.1
41. NK 80389	5.3	7.7	6.0	5.0	7.0	5.3	6.1
42. LP 792	5.7	6.7	5.7	4.7	7.7	5.7	6.0
43. Elka	5.7	6.7	5.7	4.3	7.7	5.7	5.9
44. LP 736	6.0	6.7	4.3	5.7	7.3	5.0	5.8
45. NK 79309	6.0	6.3	6.3	6.0	6.0	4.0	5.8
46. Pippin	5.0	6.7	6.0	5.0	6.3	5.3	5.7
47. Barry	5.0	7.0	5.0	4.7	6.7	3.7	5.3
48. Linn	4.3	4.3	4.7	4.7	4.7	4.0	4.4
Experiment Mean	6.4	7.5	7.5	7.0	7.7	6.8	6.7
LSD 0.05	1.4	1.1	2.0	1.8	1.3	1.3	1.0

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

Perennial Ryegrass Cultivar Evaluations

N. E. Christians

The 22 perennial ryegrass cultivars in this trial were established in 1979. The study has been maintained at a 2-inch mowing height and is fertilized with 4 lb N/1000 ft^2/yr. The area receives no fungicide or insecticide applications. The 1987 season is the final year that data will be collected from this area. It will be phased out in 1988.

Elka, Yorktown, Fiesta, Loretta, and Belle received the highest overall quality ratings in 1987. Regal and Pennfine ranked unusually low in this trial in 1987. This was due to the development of a disease believed to be Brown Patch in these two cultivars in midsummer. Regal also ranked somewhat lower in the newer perennial ryegrass trial (Table 5), than in earlier years, however, Pennfine in that trial ranked with the better cultivars. It is not unusual for certain cultivars to deteriorate in quality in older trials.

Table 5. The 1987 quality ratings for 22 perennial ryegrass cultivars established in 1979.

		Quality Ratings						
	Cultivar	May	June	July	Aug	Sept	Oct	Mean
1.	Elka	6.7	8.7	7.3	5.3	7.0	6.7	6.9
2.	Yorktown	8.0	8.0	7.0	7.0	7.0	4.7	6.9
3.	Fiesta	7.0	8.3	6.3	6.0	7.0	6.5	6.8
4.	Loretta	7.3	8.3	5.7	5.3	7.0	6.3	6.7
5.	Belle	7.7	8.0	7.0	5.7	6.3	5.7	6.7
6.	Diplomat	7.0	7.3	7.0	5.7	6.7	5.0	6.4
7.	Caravelle	6.7	6.7	5.7	5.3	6.3	6.0	6.1
8.	Medaliest North	6.7	6.7	6.3	5.0	7.0	5.0	6.1
9.	Delray	6.7	7.3	5.0	6.3	6.3	4.7	6.1
10.	Derby	7.3	7.0	6.0	5.7	5.0	5.0	6.0
11.	K5 - 88	5.0	6.7	5.0	5.3	6.3	7.3	5.9
12.	Manhattan	7.3	6.7	5.3	5.0	6.3	5.0	5.9
13.	Citation	6.7	6.7	5.7	5.7	6.0	5.0	5.9
14.	Blyes	7.0	7.0	6.3	5.3	4.3	5.0	5.8
15.	K5 - 94	7.3	7.0	4.7	4.3	6.0	4.3	5.6
16.	Goalie	6.0	6.7	4.7	4.7	5.3	5.3	5.4
17.	NK - 100	5.3	5.3	4.3	4.3	6.7	5.7	5.3
18.	J186 R24 D	6.0	6.0	4.3	4.0	5.3	5.3	5.2
19.	Regal	5.3	6.0	4.7	4.7	5.0	5.7	5.2
20.	NK - 200	6.0	6.0	4.3	4.3	5.0	5.0	5.1
21.	Linn	5.0	5.0	4.7	3.7	5.7	5.3	4.9
22.	Pennfine	5.0	5.5	5.0	4.5	4.0	4.0	4.7
	LSD 0.05	1.4	1.7	1.8	N.S.	N.S.	1.8	1.2

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

Fine Fescue Cultivar Trial

N. E. Christians and K. L. Diesburg

This is the fifth year for the fine fescue cultivar trial established in the fall of 1982. The purpose of the trial is to identify regional adaptation of the 32 fine fescue cultivars and blends in a full sun exposure. Cultivars are evaluated each month of the growing season for turf quality.

The trial is maintained at a 2-inch 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.

Shadow, Banner, Checker, Scaldis, and Atlanta were the best cultivars under these conditions in 1987 (Table 6). Many of the cultivars have allowed the encroachment of Kentucky bluegrass since 1982. Tournament, Pennlawn, NK79190, NK79191, NK80345, NK80347, NK80348, and Duar had 20 to 80 percent Kentucky bluegrass in two or three of their replications. This may be due to a lack of competitiveness with Kentucky bluegrass. There also may have been some contamination of the experimental cultivars with bluegrass seed at the time of establishment.

This trial will be eliminated in 1988. A new shade study that includes many of the fine fescues was established in the fall of 1987.

Table 6. Turf quality ratings of fine fescue cultivars and blends.

	Cultivar	Turf Quality[a]						
		May	June	July	Aug	Sept	Oct	Mean
1.	Shadow	8.7	9.0	7.3	6.0	5.0	6.3	7.1
2.	Banner/Checker	6.7	8.7	7.0	6.3	6.3	6.0	6.8
3.	Banner	7.7	8.3	7.0	5.3	4.7	6.7	6.6
4.	Checker	6.0	8.7	7.7	4.7	5.0	5.3	6.2
5.	Scaldis/Atlanta	7.7	8.7	7.0	4.3	4.0	5.7	6.2
6.	Atlanta	7.3	8.0	6.7	4.3	4.3	5.7	6.1
7.	Barfalla	5.7	8.0	6.7	4.0	4.3	5.3	5.7
8.	Dawson	5.0	8.3	7.0	4.0	4.3	5.7	5.7
9.	Agram	6.7	8.3	5.0	4.3	5.0	4.3	5.6
10.	Waldina	5.3	5.7	5.3	5.0	4.7	4.7	5.1
11.	Jamestown	6.0	6.3	5.3	4.0	4.3	4.3	5.1
12.	Aurora	4.7	5.7	5.0	5.0	5.0	4.7	5.0
13.	FOF - WC	5.0	5.3	5.3	4.7	4.7	4.7	4.9
14.	Ruby	4.7	6.0	6.3	4.0	5.3	3.3	4.9
15.	Koket	5.0	6.0	5.0	3.7	4.7	4.3	4.8
16.	Wintergreen	5.0	6.7	4.0	2.7	4.0	4.0	4.4
17.	NK 80346	6.3	5.3	6.3	1.7	3.0	2.3	4.2
18.	Dawson/Pennlawn	3.7	6.0	4.7	3.3	3.7	4.0	4.2
19.	Ensylva	4.3	5.7	4.7	3.0	3.3	3.7	4.1
20.	Pennlawn	4.3	5.0	4.7	3.7	3.7	3.0	4.1
21.	Scaldis	4.0	5.0	5.0	3.7	1.0	4.7	3.9
22.	Highlight	3.7	3.0	2.3	3.7	2.7	4.3	3.3
23.	NK 79189	4.7	5.7	4.7	3.0	1.0	1.0	3.3
24.	Fortress	3.0	5.3	2.3	2.3	3.0	3.0	3.2
25.	Biljart	4.7	3.3	3.0	3.0	1.0	2.7	2.9
26.	Duar	4.3	4.3	4.0	2.3	1.7	1.0	2.9
27.	NK 79190	2.3	3.3	2.3	2.0	2.3	2.7	2.5
28.	Tournament	3.0	3.0	2.7	2.3	1.0	1.0	2.2
29.	NK 80345	2.7	3.3	3.0	2.3	1.0	1.0	2.2
30.	NK 79191	3.0	3.0	1.0	1.0	1.0	1.0	1.7
31.	NK 80347	3.7	1.0	1.0	1.0	1.0	1.0	1.4
32.	NK 80348	2.7	1.0	1.0	1.0	1.0	1.0	1.3
	LSD = 0.05	3.8	4.5	3.7	2.9	3.7	3.2	2.9

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

Fine Fescue Management Study

N. E. Christians

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 at two mowing heights: 1 and 2 inches. Each plot is divided into two fertilizer treatments: 1 and 3 lb N/1000 ft^2, applied as IBDU. Each plot is irrigated as needed. The study was established on September 8, 1979.

The quality ratings in table 7 are the means of monthly ratings taken on repli-cated plots from May to October. As has been the case for several years, Reliant and Scaldis Hard Fescue had the best overall quality for the year (Table 7). Jamestown chewings fescue also performed very well in 1987.

At the 2-inch mowing height, only Reliant and Scaldis maintained a satisfactory quality rating of 6 or better at the 1 lb N/1000 ft^2/yr fertility rate. At the 3 lb N/1000 ft^2/yr rate, most of the grasses tested were acceptable.

At the 1-inch mowing height, only Scaldis maintained a satisfactory quality at the 1 lb N/1000 ft^2/yr rate. Reliant, Scaldis, and Jamestown were the best cultivars at the 3 lb N/1000 ft^2/yr rate. This study has been in progress for eight seasons. The fact that any of these grasses have maintained an acceptable cover at a 1-inch mowing height for that length of time is surprising.

The cultivars listed as acceptable have consistently performed well during the study. There is a large difference between poorly rated cultivars and acceptable cultivars. The choice of fine fescue cultivars for this region should be made carefully, as many are not well adapted to Iowa conditions.

Table 7. The effects of mowing height and nitrogen fertilizer on quality of 10 fine fescues.

		Mowing Height				
		1 inch		2 inch		
		N Rate		N Rate		Overall
		1 lb[a]	3 lb	1 lb	3 lb	Mean
1.	Pennlawn Red Fescue	5.0[b,c]	5.6	5.7	6.3	5.7
2.	Scaldis Hard Fescue	6.2	6.7	6.8	7.2	6.7
3.	Ruby Red Fescue	4.1	4.8	5.1	6.2	5.0
4.	Atlanta Chewings Fescue	5.6	5.8	5.8	6.2	5.8
5.	K5-29 Red Fescue	4.7	4.9	5.1	5.7	5.1
6.	Dawson Red Fescue	4.2	4.5	3.0	5.7	4.8
7.	Reliant Hard Fescue	6.1	6.7	6.7	7.3	6.7
8.	Ensylva Red Fescue	4.2	4.7	5.3	6.7	5.1
9.	Highlight Chewings Fescue	3.6	3.6	4.0	4.1	3.8
10.	Jamestown Chewings Fescue	5.8	6.6	5.8	6.8	6.3

[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 Management Study

N. E. Christians and K. L. Diesburg

This is a report of the fourth 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 ft4^2/yr and cutting heights of 2 and 3 inches. One pound of N was applied once during each month of 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.

The 2-inch cut resulted in higher quality turf for all cultivars (Table 8). Turf quality increased with each increment of nitrogen for all of the cultivars at both mowing heights. Each cultivar performed best at a 2-inch mowing height and 4 lb N/1000 ft^2/yr.

Mustang was the best cultivar under higher maintenance conditions in 1987. In general, each of the turf-type cultivars performed better than Kentucky 31.

Table 8. Turf quality of tall fescue cultivars at two clipping heights and three fertility levels.

Cultivar	Clip Hgt inch	lb N/ 1000 ft^2	Ratings[a] May	June	July	Aug	Sept	Oct	Mean
Mustang	2	0	5.0	4.0	5.3	4.3	4.7	4.0	4.6
	2	2	5.0	5.0	6.7	5.7	4.7	5.3	5.4
	2	4	7.0	7.3	8.0	7.0	7.7	7.0	7.3
	3	0	4.3	3.7	4.3	4.0	4.7	3.0	3.0
	3	2	4.0	5.0	6.3	5.3	4.7	4.3	4.9
	3	4	6.0	7.0	7.7	7.3	7.3	6.3	6.9
Houndog	2	0	5.7	4.0	5.0	4.3	5.7	4.0	4.8
	2	2	5.3	5.0	6.7	6.0	6.7	5.0	5.8
	2	4	7.0	8.0	7.7	6.7	4.7	6.7	6.8
	3	0	4.3	4.0	4.0	4.0	5.7	3.0	4.2
	3	2	4.3	5.0	6.0	5.0	6.3	4.0	5.1
	3	4	5.7	7.0	7.3	6.3	4.3	6.3	6.2
Rebel	2	0	5.0	4.0	6.0	4.0	6.0	4.0	4.8
	2	2	5.3	5.0	6.3	5.0	5.0	5.0	5.3
	2	4	7.0	7.7	6.7	5.3	4.0	6.3	6.2
	3	0	4.0	3.3	5.3	3.6	6.3	3.3	4.3
	3	2	4.3	5.0	5.7	4.7	5.0	5.0	4.9
	3	4	6.0	7.0	6.0	6.3	3.7	6.0	5.8
Falcon	2	0	5.0	4.0	4.7	4.7	5.0	4.0	4.6
	2	2	5.0	5.0	6.3	6.0	6.0	5.0	5.6
	2	4	7.0	8.0	8.0	6.3	4.3	7.0	6.8
	3	0	4.0	3.7	4.0	4.0	5.0	3.0	3.9
	3	2	4.0	5.0	5.7	5.0	5.7	4.0	4.9
	3	4	6.0	7.0	7.0	6.3	4.0	6.0	6.1
Kentucky 31	2	0	4.3	3.7	3.3	3.7	4.3	2.7	3.7
	2	2	4.7	4.7	5.3	4.7	7.0	4.3	5.1
	2	4	6.0	6.0	7.0	6.7	4.7	6.0	6.1
	3	0	4.0	3.0	3.0	3.7	4.0	2.0	3.3
	3	2	4.0	4.3	5.0	5.0	7.0	3.7	4.8
	3	4	5.0	6.0	6.0	6.3	4.3	5.0	5.4
LSD cultivar averages			0.3	0.2	0.3	0.9	0.8	0.4	0.3
LSD managements			0.4	0.5	0.6	1.1	0.8	0.5	0.3

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

Evaluation of Different Granular Nitrogen Sources for Maintenance Fertilization of Kentucky Bluegrass

M. L. Agnew, N. E. Christians, and R. W. Moore

In this study, seven granular nitrogen (N) sources are being evaluated for maintenance fertilization. The turf is Glade Kentucky bluegrass established in September, 1984. It is maintained at a cutting height of 2 inches. The study is replicated three times in a complete block design. Plot size is 3.5 ft X 7 ft.

The treatments include six slow-release N sources applied at 4 lb N/1000 ft^2/year split into two equal applications. The six slow-release N sources include: IBDU and Plastic Coated Urea (PCU) from Estech Corporation, Sulfur Coated Urea from the Anderson Company (SCU/CIL), Sulfur Coated Urea from the Lesco Company (SCU/TVA), Methylene Urea from O.M. Scotts, and Ureaformaldehyde (UF) as Blue Chip from the NOR-AM Company In addition, one urea treatment was applied at 4 lb N/1000 ft^2/year split into four equal applications. Treatments were initiated in the spring of 1985. The dates of fertilizer application are May 1 and August 15. The additional urea treatments were applied on June 1 and September 15.

The results of the 1987 data indicate that urea, SCU/CIL, SCU/TVA, and PCU/Estech provided the overall best quality (Table 9), while IBDU and Blue Chip had the poorest overall quality. SCU/TVA, SCU/CIL, urea, and methylene urea produced more clippings following the spring application of fertilizers (Table 10), whereas, there was no difference in the density of the turf and thatch depth among the treatments.

Table 9. Effects of granular N sources on visual quality.

Nitrogen Source	Visual Quality[a] 4/20	5/14	5/27	6/09	6/25	7/07	7/21
Urea	6.5	7.5	6.5	8.0	8.0	6.5	8.5
IBDU	4.7	4.3	5.3	6.0	6.0	5.3	7.3
SCU/CIL	6.3	7.3	7.7	7.0	7.3	6.7	7.3
SCU/TVA	6.0	8.0	8.0	6.7	6.7	6.7	7.7
Methylene urea	6.3	6.7	7.3	5.7	5.7	5.3	7.7
UF/Blue chip	5.3	5.0	5.0	5.0	6.0	6.3	7.4
PCU/Estech	7.0	5.3	5.7	6.3	8.0	8.0	8.7
LSD = (0.05)	0.8	1.1	0.8	0.7	0.8	1.5	NS

Table 9. (continued)

Nitrogen Source	Visual Quality 8/04	8/20	9/04	9/16	10/14	10/27	Mean
Urea	7.0	6.5	6.0	6.0	8.0	8.0	7.2
IBDU	6.0	5.3	5.0	5.3	4.7	5.7	5.5
SCU/CIL	5.7	7.0	8.0	8.0	6.3	6.3	7.0
SCU/TVA	6.0	7.7	7.7	7.7	6.3	6.3	7.0
Methylene urea	6.3	6.7	6.7	7.0	5.3	6.0	6.4
UF/Blue chip	5.7	6.0	5.0	5.3	5.3	5.7	5.6
PCU/Estech	8.0	5.6	6.3	7.3	7.7	7.7	7.1
LSD = (0.05)	NS	0.8	0.6	0.8	2.0	1.4	0.5

[a] Visual quality is based on a scale of 9 to 1; 9 = best possible quality, 6 = acceptable quality, and 1 = dead turf.

Table 10. Effects of granular N sources on shoot density, clipping yields, and thatch development.

Nitrogen Source	Shoot Density[a] 6/23	Clipping Yields[b] 5/22	Clipping Yields[b] 6/16	Thatch Development[c] 5/21
Urea	72.8	73.2	55.4	19.8
IBDU	50.8	57.1	50.8	19.3
SCU/CIL	60.0	71.5	51.2	21.1
SCU/TVA	59.8	78.2	54.6	20.2
Methylene Urea	63.3	77.2	50.1	18.6
UF/Blue chip	57.5	63.7	46.8	19.4
PCU/Estech	57.8	67.1	49.9	18.6
LSD = (0.05)	NS	8.6	4.4	NS

[a] Shoot density = number of tillers per 15 square inches.
[b] Clippings yields = dry weight of clippings removed.
[c] Thatch development = mm depth of the thatch layer. 25.4 mm = 1 inch.

Summer Slow-Release Nitrogen Sources Comparison Study

M. L. Agnew, N. E. Christians, R. W. Moore

The purpose of this study was to compare eight slow-release N sources for the summer application of nitrogen. The turf is Glade Kentucky bluegrass, established in September 1984. Treatments were initiated in the spring of 1985 and will continue for several years. Individual treatment cells measured 5 ft x 5 ft and were randomized in a complete block design with three replications. The turf was mowed at 2 inches and water was applied to prevent drought stress.

Treatments include eight slow-release N sources applied at 2 lb N/1000 ft^2/season split into two equal applications on May 20 and August 10. Each treatment received 2 lb N/1000 ft^2/season of urea (46-0-0) split into two equal applications on April 10 and September 20. One additional treatment, which included combinations of Powder Blue and urea, was applied for comparison. This 0.25 lb N treatment applies 0.25 lb N (Powder Blue)/0.75 lb N (urea in April, 0.5 - 0.5 lb N as Powder Blue/urea in May, 0.5 lb N (Powder Blue)/0.5 lb N (urea) in August, and 0.75 lb N (Powder Blue)/0.75 lb N (urea) in September. The N-Sure treatment was established in 1986, while the other treatments were established in 1985.

Visual quality data were collected monthly from May through October (Table 11). All treatments, except Powder Blue, had an overall acceptable quality level with SCU/CIL performing better for the entire season.

Shoot density and thatch determinations were made once during 1987 (Table 12). There were no differences in shoot density between treatments on June 23 (1 month after application of slow-release product). In addition, there was only a slight difference in thatch depth between the treatments (2.5 mm = 0.1 inch). SCU/TVA and SCU/CIL were the greatest thatch producers of the fertilizer sources.

Table 11. Effects of slow-release nitrogen sources in summer fertilization on visual quality.

Slow-release N source	Visual Quality[a] 5/18	6/15	7/17	8/17	9/16	10/14	Mean
Powder Blue	8.0	5.0	4.3	6.3	5.3	6.3	5.9
Fluf	8.0	5.7	5.3	7.3	6.0	7.3	6.4
Formolene	8.0	6.7	3.7	6.3	7.3	7.7	6.6
N-Sure	8.0	6.0	6.0	7.0	6.3	7.3	7.0
IBDU	8.0	6.7	6.7	7.3	6.0	7.3	7.0
SCU/TVA	8.0	7.7	5.7	5.7	7.3	7.7	7.0
SCU/CIL	8.0	8.0	6.7	7.3	7.3	7.7	7.5
Azolone	8.0	5.0	5.7	7.3	6.0	6.7	6.4
Powder Blue/Urea	7.6	7.0	6.7	7.7	5.0	7.0	6.8
LSD 0.05	0.3	0.6	1.2	N.S.	1.1	N.S.	0.5

a Visual quality is based on a scale of 9 to 1: 9 = best visual quality, 6 = acceptable quality, and 1 = no live grass.

Table 12. Effects of slow-release nitrogen sources in summer fertilization on shoot density and thatch development.

Slow-Release N Source	Shoot Density[a] 6/23	Thatch depth[b] 5/21
Powder Blue	61.8	22.5
Fluf	57.5	20.3
Formolene	57.7	20.3
N-Sure	65.8	22.3
IBDU	65.8	21.3
SCU/TVA	66.0	23.2
SCU/CIL	63.7	23.0
Azolone	62.3	22.5
Powder Blue/Urea	57.0	22.0
LSD 0.05	N.S.	2.2

a Shoot density = number of tillers per 15 square inches.

b Thatch depth = mm depth of the thatch layer. 25.4 mm = 1 inch.

Evaluation of Liquid Fertilizer Programs on Three Kentucky Bluegrass Cultivars

R. W. Moore, M. L. Agnew, and N. E. Christians

This study compares 12 liquid fertilizer programs using four nitrogen sources on three Kentucky bluegrass cultivars. The treatments were started in the spring of 1985 and will continue through 1990. The turf is maintained at a cutting height of 2 inches and all clippings are removed.

The four fertilizers include Urea, Powder Blue, Fluf, and Formolene. They were applied using different application schedules and three different application rates. Each schedule received a total of 4 lb N/1000 ft^2/growing season. The balanced program received 1 lb N/1000 ft^2 in each of the months of April, May, August, and September. The heavy spring program received 1/2 lb N in April, 1-1/2 lb in May, and 1 lb N each in August and September. The late fall program required 1/2 lb N in April, 3/4 lb in May, 3/4 lb in August, 1 lb in September, and 1 lb in November.

The three cultivars of Kentucky bluegrass are Majestic (high-maintenance grass), Vantage (medium-maintenance grass), and Park (low-maintenance grass). Each cultivar was replicated three times, and each of the 12 fertilizer programs were randomized within each cultivar.

The data taken in 1987 include visual quality, clipping weight, shoot density, thatch depth, and root weights by depth. Treatments were rated for visual quality 2 days each month, while clippings were collected dried and weighed on or about the 20th of each month. Shoot density was measured on June 23 and thatch depth and percent organic matter in the thatch layer was determined on May 22. Finally, root samples were collected in November 1986 and July 1987.

In comparing the cultivars (Table 13), the overall visual quality ratings were equal for Majestic, Vantage, and Park. However, Majestic had substantially better quality in mid-July. In addition, Majestic produced only half to two thirds as much clipping weight as Vantage or Park. This difference is not surprising since Majestic is a prostrate-growing cultivar, and Majestic had 35 percent fewer shoots than Park and Vantage. Furthermore, thatch accumulated quickest in Majestic (Table 14). In the accumulated thatch, Vantage contained 76 percent soil, while Majestic contained 65 percent soil, thus more of the thatch in Majestic is organic matter. Table 15 contains the rooting data for cultivars during November 1986 and June 1987. In November, Majestic contained greater amounts of roots in the upper 3 root zones. In June, both Majestic and Vantage had more roots than Park in all root zones.

In comparing programs (Table 16), the late fall program had the best visual quality rating and the lowest clipping yields in the spring, while the balanced program had the best overall visual quality. Clipping yields and shoot densities were not effected for most of the summer. However, root weights by depth were directly affected by fertilizer programs. Late fall programs had more roots in the deeper soil depths in the fall (Table 17), and more roots in the 0 to 5 cm and 5 to 10 cm depths during the early summer (Table 18). There were no effects of programs on thatch development.

In comparing the individual fertilizer sources, there were little differences in the overall quality of the turf; however, urea greened up earlier in April than Powder Blue, Formolene, or Fluf (Table 19). Visual quality of Powder Blue, Formolene, and Fluf did persist longer during the summer. Formolene and urea demonstrated better visual quality longer into the fall. Urea and Formolene produced the greatest amounts of clippings during cool weather, while Fluf and Powder Blue produced more clippings during the summer. The visual quality and clipping yield data suggest that the slow-release nitrogen of the longer chain methylene ureas become more available during mid to late summer. There were no effects of fertilizer source on thatch development or root weights.

In comparing programs and materials for the season, the balanced and late fall programs demonstrated the best visual quality early. The heavy spring application did result in good summer and fall response, especially from urea and Formolene. Powder Blue suggested good response from all three programs during the summer. A listing of all the data for visual quality and clippings are presented in Table 20.

Table 13. 1987 visual quality, clipping yield, and shoot density for three Kentucky bluegrass cultivars.

	Visual Quality[a]													
Cultivar	Apr 18	May 20	June 2	June 15	June 30	July 16	July 31	Aug 11	Aug 26	Sept 8	Sept 22	Oct 7	Oct 21	Mean
Vantage	5.9	7.2	6.8	7.1	6.8	6.3	6.8	6.9	6.3	6.6	6.6	6.4	6.6	6.6
Park	6.6	7.3	6.5	6.9	6.8	6.6	6.8	7.0	6.5	6.4	6.5	6.6	6.3	6.5
Majestic	6.7	7.1	6.4	6.5	6.7	7.4	7.0	6.8	6.5	6.4	6.4	6.5	6.5	6.5
LSD 0.05	.30	NS	.25	.34	NS	.25	NS	NS	NS	NS	NS	NS	.24	NS

a Quality based on a scale of 9 to 1; 9 = best quality, 6 = acceptable quality, and 1 = no live grass.

Table 13. (continued)

	Clipping Yield[b]						Shoot Density[c]
Cultivar	May 20	June 23	July 21	Aug 20	Sept 23	Oct 20	July 23
Vantage	74.0	61.3	45.7	87.7	66.8	15.9	51.3
Park	70.0	64.3	43.5	86.3	67.5	12.5	58.3
Majestic	55.3	44.9	41.3	61.6	47.4	8.5	36.0
LSD 0.05	2.7	2.7	0.95	2.6	2.1	2.3	3.3

b Clipping weights = grams of dry weight/1.63m2.
c Shoot density = number of tillers per 15 square inches.

Table 14. Thatch comparison of three Kentucky bluegrass cultivars (May 22).

Cultivar	Thatch depth (mm)	Organic matter (%)
Vantage	13.3	24.0
Park	14.0	28.8
Majestic	16.6	35.3
LSD 0.05	0.8	3.8

Table 15. Effects of cultivars on rooting (Nov/86-June/87).

Cultivar	Root Weights[a]							
	0-5 cm		5-10 cm		10-15 cm		15-20 cm	
	Nov.	June	Nov.	June	Nov.	June	Nov.	June
Vantage	96.9	114.4	38.9	54.5	24.7	36.4	18.8	25.8
Park	98.2	91.8	35.8	36.9	27.5	26.3	18.9	19.9
Majestic	144.8	140.3	49.4	53.8	30.6	30.1	21.0	23.3
LSD 0.05	11.6	12.1	5.3	4.3	4.6	3.4	NS	3.4

[a] Rooting weights = milligrams per 5-cm depth.

Table 16. 1987 visual quality, clipping yields, and shoot density of three liquid fertilizer programs.

	Visual Quality[a]													
Program	Apr 18	May 20	June 2	June 15	June 30	July 16	July 30	Aug 11	Aug 26	Sept 8	Sept 22	Oct 7	Oct 21	Mean
Balanced	5.1	7.5	7.1	7.4	7.3	7.0	7.1	7.1	6.2	6.7	6.8	6.5	6.6	6.9
Heavy spring	5.1	6.8	6.6	6.8	6.6	6.8	6.7	6.7	6.5	6.6	6.6	6.6	6.6	6.5
Late fall	6.8	7.3	6.1	6.3	6.5	6.6	6.8	6.9	6.6	5.9	6.2	6.3	6.2	6.6
LSD 0.05	.29	.23	.25	.34	.26	.25	.24	.28	.24	.38	.35	.26	.24	.13

a Quality based on a scale of 9 to 1; 9 = best quality, 6 = acceptable quality, and 1 = no live grass.

Table 16. (continued)

	Clipping Yield[b]					
Cultivar	May 20	June 23	July 21	Aug 20	Sept 23	Oct 20
Balanced	68.7	56.7	43.6	79.1	61.8	13.8
Heavy Spring	67.4	56.4	42.9	77.0	59.9	11.7
Late Fall	63.2	57.3	44.0	79.4	60.0	11.4
LSD 0.05	2.7	NS	0.95	NS	NS	2.3

b Clipping weights = grams dry weight/1.63 m2.

Table 17. Effects of fertilizer programs on fall rooting (1986).

Program	Rooting Depth			
	0-5 cm	5-10 cm	10-15 cm	15-20 cm
Balanced	114.3[a]	41.2	27.9	18.9
Heavy Spring	109.2	39.0	25.4	17.6
Late Fall	116.3	43.8	29.4	22.2
LSD 0.05	NS	NS	NS	3.6

[a] Rooting weights = milligrams per 5-cm depth.

Table 18. Effects of fertilizer programs on summer rooting (July/86-June/87).

Program	Rooting Depth							
	0-5 cm		5-10 cm		10-15 cm		15-20 cm	
	Jul	Jun	Jul	Jun	Jul	Jun	Jul	Jun
Balanced	68.0[a]	110.3	65.5	44.1	43.1	30.4	32.1	21.8
Heavy Spring	160.5	112.0	68.6	49.2	46.0	29.9	38.1	23.0
Late Fall	182.3	124.3	76.6	51.9	50.1	32.5	33.9	24.0
LSD 0.05	15.3	12.1	7.2	4.3	NS	NS	NS	NS

[a] Rooting weights = milligrams per 5-cm depth.

Table 19. 1987 visual quality and clipping yields for four liquid fertilizers.

Material	Apr 18	May 20	June 2	June 15	June 30	July 16	July 31	Aug 11	Aug 26	Sept 8	Sept 22	Oct 7	Oct 21	Mean
Urea	6.3	7.4	7.5	6.9	6.3	6.4	6.2	6.4	5.3	7.2	5.2	7.6	7.6	6.6
P. Blue	4.9	6.7	5.2	6.9	7.4	7.2	7.9	7.7	7.6	5.7	6.9	5.1	5.1	6.5
Fluf	5.6	7.2	6.4	6.5	6.7	6.8	6.9	7.0	7.0	6.4	7.0	6.1	5.9	6.6
Formolene	5.7	7.4	7.2	7.0	6.7	6.7	6.5	6.6	5.9	6.6	6.9	7.2	7.2	6.7
LSD 0.05	.34	.27	.29	.39	.30	.29	.28	.32	.28	.44	.41	.30	.28	.17

[a] Quality based on a scale of 9 to 1; 9 = best quality, 6 = acceptable quality, and 1 = no live grass.

Table 19. (continued)

Material	Clipping Yield[b]						Shoot Density[c]
	May 20	June 23	July 21	Aug 20	Sept 23	Oct 20	July 23
Urea	71.4	59.3	43.3	76.9	65.0	16.6	51.3
Powder Blue	60.9	54.9	44.4	81.4	56.2	7.4	49.4
Fluf	65.8	56.2	43.4	80.4	59.6	9.6	46.2
Formolene	67.6	57.0	42.8	75.4	61.3	15.5	47.4
LSD 0.05	3.1	2.0	1.1	3.0	2.4	2.6	3.8

[b] Clipping weights = grams/1.63 m^2.

Table 20. The effects of cultivar, fertilizer program, and fertilizer material on quality and yield.

	Cultivar - Vantage											
	Programs											
Data Collected	Balanced				Heavy Spring				Late Fall			
Visual Quality[a]	U[c]	PB	FL	FO	U	PB	FL	FO	U	PB	FL	FO
4/18	6.0	5.0	4.3	5.3	5.3	4.7	5.7	5.7	8.0	6.7	7.3	7.0
5/20	8.0	6.7	8.0	8.0	6.7	6.7	6.7	7.3	7.3	6.7	7.3	7.3
6/02	8.0	5.7	7.7	8.0	7.7	5.0	6.3	7.3	7.0	5.3	6.3	7.0
6/15	7.3	7.7	7.3	7.7	6.7	7.0	7.3	6.7	6.3	7.7	6.3	6.7
6/30	7.0	7.7	7.3	7.3	6.0	7.3	6.3	6.3	6.0	7.3	6.7	6.7
7/16	6.0	7.0	6.7	7.0	6.0	6.3	6.3	6.3	5.7	7.0	5.7	5.7
7/31	6.7	7.7	6.3	7.0	5.7	7.7	7.0	6.0	6.3	8.0	6.7	6.3
8/11	7.3	7.7	6.7	7.0	6.3	6.7	7.3	6.3	6.7	8.0	6.7	6.7
8/26	5.0	7.0	6.3	5.3	5.0	7.3	8.0	5.7	5.7	8.0	6.3	6.0
9/08	7.7	5.7	6.7	6.3	7.7	6.0	7.0	7.0	6.7	6.7	5.7	5.7
9/22	6.3	6.3	6.7	7.7	5.0	7.0	7.7	7.3	5.0	7.3	6.3	6.7
10/07	8.0	5.0	5.7	7.7	7.7	5.3	6.0	7.0	7.3	5.0	5.7	6.3
10/21	8.0	5.0	5.7	7.7	7.3	5.7	5.7	7.3	7.7	5.7	6.3	7.0
Clipping yield[b]	U	PB	FL	FO	U	PB	FL	FO	U	PB	FL	FO
5/20	84	68	74	75	67	70	73	76	84	72	71	75
6/23	63	58	60	62	60	61	61	62	63	63	62	60
7/21	46	46	45	47	43	45	47	45	45	51	46	44
8/20	87	88	86	80	84	90	95	88	90	94	90	81
9/23	77	60	60	71	64	63	68	71	75	63	67	63
10/20	26	11	10	23	17	11	13	19	22	10	12	15

Table 20. (continued)

	Cultivar - Park											
	Programs											
Data Collected	Balanced				Heavy Spring				Late Fall			
Visual Quality[a]	U[c]	PB	FL	FO	U	PB	FL	FO	U	PB	FL	FO
4/18	5.1	4.3	5.3	5.0	5.3	5.0	5.3	5.0	7.3	5.3	7.0	7.0
5/20	8.0	7.0	7.3	8.0	6.7	7.0	7.0	7.0	7.3	7.0	7.0	6.7
6/02	8.0	5.7	7.0	7.7	7.7	5.0	6.0	7.0	6.7	5.0	6.3	6.0
6/15	8.0	7.3	7.3	7.3	7.0	6.7	7.0	7.3	6.0	7.0	6.0	6.3
6/30	6.7	8.0	7.3	7.0	6.3	6.3	6.7	7.3	6.0	7.7	6.7	6.0
7/16	6.7	7.0	6.7	6.0	6.3	7.0	7.0	6.0	5.7	7.0	6.7	6.7
7/31	6.7	8.0	7.0	6.7	5.7	7.7	7.3	6.3	6.0	7.7	7.0	5.7
8/11	6.0	7.7	7.3	7.0	6.3	7.7	7.0	7.0	6.3	8.0	7.0	6.3
8/26	5.0	7.7	6.3	6.0	5.0	8.0	8.0	5.7	6.0	6.7	7.0	6.3
9/08	7.7	5.3	7.3	7.0	7.0	5.3	6.7	7.3	6.0	5.7	6.0	5.3
9/22	5.0	7.0	7.7	7.3	5.0	6.7	7.3	7.3	5.0	6.7	6.3	6.7
10/07	8.0	5.0	6.0	6.7	8.0	5.3	6.3	7.7	7.0	5.3	6.3	7.0
10/21	8.0	4.7	6.3	7.3	8.0	5.0	5.7	7.3	6.7	4.7	5.3	6.3
Clipping Yield[b]	U[c]	PB	FL	FO	U	PB	FL	FO	U	PB	FL	FO
5/20	79	68	77	74	69	63	67	70	73	61	70	70
6/23	65	61	64	63	69	63	63	66	66	62	65	65
7/21	44	44	44	43	43	44	43	43	42	45	45	43
8/20	85	95	90	80	80	87	86	85	80	89	93	87
9/23	75	63	67	71	71	63	69	68	68	59	66	70
10/20	17	06	10	15	18	09	13	15	18	05	11	12

Table 20. (continued)

	Cultivar - Majestic Programs											
Data Collected	Balanced				Heavy Spring				Late Fall			
Visual Quality[a]	U[c]	PB	FL	FO	U	PB	FL	FO	U	PB	FL	FO
4/18	5.7	4.3	4.7	5.3	5.7	4.0	4.3	4.7	7.7	5.0	6.3	6.7
5/20	8.0	6.3	7.3	7.7	7.0	6.0	6.7	6.3	8.0	6.7	7.0	7.7
6/02	8.0	5.3	6.7	7.3	8.0	5.0	6.0	7.7	6.7	5.0	5.0	6.3
6/15	7.7	6.7	6.7	7.7	7.3	5.7	5.3	7.7	6.0	6.0	5.3	6.0
6/30	7.3	8.0	7.3	6.7	5.7	6.7	6.0	7.7	6.0	7.3	6.3	5.7
7/16	7.7	8.0	7.3	7.7	7.3	7.7	7.3	7.3	6.7	7.7	7.3	7.3
7/31	6.7	8.0	7.0	7.0	6.0	8.0	6.7	6.3	6.0	8.0	7.0	7.0
8/11	6.7	8.0	7.3	6.3	6.0	7.3	6.7	6.0	6.0	8.0	7.0	6.3
8/26	5.3	7.7	6.7	6.0	5.0	8.0	7.3	5.3	5.3	7.7	7.3	6.3
9/08	7.0	5.7	6.7	7.3	8.0	5.7	6.3	7.0	6.7	5.3	5.0	6.0
9/22	5.3	7.3	7.7	7.0	5.3	6.7	7.0	6.7	5.0	7.0	6.7	5.7
10/07	7.3	5.0	6.7	7.3	8.0	5.0	6.0	7.3	7.0	5.0	6.0	7.3
10/21	7.7	5.0	6.0	7.7	8.0	5.3	6.0	7.3	7.0	5.0	5.7	7.0
Clipping Yield[b]	U[c]	PB	FL	FO	U	PB	FL	FO	U	PB	FL	FO
5/20	62	48	56	60	54	48	52	52	71	53	53	57
6/23	51	42	44	47	47	41	43	43	50	43	43	46
7/21	41	43	41	41	41	42	39	41	44	41	41	41
8/20	66	66	64	64	59	59	58	55	64	66	62	58
9/23	55	47	49	48	47	44	47	44	54	44	45	46
10/02	12	05	06	25	08	04	05	07	12	05	06	09

a Quality based on a scale of 9 to 1; 9 = best quality, 6 = acceptable quality, and 1 = no live grass.

b Clipping yields = grams of dry weight/1.63 m^2.

c U = urea, PB = Powder Blue, FL = Fluf, FO = Formolene.

Fertilizer Burn Study

M. L. Agnew and R. W. Moore

The objective of this study was to compare the effects of three fertilizer sources and three water dilution rates on fertilizer burn on 'Manhattan' perennial ryegrass. The three fertilizer sources include N-Sure, formolene, and urea. Each fertilizer source was diluted into 1, 2, and 4 gallons of water/1000 ft^2. Each fertilizer/water dilution rate was applied to a 5' X 5' plot at a rate of 1 lb N/1000 ft^2. The perennial ryegrass was maintained at a cutting height of 2 inches. Irrigation was applied as needed to prevent drought stress.

Treatment were applied on June 10 and August 9, 1987. A third application was scheduled for the spring of 1988. Data collected included visual quality 2, 4, and 8 days following treatment. In addition, shoot density was measured in July to test the effect of treatment on turf cover.

Visual quality for this study is a measurement of discoloration due to fertilizer treatments (9 = no visual discoloration, 6.5 = acceptable quality, and 1 = dead turfgrass). Shoot density is the number of perennial ryegrass tillers in a given area. Table 21 provides the data of each of the treatments for both application periods. While there were no significant interactions between fertilizer source and water volume within the study, there was a difference in the quality between fertilizer sources for both treatment dates and water volume for the June treatment. There were no treatment differences when measuring shoot density.

In June, the N-Sure treatment demonstrated consistently better quality (less burn) than did formolene or urea. While N-Sure did have some burn, the quality never went below an acceptable quality level. In August, the effect of fertilizer source was less. This is due to cooler temperatures present during this time period (Table 22).

The June data demonstrates that increased water volume decreases the amount of burn. This is to be expected since the fertilizer in solution would be more concentrated at lower water volumes. However, the August data does not show any treatment effects due to a 2.41 inch rain the night of August 9, 1987, (Table 22).

When looking at the June data, the degree of burn damage became worse over a period of time. During the 10 days following treatment, there were 6 days where the high temperature for that day reached 90F or higher. This demonstrates that care should be taken when applying fertilizers during stress periods.

In summary, the use of N-Sure resulted in less fertilizer burn, and increasing water volume decreased the amount of fertilizer burn. Further study needs to be done to investigate fertilizer rates and water volumes.

Table 21. The effects of fertilizer source and water volume on fertilizer burn.

Fertilizer Source	Water Volume	Visual Quality 6/14	6/16	6/20	8/11	8/13	8/17	Shoot Density
Urea	1	4.3	4.0	5.0	7.7	6.3	7.7	155
	2	6.7	5.7	5.6	7.7	6.7	7.7	159
	4	7.0	6.0	6.3	8.3	6.7	7.3	177
N-Sure	1	7.3	6.7	6.7	9.0	9.0	9.0	174
	2	8.0	7.3	6.7	9.0	9.0	9.0	176
	4	8.3	7.7	7.0	9.0	9.0	9.0	181
Formolene	1	5.7	5.0	5.0	9.0	8.3	9.0	185
	2	7.0	6.0	5.7	9.0	8.0	8.7	169
	4	7.0	6.3	6.0	9.0	8.3	9.0	200
LSD fert. (0.05)		0.9	0.9	0.8	0.3	0.5	0.4	N.S.
LSD water (0.05)		0.9	0.9	N.S.	N.S.	N.S.	N.S.	N.S.
LSD fert X water		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 22. Weather data collection at ISU Horticulture Station Turfgrass Research Area for June 12 to June 20 and August 9 to August 17, 1987.

Date	High (F)	Low (F)	Precipitation (inches)
6-12	95	60	0
6-13	99	62	0
6-14	99	68	0
6-15	89	70	0
6-16	90	64	0
6-17	90	67	0.55
6-18	89	69	0
6-19	90	68	0
6-20	76	68	0.39
8-09	85	62	2.41
8-10	86	62	0
8-11	84	65	0
8-12	78	66	0
8-13	77	70	0.87
8-14	84	76	0.16
8-15	89	69	0
8-16	85	67	0.16
8-17	80	62	0.08

Preemergence Crabgrass Control Study - 1987

N. E. Christians, Z. J. Reicher, and M. G. Burt

The 1987 preemergence crabgrass control study was located at the Horticulture Research Station on a Nicollet (fine-loamy, mixed mesic, Aquic Hapludall) soil with a pH of 7.2, 15 lb/A phosphorus (p), 120 lb/A potassium (K), and 2.3% organic matter. The grass on the site is Vantage Kentucky bluegrass.

The treatments included EL-107, Balan, and Team from Elanco, Dacthal from Fermenta, Prodiamine from Sandoz Chemical, Pendimethalin from O. M. Scotts, Ronstar and DFF from Rhone Poulenc, Mon 15172 and 15126 from Monsanto, and Premier from Ciba-Geigy. The And-1,-2, and -3 are fertilizer herbicide combinations from The Anderson's Company (see table 23 for treatment rates). Treatments were applied on April 16, 1987, to 25 ft^2 plots in three replications. The area had a natural stand of crabgrass in the 1986 season. Crabgrass seed was applied to the area on April 20, at a rate of 0.5 lb/1000 ft^2.

Two-tenths of an inch of rain fell on the plot area within four hours after treatment. The 1987 season was unusually moist in the Ames area and there was little stress on the plot areas. The plot area was observed weekly through the season for phytotoxicity. No visible signs of phytotoxicity were observed on any of the treated plots at any time during the season.

Estimates of crabgrass cover on the plots were made on July 15 and September 3 (Table 23). Counts of prostrate spurge also were made on September 3. The EL-107 combined with Balan and Team (Treatment 2, 3, and 4) were very effective at controlling crabgrass throughout the season, as was the Team 2G at 3 lb ai/A. The Mon 15172 was effective at season long control of crabgrass at all rates. The Mon 15126 was effective in controlling crabgrass all season long; however, the plots treated at the 0.5 lb rate of this material showed some increase in crabgrass numbers by September 3.

The very moist conditions in mid-summer resulted in less than complete crabgrass controls by many of the other products including Dacthal, Prodiamine, Pendimethalin, and Ronstar G. The Ronstar 50 WP was effective in controlling crabgrass through the season. In past years, we have had some phytotoxicity with this product, but at the 1.5 lb ai/A rate in this trial no phytotoxicity was observed. The DFF experimental material was not effective at any of the rates tested.

Complete prostrate spurge control was observed in plots treated with the EL-107, the Pendimethalin at the 3.0 lb ai/A rate (the 1.5 lb rate was not effective), and the Mon 15172.

Table 24 contains information on a second trial conducted on the same sight. This study was designed to evaluate increasing rates of Ronstar 50 ME (micro encapsulated). This material was very effective at rates of 3.0 lb a.i. and above. It was not effective against spurge.

Table 23. Preemergence Annual Weed Control Study - 1987.

	Treatment	Rate (lb ai/A)	July 15		September 3		
			Crabgrass % cover	Percent control	Crabgrass % cover	Percent control	Spurge[a]
1.	Control	----	23	0	65	0	13
2.	EL107 75 DF+Balan+Trimec	0.6 +2.4+1	0	100	1	99	0
3.	EL107 75DF+Team 2G	0.5 +2	0	100	1	99	0
4.	EL107 75DF+Team 2G	0.75+2	0	100	1	99	0
5.	Team 2G	3	0	100	0	100	2
6.	Balan 2.5G	2	1	99	7	90	2
7.	Dacthal 75WP	10.5	4	81	31	52	3
8.	Bensulide 4E	7.5	3	85	10	85	14
9.	Prodiamine 65WD6	0.5	8	64	22	66	12
10.	Prodiamine 65WD6	0.75	3	88	13	80	6
11.	Pendimethalin 60WP	1.5	8	63	38	41	5
12.	Pendimethalin 60WP	3.0	1	94	12	82	0
13.	Ronstar 2G	3.0	5	78	35	46	7
14.	Ronstar 50WP	1.5	1	96	4	94	3
15.	DFF 4.17F	0.05	50	0	70	0	3
16.	DFF 4.17F	0.10	62	0	65	0	2
17.	DFF 4.17F	0.15	32	0	53	18	1
18.	DFF 4.17F	0.20	43	0	72	0	6
19.	DFF 4.17F	0.25	32	0	63	3	6
20.	And-1	18.9 ml/100 ft^2	15	33	25	62	4
21.	And-2	18.9 ml/100 ft^2	3	88	16	75	5
22.	And-3	18.9 ml/100 ft^2	15	33	39	40	9
23.	Mon 15172 (0.5%)	0.378	0	100	0	100	0
24.	Mon 15172 (0.5%)	0.5	1	99	1	99	0
25.	Mon 15172 (0.5%)	0.75	0	100	0	100	1
26.	Mon 14126 3EC	0.5	1	97	8	88	7
27.	Mon 15126 3EC	0.75	0	100	1	98	1
28.	Premier 1EC	1.13	4	84	18	73	3
	LSD 0.05	----	17	77	25	38	9

All treatments were applied on April 16, 1987.
All plots measure 5 ft x 5 ft = 25 ft^2.
The study is located on the North end of the Turfgrass Research area on a stand of Vantage Kentucky bluegrass seeded in the fall of 1985.
The area was seeded with crabgrass on April 20, 1987, at a rate of 0.5 lb/1000 ft^2.
[a] Average number of spurge plants per plot.

Table 24. Ronstar Trial - 1987.

Treatment	Rate (lb ai/A)	July 15 Crabgrass % cover	July 15 Percent control	September 3 Crabgrass % cover	September 3 Percent control	Spurge[a]
1. Control	----	64	0	63	0	3
2. Ronstar 50 ME*	0.75	61	4	68	0	5
3. Ronstar 50 ME	1.50	23	64	48	24	4
4. Ronstar 50 ME	3.00	9	87	21	66	4
5. Ronstar 50 WP	1.50	8	88	25	60	4
LSD 0.05	----	18	28	21	33	N.S.

* 12.8 g/100 ml

Plots measured 5 ft by 5 ft.

a Average number of spurge plants per plot.

Postemergence Annual Grass Control Study - 1987

Z. J. Reicher, N. E. Christians, and M. G. Burt

The 1987 postemergence crabgrass control study was located at the Horticulture Research Station on a two-year-old stand of South Dakota Common Kentucky bluegrass. The soil on this site is a Nicollet (fine-loamy, mixed mesic, Aquic Hapludoll) with a pH of 7.2, 15 lb/A phosphorus, 120 lb/A potassium, and 2.3 percent organic matter.

Even though the site had a substantial crabgrass population, the area was vertical mowed and seeded with crabgrass at 0.5 lb seed/A prior to application. The crabgrass was allowed to germinate and was in the 3-leaf to 1-tiller stage at the time of application.

Treatments included American Hoechst's Acclaim alone and in combination with prodiamine, pendimethalin, Turflon D, PBI Gordon's Trimec, Starane, Lontrel (chopyralid), and The Anderson's Break-Thru (chlorflurenol). Other treatments included a BASF experimental, BAS 51400H, and a Monsanto experimental, Mon 15126 in combinations with the spreader/sticker X77 and Acclaim.

The herbicides were applied on June 2, 1987, in the equivalent of 120 gal water/A. The plots were checked weekly for phytotoxicity but there was none throughout the duration of the experiment.

The first crabgrass count was taken on July 15, 1987 (Table 25). The experimentals from BASF and Monsanto had excellent control at all rates and in all combinations. In contrast to previous years, Acclaim showed inadequate control in all but a few combinations on the July 15 count. Only Acclaim in combination with pendimethalin, Starane, and chlorflurenol had 90 percent or better control.

Only the Monsanto experimental, Mon-15126, in combinations with X77 and Acclaim had better than 90 percent control on the September 3 count. Mon-15126 at 0.75, 1.0, and 1.5 lb ai/A with 0.5 percent X77 showed excellent control as did the combination of Mon-15126, Acclaim, and X77. The Acclaim plus pendimethalin plus X77 combination and Mon-15126 at 0.5 lb ai/A with 0.5 percent X77 had 86 and 82 percent control, respectively, but the rest of the treatments had less than 80 percent control by September 3, which is below a satisfactory level.

Table 25. Crabgrass cover and percent crabgrass control in the postemergence annual grass control study - 1987.

Treatment	Rate (lb ai/A)	July 15 Crabgrass % cover	July 15 Percent control	September 3 Crabgrass % cover	September 3 Percent control
1. Control	----	62	0	83	0
2. Acclaim 1EC	0.08	26	57	41	51
3. Acclaim + prodiamine 65WDG	0.08/0.5	11	83	35	58
4. Acclaim + pendimethalin	0.08/1.5	6	90	43	48
5. Acclaim	0.12	8	87	63	24
6. Acclaim + prodiamine	0.12/0.5	9	85	37	56
7. Acclaim + pendimethalin	0.12/1.5	5	92	30	64
8. Acclaim	0.18	11	82	65	22
9. Acclaim + Turflon D	0.18/2.5 (pts ai/A)	15	75	58	30
10. Acclaim + Trimec	0.18/3.5 (pts ai/A)	33	46	60	28
11. Acclaim + Starane	0.18/0.375	0	100	24	72
12. Acclaim + chopyralid	0.18/0.25	13	78	58	30
13. Acclaim + chloroflurenol	0.18/0.125	6	91	52	38
14. BAS 51400H 50WP	0.5	3	96	35	58
15. BAS 51400H 50WP	1.0	0	100	20	76
16. Mon-15126 + X77	0.5 + 0.5%	1	99	15	82
17. Mon-15126 + X77	0.75 + 0.5%	1	99	3	96
18. Mon-15126 + X77	1.0 + 0.5%	0	100	1	99
19. Mon-15126 + X77	1.5 + 0.5%	0	100	1	99
20. Mon-15126 + Acclaim + X77	0.5 + 0.25 + 0.5	0	100	1	99
21. Acclaim + X77	0.25 + 0.5	9	85	50	40
22. Acclaim + Pendimethalin + X77	0.25 + 1.5 + 0.5	2	97	12	86
LSD 0.05	----	12	20	25	30

Broadleaf Weed Control Study - 1987

M. G. Burt, Z. J. Reicher, and N. E. Christians

The 1987 broadleaf weed control study took place at the Iowa State University Horticulture Research Farm on an area of Ram 1 Kentucky bluegrass. This area was established in the fall of 1985 and received no prior herbicide treatments. The soil type at the Horticulture turfgrass research area is a Nicollet (fine-loamy, mixed mesic, Aquic Hapludall) with a pH of 7.2, 15 lb/A phosphorous (P), 120 lb/A potassium (K), and 2.3 percent organic matter.

Twenty varieties of broadleaf weeds were present in our plots prior to treatment. The most prevalent weeds were: dandelion (*Taraxacum officinale*), clover (*Trifolium repens*), prostrate knotweed (*Polygonum aviculare*), Virginia pepperweed (*Lepidium virginicum*), goldenrod (*Solidago missouriensis*), black medic (*Medicago lupulina*), and shepherd's purse (*Capsella bursa-pastoris*). Less prevalent weeds were: blackseed plantain (*Plantago rugelii*), oxalis (*Oxalis stricta*), pineapple weed (*Matricaria matricarioides*), common ragweed (*Ambrosia artemisiifolia*), yellow rocket (*Barbarea vulgaris*), curly dock (*Rumex crispus*), ladysthumb (*Polygonum persicaria*), and prostrate spurge (*Euphorbia maculata*). Broadleaf weeds that were present but very widely scattered throughout the plot area were: Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvenis*), speedwell (*Veronica agrestis*), blue vervain (*Verbena hastata*), and red sorrel (*Rumex acetosella).*

The herbicide treatments were made in the early afternoon on June 2. The temperature was near 75F at the time of application, and the area received no rainfall for more than 48 hours after application. Treatments were made in three replications to 5 x 10 ft plots in the equivalent of 50 gal water/A. Counts of the number of each weed species in all plots were made shortly after treatment on June 2, and the final weed counts were made on July 15. These counts and the percent weed control by each treatment are included in Table 26. Data on the rapidness of herbicide activity as measured by leaf curl are given in Table 27. These ratings were taken 12, 24, 36, 48, 72, 96, and 120 hours after treatment. Ratings were made on a scale of 9 to 1 with 9 indicating no visible herbicide effect and 1 indicating total weed kill. No phytotoxicity on the bluegrass was observed at any time following treatment.

The herbicide treatments from Dow Chemical included Turflon II Amine at three rates, six treatments in combinations of two rates of XRM 3724 plus XRM 3972 at three rates, two treatments in combinations of two rates of XRM 3724 plus XRM 3972 at two rates plus Dicamba, XRM 3724 plus Break-Thru, and XRM 3724 plus Break-Thru plus Dicamba. The 414-RD, 772-RD, 880-RD, 414-PG, 772-PG, and 880-PG were experimentals submitted by Chesebrough-Pond's, Inc. and Riverdale Chemical Company. Treatments from PBI Gordon included EH 888 (D-Free Trimec), EH 884, and CODE 992 (Trimec). From The Andersons, treatments were DD Fert plus Herbicide #1, DD Fert plus Herbicide #2, AND-Program 2, Break-Thru plus Banvel, two treatments in combinations of Break-Thru and two rates of Lontrel 3A, and Break-Thru plus Lontrel 3A plus Turflon. Treatments from BASF included BAS 51400H at two rates (Table 26).

The treatments from Dow Chemical that included combinations of XRM 3724 plus XRM 3972 provided very good weed control. Two treatments gave total weed control. These were XRM 3724 at 0.38 and XRM 3972 at 0.125 lb ai/A, and XRM 3724 at 0.5 and XRM 3972 at 0.062 lb ai/A. The treatments that included XRM 3724 plus XRM 3972 plus Dicamba also gave very good weed control. Total weed control was obtained when XRM 3724 and XRM 3972 were applied in this combination at the 0.5 and 0.3 lb ai/A rate. Dandelion was the only weed not totally controlled when XRM 3724 plus XRM 3972 were applied in this combination at the 0.25 and 0.125 lb ai/A rate. The XRM 3724 plus Break-Thru provided unacceptable weed control. The XRM 3724 plus Break-Thru plus Dicamba gave very good weed control on all weeds except dandelion. It is interesting to note that in the treatment combinations when XRM 3724 was present in low rates, dandelion was not effectively controlled. The Turflon II Amine provided less than adequate control of dandelion and field bindweed, and less than total control of clover at the low rate. It provided less than adequate control of clover at the medium rate, and less than adequate control of knotweed and less than total control of dandelion and clover at the high rate.

Two treatments from Chesebrough-Pond's provided total weed control. These were 772-PG and 880-PG. The 414-PG did not control dandelion adequately and did not totally control clover. The 414-RD provided almost total weed control, while the 772-RD did not quite control all the dandelion or clover. The 880-RD provided less than adequate control of dandelion and ladysthumb.

The EH 888 (D-Free Trimec) from PBI Gordon gave very close to total weed control. The EH 884 did not control dandelion very well, but it did totally control all other weeds. The CODE 992 (Trimec) did not control pineapple weed well and did not totally control dandelion, but it did control all other weeds.

Treatments from The Andersons controlled weeds as follows: The AND-Program #2 gave almost total weed control. DD Fert plus Herbicide #1 gave no control of dandelion and knotweed, and less than total control of clover. DD Fert plus Herbicide #2 gave only partial control of dandelion and knotweed and, again, less than total control of clover. The Break-Thru plus Banvel provided less than adequate control of dandelion, knotweed, and black medic, and did not totally control clover. The Break-Thru plus Lontrel 3A combinations did not effectively control dandelion, knotweed, oxalis, blue vervain, and prostrate spurge, while the Break-Thru plus Lontrel 3A plus Turflon gave total weed control.

The low rate of BAS 51400H from BASF gave unacceptable overall weed control. At the higher rate, total weed control was obtained on all weeds except knotweed and oxalis.

Table 26. Broadleaf Weed Control Study - 1987.

Treatment	Rate (lb ai/A)	Dandelion Before	Dandelion After	Dandelion % Control
1. Control		6.33	5.00	---
2. XRM 3724 + XRM 3972	0.38 + 0.062	1.00	0.00	100
3. XRM 3724 + XRM 3972	0.38 + 0.125	4.00	0.00	100
4. XRM 3724 + XRM 3972	0.38 + 0.25	2.67	0.00	100
5. XRM 3724 + XRM 3972	0.5 + 0.062	2.00	0.00	100
6. XRM 3724 + XRM 3972	0.5 + 0.125	11.67	0.33	98
7. XRM 3724 + XRM 3972	0.5 + 0.25	2.67	0.00	100
8. XRM 3724 + XRM 3972 + Dicamba	0.5 + 0.3 + 0.1	6.00	0.00	100
9. XRM 3724 + XRM 3972 + Dicamba	0.25 + 0.125 + 0.1	2.67	0.67	77
10. XRM 3724 + Break-Thru	0.125 + 0.125	4.00	4.00	0
11. XRM 3724 + Break-Thru + Dicamba	0.125 + 0.125 + 0.125	3.33	0.67	75
12. Turflon II Amine	2.0 pt/A	5.00	0.33	89
13. Turflon II Amine	2.5 pt/A	2.33	0.00	100
14. Turflon II Amine	3.0 pt/A	4.67	1.00	92
15. DD Fert + Herbicide #2	18.94 ml/1000 ft^2	3.33	2.33	61
16. 414-RD	64 oz/ 5000 ft^2	8.00	0.33	98
17. 772-RD	64 oz/10000 ft^2	7.33	0.67	89
18. 880-RD	64 oz/10000 ft^2	4.00	0.67	83
19. 414-PG	64 oz/ 5000 ft^2	4.00	0.67	84
20. 772-PG	64 oz/10000 ft^2	2.67	0.00	100
21. 880-PG	64 oz/ 5000 ft^2	5.00	0.00	100
22. EH 888 (D-Free Trimec)	3.0 pt/A	4.00	0.00	100
23. EH 884	3.0 pt/A	1.33	0.33	50
24. CODE 992 (Trimec)	3.0 pt/A	4.67	0.33	94
25. Break-Thru + Banvel	0.125 + 0.125	2.67	1.33	63
26. Break-Thru + Lontrel 3A	0.125 + 0.125	2.00	0.33	83
27. Break-Thru + Lontrel 3A	0.125 + 0.1	5.33	2.00	70
28. Break-Thru + Lontrel 3A + Turflon	0.125 + 0.1 + 0.1	1.33	0.00	100
29. DD Fert + Herbicide #1	18.94 m./100 ft^2	3.00	4.00	0
30. AND - Program #2	18.94 ml/100 ft^2	4.33	0.33	97
31. BAS 51400H 50 WP	0.5	2.67	0.33	90
32. BAS 51400H 50 WP	1.0	4.33	0.00	100

Table 26. (continued)

	Blackseed Plantain			Clover			Virginia Pepperweed		
	Before	After	Percent control	Before	After	Percent control	Before	After	Percent control
1.	0.67	0.67	---	11.00	7.33	---	5.33	1.00	---
2.	0.00	0.00	---	1.33	0.00	100	2.33	0.00	100
3.	1.00	0.00	100	2.67	0.00	100	3.00	0.00	100
4.	0.00	0.00	---	25.33	0.00	100	3.33	0.00	100
5.	0.00	0.00	---	7.00	0.00	100	0.00	0.00	---
6.	0.00	0.00	---	29.67	0.00	100	5.00	0.00	100
7.	0.00	0.00	---	15.67	0.00	100	7.67	0.00	100
8.	0.33	0.00	100	23.33	0.00	100	1.33	0.00	100
9.	0.00	0.00	---	11.67	0.00	100	10.33	0.00	100
10.	0.00	0.00	---	22.33	3.33	90	8.33	0.00	100
11.	0.00	0.00	---	24.33	0.33	99	12.33	0.00	100
12.	0.33	0.00	100	23.67	1.33	96	3.67	0.00	100
13.	0.33	0.00	100	36.67	6.33	84	5.00	0.00	100
14.	0.00	0.00	100	3.67	0.33	95	4.00	0.00	100
15.	0.33	0.00	100	30.00	1.33	87	4.00	0.00	100
16.	0.00	0.00	100	7.00	0.00	100	3.67	0.00	100
17.	0.00	0.00	---	15.00	1.33	96	20.00	0.00	100
18.	0.00	0.00	100	8.67	0.00	100	1.00	0.00	100
19.	0.33	0.00	100	10.00	0.33	93	0.00	0.00	---
20.	0.00	0.00	---	5.00	0.00	100	2.67	0.00	100
21.	0.33	0.00	100	6.67	0.00	100	5.33	0.00	100
22.	0.00	0.00	---	26.33	0.33	99	3.67	0.00	100
23.	0.33	0.00	100	56.67	0.00	100	2.33	0.00	100
24.	0.00	0.00	---	20.33	0.00	100	1.33	0.00	100
25.	0.00	0.00	---	11.67	0.33	97	11.00	0.00	100
26.	0.00	0.00	---	26.00	0.00	100	4.00	0.00	100
27.	0.00	0.00	---	15.00	0.00	100	3.67	0.00	100
28.	0.33	0.00	100	29.67	0.00	100	2.67	0.00	100
29.	0.00	0.00	---	30.67	5.00	89	3.00	0.00	100
30.	1.67	0.00	100	11.67	0.00	100	5.33	0.00	100
31.	0.00	0.00	---	8.67	0.33	92	5.67	0.33	89
32.	0.00	0.00	---	13.33	0.00	100	4.67	0.00	100

Table 26. (continued)

	Pineapple Weed			Shepherd's Purse			Black Medic		
	Before	After	Percent control	Before	After	Percent control	Before	After	Percent control
1.	0.33	0.33	---	2.67	2.00	---	1.00	1.00	---
2.	0.33	0.00	100	0.00	0.00	---	5.00	1.00	80
3.	0.00	0.00	---	0.33	0.00	100	0.00	0.00	---
4.	0.00	0.00	---	0.00	0.00	---	0.33	0.00	100
5.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
6.	0.00	0.00	---	0.00	0.00	---	1.67	0.00	100
7.	0.00	0.00	---	2.00	0.00	100	0.00	0.00	---
8.	0.00	0.00	---	8.33	0.00	100	0.00	0.00	---
9.	0.00	0.00	---	5.67	0.00	100	3.67	0.00	100
10.	0.00	0.00	---	0.00	0.00	---	2.67	0.00	100
11.	0.67	0.00	100	0.00	0.00	---	0.00	1.00	---
12.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
13	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
14.	0.00	0.00	---	0.00	0.00	---	0.67	0.00	100
15.	0.00	0.00	---	4.33	0.00	100	1.33	0.00	100
16.	0.00	0.00	---	5.00	0.00	100	0.00	0.00	---
17.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
18.	0.33	0.00	100	0.67	0.00	100	1.33	0.00	100
19.	2.67	0.00	100	4.00	0.00	100	3.67	0.00	100
20.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
21.	0.00	0.00	---	0.33	0.00	100	0.67	0.00	100
22.	0.33	0.00	100	2.00	0.00	100	0.00	0.00	---
23.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
24.	0.67	0.33	50	0.00	0.00	---	0.33	0.00	100
25.	0.00	0.00	---	0.00	0.00	---	1.67	0.33	80
26.	1.00	0.00	100	0.00	0.00	---	0.00	0.00	---
27.	0.33	0.00	100	4.00	0.00	100	4.67	0.00	100
28.	0.00	0.00	---	2.67	0.00	100	0.00	0.00	---
29.	0.33	0.00	100	0.00	0.00	---	2.67	0.00	100
30.	0.00	0.00	---	5.00	0.00	100	1.33	0.00	100
31.	2.67	1.00	63	2.67	0.33	100	1.00	0.00	100
32.	0.00	0.00	---	2.00	0.00	100	0.00	0.00	---

Table 26. (continued)

	Goldenrod			Common Ragweed			Yellow Rocket		
	Before	After	Percent Control	Before	After	Percent Control	Before	After	Percent Control
1.	0.67	1.00	---	1.00	2.33	---	0.00	0.00	---
2.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
3.	0.00	0.00	---	0.67	0.00	100	0.00	0.00	---
4.	1.33	0.00	100	0.00	0.00	---	0.00	0.00	---
5.	1.00	0.00	100	2.67	0.00	100	0.00	0.00	---
6.	2.33	0.00	100	0.00	0.00	---	0.00	0.00	---
7.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
8.	0.00	0.00	---	0.00	0.00	---	1.33	0.00	100
9.	0.00	0.00	---	0.00	0.00	---	3.00	0.00	100
10.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
11.	0.67	0.00	100	0.00	0.00	---	0.00	0.00	---
12.	0.33	0.00	100	0.00	0.00	---	0.67	0.00	100
13.	0.00	0.00	---	0.00	0.00	---	0.33	0.00	100
14.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
15.	2.67	0.00	100	2.00	0.00	100	0.00	0.00	---
16.	1.33	0.00	100	0.00	0.00	---	0.00	0.00	---
17.	3.67	0.00	100	0.67	0.00	100	0.67	0.00	100
18.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
19.	1.33	0.00	100	0.00	0.00	---	0.00	0.00	---
20.	3.00	0.00	100	0.00	0.00	---	0.00	0.00	---
21.	3.33	0.00	100	0.00	0.00	---	0.67	0.00	100
22.	0.33	0.00	100	2.00	0.00	100	0.00	0.00	---
23.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
24.	0.00	0.00	---	2.33	0.00	100	0.00	0.00	---
25.	1.33	0.00	100	3.67	0.00	100	1.00	0.00	100
26.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
27.	1.00	0.00	100	0.00	0.00	---	0.00	0.00	---
28.	1.00	0.00	100	0.67	0.00	100	0.00	0.00	---
29.	0.67	0.00	100	0.33	0.00	100	0.67	0.00	100
30.	2.33	0.00	100	0.00	0.00	---	0.33	0.00	100
31.	1.33	0.00	100	0.00	0.00	---	0.00	0.00	---
32.	2.33	0.00	100	2.67	0.00	100	1.33	0.00	100

Table 26. (continued)

	Speedwell			Blue Vervain			Red Sorrel		
	Before	After	Percent control	Before	After	Percent control	Before	After	Percent control
1.	3.00	3.00	---	0.00	0.00	---	0.00	0.00	---
2.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
3.	0.00	0.00	---	1.00	0.00	100	0.00	0.00	---
4.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
5.	0.00	0.00	---	0.67	0.00	100	0.00	0.00	---
6.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
7.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
8.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
9.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
10.	0.00	0.00	---	0.33	0.00	---	0.00	0.00	---
11.	0.00	0.00	---	0.00	0.00	---	3.00	0.00	100
12.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
13.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
14.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
15.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
16.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
17.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
18.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
19.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
20.	2.33	0.00	100	0.00	0.00	---	0.00	0.00	---
21.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
22.	0.00	0.00	---	0.00	0.00	---	2.33	0.00	100
23.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
24.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
25.	0.00	0.00	---	1.33	0.00	100	0.00	0.00	---
26.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
27.	0.00	0.00	---	0.33	0.33	0	0.00	0.00	---
28.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
29.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
30.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
31.	0.00	0.00	---	1.00	2.00	0	0.00	0.00	---
32.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---

Table 26. (continued)

	Ladysthumb			Canada Thistle			Field Bindweed		
	Before	After	Percent Control	Before	After	Percent Control	Before	After	Percent Control
1.	0.00	0.33	---	0.00	0.00	---	0.00	0.00	---
2.	1.33	0.00	100	0.00	0.00	---	0.00	0.00	---
3.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
4.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
5.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
6.	0.00	0.00	---	0.67	0.00	100	1.33	0.00	100
7.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
8.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
9.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
10.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
11.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
12.	0.00	0.00	---	0.00	0.00	---	2.33	1.00	57
13.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
14.	0.00	0.33	---	0.00	0.00	---	0.00	0.00	---
15.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
16.	0.67	0.00	100	0.00	0.00	---	0.00	0.00	---
17.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
18.	1.00	0.33	67	0.00	0.00	---	0.00	0.00	---
19.	2.33	0.00	100	0.00	0.00	---	0.00	0.00	---
20.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
21.	0.00	1.00	---	0.00	0.00	---	0.00	0.00	---
22.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
23.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
24.	3.00	0.00	100	0.00	0.00	---	0.00	0.00	---
25.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
26.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
27.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
28.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
29.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
30.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
31.	2.67	1.00	63	0.33	0.00	100	1.67	1.67	0
32.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---

Table 26. (continued)

	Knotweed			Oxalis			Curly Dock		
	Before	After	Percent control	Before	After	Percent control	Before	After	Percent control
1.	6.67	1.67	---	0.00	0.67	---	0.00	0.00	---
2.	5.00	0.00	100	11.67	0.00	100	0.00	0.00	---
3.	0.00	0.00	---	0.00	1.00	---	0.33	0.00	100
4.	5.00	5.00	0	0.00	0.00	---	0.00	0.00	---
5.	0.00	0.00	---	4.67	0.00	100	0.00	0.00	---
6.	2.00	1.00	50	0.00	0.33	---	0.00	0.00	---
7.	3.33	1.00	70	2.00	0.67	0	0.33	0.00	100
8.	2.67	0.00	100	0.00	0.00	---	0.00	0.00	---
9.	0.33	0.00	100	0.00	0.00	---	0.00	0.00	---
10.	2.00	5.00	0	0.00	0.33	---	0.00	0.00	---
11.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
12.	8.67	0.00	100	0.00	5.00	---	0.00	0.00	---
13.	0.00	0.00	---	1.67	0.00	100	0.00	0.00	---
14.	3.33	0.67	80	0.00	0.00	---	1.00	0.00	100
15.	12.33	2.00	57	0.00	1.67	---	0.00	0.00	---
16.	0.00	0.00	---	0.00	0.00	---	0.00	0.00	---
17.	0.00	0.33	---	5.00	0.00	100	0.33	0.00	100
18.	2.67	0.00	100	0.00	0.33	---	0.00	0.00	---
19.	0.00	0.00	---	3.33	0.33	100	0.33	0.00	100
20.	5.00	0.00	100	0.00	0.00	---	0.00	0.00	---
21.	6.67	0.00	100	3.67	0.00	100	0.33	0.00	100
22.	2.33	0.00	100	0.00	0.00	---	0.00	0.00	---
23.	1.00	0.00	100	0.00	0.00	---	0.33	0.00	100
24.	2.00	0.00	100	0.00	0.00	---	0.00	0.00	---
25.	33.00	8.33	75	0.00	1.33	---	0.00	0.00	---
26.	4.00	0.00	100	3.67	11.67	0	0.00	0.00	---
27.	7.00	2.67	33	0.00	1.33	---	0.00	0.00	---
28.	2.00	0.00	100	0.00	0.00	---	0.00	0.00	---
29.	4.00	2.67	0	0.00	1.00	---	0.00	0.00	---
30.	2.00	0.00	100	0.00	0.33	---	0.00	0.00	---
31.	7.67	6.00	13	3.33	8.00	0	0.00	0.00	---
32.	10.00	6.67	33	3.33	13.33	0	0.00	0.00	---

Table 26. (continued)

	Prostrate Spurge		
	Before	After	Percent control
1.	0.00	0.00	---
2.	0.00	0.00	---
3.	0.00	0.33	---
4.	0.33	0.00	100
5.	0.00	0.00	---
6.	0.00	0.00	---
7.	0.00	0.00	---
8.	0.00	0.00	---
9.	0.00	0.00	---
10.	0.00	0.00	---
11.	0.33	0.00	100
12.	0.33	0.00	100
13.	0.33	0.00	100
14.	0.00	0.00	---
15.	0.00	0.00	---
16.	0.00	0.00	---
17.	0.00	0.00	---
18.	2.00	0.00	100
19.	0.00	0.00	---
20.	0.00	0.00	---
21.	0.00	0.33	---
22.	0.00	0.00	---
23.	1.00	0.00	100
24.	0.33	0.00	100
25.	0.00	0.00	---
26.	0.00	0.00	---
27.	0.33	0.33	0
28.	0.00	2.00	---
29.	0.00	0.00	---
30.	0.00	0.00	---
31.	0.00	0.00	---
32.	0.00	0.00	---

Table 27. Herbicide activity ratings measured by weed leaf curl.

	Treatment	12 hr	24 hr	36 hr	48 hr	72 hr	96 hr	120 hr
1.	Control	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2.	XRM 3724 + XRM 3972	8.5	8.5	8.5	8.0	7.0	6.5	6.5
3.	XRM 3274 + XRM 3972	8.3	8.0	8.0	8.0	7.7	7.0	6.7
4.	XRM 3724 + XRM 3972	9.0	7.7	7.0	7.0	6.3	6.3	6.3
5.	XRM 3724 + XRM 3972	7.5	7.0	7.0	7.0	7.0	7.0	7.0
6.	XRM 3724 + XRM 3972	8.7	8.3	8.0	7.0	6.3	6.0	5.7
7.	XRM 3724 + XRM 3972	8.7	8.7	8.3	8.0	6.7	6.7	6.3
8.	XRM 3724 + XRM 3972 + Dicamba	8.7	8.3	8.0	7.7	6.7	6.7	6.3
9.	XRM 3724 + XRM 3972 + Dicamba	8.7	8.3	8.0	7.3	6.7	6.3	6.0
10.	XRM 3724 + Break-Thru	8.7	8.3	7.7	7.7	7.7	7.7	7.7
11.	XRM 3724 + Break-Thru + Dicamba	8.3	8.0	7.3	7.0	6.7	6.7	6.7
12.	Turflon II Amine	8.7	8.7	8.3	8.0	7.7	7.0	6.7
13.	Turflon II Amine	8.0	8.0	7.0	6.0	5.5	5.5	5.5
14.	Turflon II Amine	8.0	7.7	7.7	7.3	7.3	7.3	7.0
15.	DD Fert + Herbicide #2	9.0	9.0	8.7	7.3	6.3	6.0	6.0
16.	414-RD	9.0	8.3	8.0	6.7	6.3	6.3	6.0
17.	772-RD	8.3	8.3	8.0	7.3	7.3	7.0	6.7
18.	880-RD	7.7	7.3	6.3	5.7	5.7	5.7	5.7
19.	414-PG	8.0	7.3	7.0	6.0	5.7	5.3	5.0
20.	772-PG	8.3	8.0	7.3	7.3	7.0	7.0	6.7
21.	880-PG	8.6	8.3	8.0	6.7	6.3	5.7	5.7
22.	EH 888 (D-Free Trimec)	7.3	7.3	7.0	7.0	6.7	6.3	6.3
23.	EH 884	8.0	6.7	6.3	6.3	5.7	5.7	5.3
24.	CODE 992 (Trimec)	8.3	7.7	7.0	6.7	6.7	6.7	6.7
25.	Break-Thru + Banvel	8.3	7.7	7.7	7.7	7.3	7.3	7.0
26.	Break-Thru + Lontrel 3A	9.0	8.7	7.7	7.3	7.0	6.3	6.0
27.	Break-Thru + Lontrel 3A	9.0	8.7	8.0	7.0	7.0	5.7	5.7
28.	Break-Thru + Lontrel 3A + Turflon	8.7	8.7	7.7	7.0	6.0	6.0	5.7
29.	DD Fert + Herbicide #1	9.0	9.0	9.0	8.7	8.3	8.3	7.7
30.	AND - Program #2	8.3	7.7	7.0	6.7	6.3	6.0	6.0
31.	BAS 51400H 50 WP	9.0	9.0	9.0	9.0	8.7	8.3	8.0
32.	BAS 51400H 50 WP	9.0	9.0	8.5	8.0	7.5	7.5	7.0
	LSD 0.05	N.S.	N.S.	N.S.	1.7	1.9	1.7	1.8

Preemergence Herbicide Timing Control Studies - 1987

M. L. Agnew and N. E. Christians

The purpose of this study was to investigate the effectiveness of five preemergence herbicides when applied on six dates ranging from late fall of 1985 to late spring of 1986. The herbicides used were Benefin, Bensulide, Bensulide/Devrinol, Dacthal, and Pendimethalin. The herbicides were applied at rates of 2 lb ai/A (Benefin), 7.5 lb ai/A (Bensulide), 7.5 lb ai/A-1.5 lb ai/A (Bensulide/Devrinol), 10.5 lb ai/A (Dacthal), and 1.5 lb ai/A (Pendimethalin). Application dates were November 8, 1985, March 6, March 20, April 4, April 18, and May 6, 1986. On November 8, an additional treatment of Pendimethalin at a rate of 3.0 lb ai/A was added.

The area chosen for the study was a nonirrigated Kentucky bluegrass rough at Homewood Golf Course in Ames, Iowa. Individual plots measured 5 feet by 5 feet and each was replicated three times.

The environmental conditions in 1987 can be classified as a dry spring and wet summer. Perfect conditions for late crabgrass germination were present.

On July 17 and September 8, 1987, the number of crabgrass plants per plot were recorded (Table 28) and the percent crabgrass control was calculated. Crabgrass control of 90 percent was considered good control. Bensulide, Bensulide/Devrinol, and Dacthal consistently gave 90 percent or better crabgrass control. All treatments of Balan and all but the May treatment of Pendimethalin provided less than 90 percent control of crabgrass.

The application of preemergence herbicide on May 6, provided consistently better crabgrass control than all other herbicide application dates. The poor crabgrass control by Balan and Pendimethalin prior to May 6 demonstrates the need for a second application for crabgrass control when applied early.

Table 28. Weed control in the 1987 preemergence annual grass timing control study.

Herbicide	Rate lb ai/acre	Date of application	% Crabgrass control[a] July 17	% Crabgrass control[a] Sept 8
Balan	2	11-08-85	70	73
Balan	2	3-06-86	59	64
Balan	2	3-20-86	93	76
Balan	2	4-04-86	57	62
Balan	2	4-18-86	69	73
Balan	2	5-06-86	84	86
Bensulide	7.5	11-08-85	98	99
Bensulide	7.5	3-06-86	98	98
Bensulide	7.5	3-20-86	100	100
Bensulide	7.5	4-04-86	99	99
Bensulide	7.5	4-18-86	96	96
Bensulide	7.5	5-06-86	98	98
Bensulide/Devrinol	7.5/1.5	11-08-85	97	97
Bensulide/Devrinol	7.5/1.5	3-06-86	98	98
Bensulide/Devrinol	7.5/1.5	3-20-86	97	97
Bensulide/Devrinol	7.5/1.5	4-04-86	96	96
Bensulide/Devrinol	7.5/1.5	4-18-86	90	90
Bensulide/Devrinol	7.5/1.5	5-06-86	94	94
Dacthal	10.5	11-08-85	91	91
Dacthal	10.5	3-06-86	89	90
Dacthal	10.5	3-20-86	95	96
Dacthal	10.5	4-04-86	98	98
Dacthal	10.5	4-18-86	99	99
Dacthal	10.5	5-06-86	99	99
Pendimethalin	1.5	11-08-85	61	65
Pendimethalin	1.5	3-06-86	73	76
Pendimethalin	1.5	3-20-86	85	86
Pendimethalin	1.5	4-04-86	65	68
Pendimethalin	1.5	4-18-86	52	57
Pendimethalin	1.5	5-06-86	95	95
LSD (Herbicide) 0.05			8	8
LSD (App. date) 0.05			10	9

[a] Percent crabgrass control = control minus plot count divided by control. Control plots contained 243 and 277 crabgrass plants on July 17 and September 8, respectively.

Herbicide Effects on Rooting of Kentucky Bluegrass

Z. J. Reicher and N. E. Christians

A series of studies were conducted over a three year period with varying environmental and management conditions to investigate the effects of herbicides on rooting of Kentucky bluegrass. High- and low-maintenance regimes were used in each year. High-maintenance areas received 4.0 lb nitrogen (N)/1000 ft^2 yearly and irrigation to prevent moisture stress. Low-maintenance areas received 1.0 lb N/1000 ft^2 and no irrigation other than needed to facilitate root sampling.

The treatments in the 1985 high-maintenance study (expressed in active ingredient) were Dacthal 75 WP at 10.5 and 15.0 lb/A, Ronstar 2G at 2.0 and 3.5 lb/A, Betasan 4EC at 7.5 and 14.0 lb/A, and Balan 2.5G at 2.0 and 3.0 lb/A. Treatments were applied on April 20 to a three-year-old stand of Enmundi Kentucky bluegrass. Eight 8-inch deep root samples were taken from each plot in June of 1985 and divided into four 2-inch segments to check rooting differences by depth due to the herbicides. The samples were washed through a series of screens, oven-dried, and weighed. There were no differences in either rooting by depth or in total root weight of the treated plots compared to the control (Table 29).

The 1985 low-maintenance study was located on an abandoned fairway of common Kentucky bluegrass on Veenker Memorial Golf Course in Ames, Iowa. Betasan 4EC at 8.0 and 12.5 lb/A, Pendimethalin 60 WDG at 1.5 and 3.0 lb/A, Ronstar 2G at 3.0 lb/A, and Dacthal 75 WP at 10.5 lb/A were applied on April 25. Root zone samples were taken as in the high-maintenance study on June 25 and August 8, 1985. Because of the extremely dry conditions, only 6-inch samples could be taken. The samples were divided into three 2-inch segments, washed through screens, and ash weights were determined. Compared to the control, Pendimethalin at 1.5 and 3.0 lb/A reduced total root weight 18 percent and 20 percent, respectively, on the June sampling. There was no difference in rooting among the treatments on the August sampling.

The 1986 and 1987 studies were located at the ISU Horticulture Research Station north of Ames. The maintenance regimes were identical to those of the 1985 studies. The high-maintenance study was on Midnight Kentucky bluegrass in 1986 and a Premium Sod Blend in 1987. The low-maintenance study was on Parade Kentucky bluegrass in both years. The treatments were identical in 1986 and 1987. They were Dacthal 75 WP at 10.5 and 15.0 lb/A, Ronstar 2G at 2.0 and 4.0 lb/A, Betasan 4E at 7.5 and 14.0 lb/A, Balan 2.5G at 2.0 and 3.0 lb/A, Pendimethalin 60 WDG at 1.5 and 3.0 lb/A, Prodiamine 65 WDG at 0.5 and 1.0 lb/A, and Acclaim 1EC at 0.12 lb/A. Treatments were applied in late April of each year and rooting samples were taken in late May, late June, and late July of each year. Eight 6-inch samples were taken from each plot and divided into two 3-inch segments. Samples were washed through screens and ash weights were determined. There were no differences in either total root weight or in root weights of individual depths in any of the sampling dates of these studies.

The summer of 1985 was an extremely hot, dry, and stressful summer for the grass plant, especially under low-maintenance conditions. Plants under stress are more susceptible to herbicide damage than vigorous plants that can grow out of the damage. The summers of 1986 and 1987 were less stressful which could explain why there was root inhibition only in 1985.

Greenhouse Study

Clear polyethylene tubing was filled with fritted clay, placed in a PVC sleeve, and supported at a 30 angle in the greenhouse. Single tillers of Glade Kentucky bluegrass were established in each tube. Treatments were identical to those in the 1986 and 1987 field studies. Herbicides were applied 10 days after establishment of the tillers. Granular herbicides were applied by hand while the sprayables were applied with a spray mist atomizer. The tubes were watered with the equivalent of 1-inch of water per week. Clipping weights were taken weekly and root weights were taken at the termination of the study. The study was begun in September 1987 and repeated in December 1987. The September study was harvested 60 days after application, whereas the December study was harvested after 35 days because a number of plants had rooted to the bottom of the tubes.

Because of the nature of the greenhouse study, root growth could be more accurately observed and quantified than in the field. The three dinitroaniline herbicides, Balan, Pendimethalin, and Prodiamine, were consistently injurious to the roots. Balan at 2.0 lb/A reduced rooting 53 percent in the first study, but had no effect in the second (Table 30). The 3.0 lb/A rate of benefin reduced rooting in both studies, 47 percent in the first and 25 percent in the second. Pendimethalin at 1.5 lb/A reduced total root weight 32 percent in the first study and 23 percent in the second. The 3.0 lb/A rate was more damaging, reducing root weight 44 percent and 28 percent, respectively. Acclaim reduced root weight 37 percent only in the first study. Prodiamine, consistently the most damaging of the herbicides, reduced root weights by as much as 71 percent. Dacthal at 10.5 lb/A reduced total root weight 25 percent in the first study. The 15.0 lb/A rate of DCPA reduced total root weight 39 percent in the second study.

In the first study, severe root inhibition often was seen in the top 4 to 5 inches of the column with normal root growth below this area. To quantify this observation, the tubes were divided into three depths in the second study; 0 to 5.5 inches, 5.5 to 11.0 inches, and 11.0 to 22.0 inches. Root inhibition consistently took place in the upper 11 inches of the column and more precisely, the top 5.5 inches of the column. No inhibition was seen in the lower depths of the column and there were no differences in depth of rooting at any time in the studies. Preemergence herbicides may only affect the roots near the soil surface with normal root growth deeper in the profile. This may be a problem with shallow-rooted turf species.

Prodiamine at 0.5 and 1.0 lb/A consistently reduced clipping weights 75 percent and more throughout both studies (Table 31). Both rates of Prodiamine reduced the final above ground shoot weight 73 percent in the first study, whereas the low rate reduced final shoot weight 33 percent in the second study and the high rate reduced it 66 percent. Acclaim reduced clipping weights the first three weeks after application in the first study, whereas Pendimethalin reduced clipping weights 28 and 42 days after application.

Table 29. Root weights from the 1985 field study expressed as percent of control.

		Maintenance		
		High	Low	
Treatment	lb/A	June	June	August
Control	----	100	100	100
Balan	2.0	89		
Balan	3.0	83		
Betasan	7.5	75		
Betasan	8.0		88	86
Betasan	12.5		94	97
Betasan	14.0	100		
Dacthal	10.5	87	100	95
Dacthal	15.0	86		
Ronstar	2.0	79		
Ronstar	3.0		110	96
Ronstar	3.5	79		
Pendimethalin	1.5		81	82
Pendimethalin	3.0		80	85
LSD 0.05		N.S.	17	N.S.

Even though many of the herbicides inhibited rooting, very few inhibited top growth of the grass plants. With the high-maintenance, low-stress conditions found in the greenhouse, a grass plant could appear healthy even though root growth was inhibited as happened in this study. Healthy top growth may not be reflective of the safety of herbicides to Kentucky bluegrass. Observations on the effect of these herbicides on rooting is needed before one can be confident of the safety of these materials.

Table 30. Rooting of the greenhouse study expressed in percent of control.

Treatment	lb/A	Study I 0-28 cm	Study I 28-56 cm	Study I Total	Study II 0-14 cm	Study II 14-28 cm	Study II 28-50 cm	Study II Total
Control	----	100	100	100	100	100	100	100
Dacthal	10.5	70	142	75	98	102	141	105
Dacthal	15.8	82	77	81	67	51	71	61
Ronstar	2.0	110	118	111	98	81	109	94
Ronstar	4.0	91	86	91	89	74	106	86
Betasan	7.5	92	77	91	95	88	124	96
Betasan	14.0	98	83	97	78	72	120	81
Balan	2.0	46	60	47	70	85	109	80
Balan	3.0	51	86	53	67	78	120	77
Pendimethalin	1.5	69	77	68	72	77	98	77
Pendimethalin	3.0	55	79	56	75	58	97	72
Prodiamine	0.5	25	85	29	50	36	25	37
Prodiamine	1.0	28	111	33	41	53	25	48
Acclaim	0.12	63	58	63	95	80	79	88
LSD 0.05		24	N.S.	24	25	33	N.S.	28

Table 31. Fresh clippings of greenhouse study expressed in percent of the control.

		Study I						Study II			
		Days following application									
Treatment	lb/A	14	21	28	35	42	Final	14	21	28	Final
Control	----	100	100	100	100	100	100	100	100	100	100
Dacthal	10.5	126	86	87	98	75	103	107	98	111	108
Dacthal	15.8	150	93	72	110	94	105	73	71	97	87
Ronstar	2.0	115	95	83	119	95	111	93	114	99	89
Ronstar	4.0	88	98	100	135	94	104	80	96	114	97
Betasan	7.5	100	86	85	113	84	99	124	109	106	101
Betasan	14.5	109	93	80	100	84	107	129	111	113	89
Balan	2.0	112	83	65	83	80	80	127	108	120	92
Balan	3.0	106	98	78	104	103	95	85	87	114	86
Pendimethalin	1.5	88	79	72	83	92	95	98	80	78	90
Pendimethalin	3.0	73	74	63	69	65	80	80	97	95	89
Prodiamine	0.5	18	26	24	21	19	29	29	15	33	67
Prodiamine	1.0	21	17	13	17	9	28	0	0	1	34
Acclaim	0.12	35	60	67	67	42	73	132	112	113	89
LSD 0.05		47	37	36	38	29	24	73	50	37	29

Herbicide Effects on the Establishment of Kentucky Bluegrass Sod

Z. J. Reicher and N. E. Christians

The effect of preemergence herbicide applications and the timing of Acclaim applications on establishment of freshly laid Kentucky bluegrass sod was investigated. The study was run in 1986 and repeated in 1987. The experiment was located at the Iowa State University Horticulture Research Station on a Premium Sod Blend consisting of Adelphi, Glade, Parade, and Rugby Kentucky Bluegrass.

The 1986 treatments (expressed in a.i.) included the postemergence herbicide Acclaim at 0.18 and 0.36 lb/A applied 28 and 14 days before sod harvest and 14 and 28 days after sod laying. Three preemergence herbicides, Betasan 7.5 lb/A, Dacthal at 10.5 lb/A, and Pendimethalin at 1.5 lb/A were applied over the top of the freshly laid sod. The actual dates of Acclaim application in 1986 were July 2 and 16 before sod harvest and August 14 and 29 after sod laying. The sod was cut and moved to a prepared sod bed on July 29, 1986, and the preemergence herbicides were applied the next day. The treatments in the 1987 study were identical to those in 1986 but with the addition of Acclaim at 0.25 lb/A. The study was run one month earlier in 1987 with Acclaim applications on June 2 and 16 before harvest and July 16 and 30 after sod was established. The sod was cut and reestablished on June 30, 1987, and the preemergence herbicides applied the following day.

Phytotoxicity was recorded 14 days following herbicide application because this was the period of peak damage. Phytotoxicity was rated on a scale of 9 to 1; 9 = no damage, 6 = acceptable damage, and 1 = dead turf. Rooting was measured 28 and 56 days after sod laying. Rooting was measured with a technique modified from King (*Agronomy Journal* 61,497-499, 1975). Sod pieces were transplanted into wooden frames with 18-mesh fiberglass screen bottoms at the time of laying. The frames were constructed of 2.5 by 5.0 cm pine boards with inside dimensions of 30 by 30 cm. At each of the four corners, screw hooks were placed for use as the point of attachment for the hydraulic lift apparatus. Woven steel cords (3 mm diameter) were attached to each of the four hook screws on the frame and drawn to an apex over the center of the frame. the lift apparatus was centered carefully over the frame to assure the lifting force was vertical. The second year, the lifting apparatus was raised by mounting it on a cart 65 cm above the level of the frame. A gauge measuring hydraulic pressure was attached to the pump to facilitate measurement of force at the point of root breakage from the soil. The force needed for the vertical lift of rooting frames correlates with fresh and dry root weights. Rooting measurements were used as an indication of sod establishment.

In 1986, Acclaim at 0.36 lb/A caused phytotoxicity at all applications (Table 32). No treatments inhibited rooting after 28 days, and Acclaim at 0.36 lb/A applied 14 and 28 days after sod laying were the only treatments to inhibit rooting 56 days after sod laying in 1986. (Table 33). Acclaim at 0.25 and 36 lb/A caused phytotoxicity on three of the four application dates, and Acclaim at 0.18 lb/A burned the turf when applied 14 days preceding sod harvest. None of the treatments affected rooting 28 or 56 days after sod laying.

Betasan, Dacthal, and Pendimethalin are effective at controlling annual grasses at the rates used and would be safe to use over the top of Kentucky bluegrass sod. Acclaim at 0.25 lb/A and 0.36 lb/A can slow sod establishment by causing phytotoxicity and possible root inhibition and should not be used on Kentucky bluegrass sod at these rates. Acclaim is effective on annual grasses applied throughout the year at 0.18 lb/A and is safe for use on Kentucky bluegrass sod.

Table 32. Evaluation of Kentucky bluegrass sod injury from herbicide applications taken two weeks after treatment.

Treatment	Rate (lb/A)	Timing of application	Visual estimate of injury[a] 1986	1987
Control	----	----	9.0	9.0
Acclaim	0.18	28 days prior	9.0	9.0
Acclaim	0.25	28 days prior	---	7.7
Acclaim	0.36	28 days prior	7.7	6.3
Acclaim	0.18	14 days prior	9.0	8.0
Acclaim	0.25	14 days prior	---	6.3
Acclaim	0.36	14 days prior	7.3	5.3
Betasan	7.50	at sod laying	9.0	9.0
Dacthal	10.50	at sod laying	9.0	9.0
Pendimethalin	1.50	at sod laying	9.0	9.0
Acclaim	0.18	14 days after	9.0	9.0
Acclaim	0.25	14 days after	---	8.7
Acclaim	0.36	14 days after	5.6	8.7
Acclaim	0.18	28 days after	8.6	9.0
Acclaim	0.25	28 days after	---	8.3
Acclaim	0.36	28 days after	5.3	8.0
LSD 0.05			0.6	0.7

[a] Ratings based on a scale of 9 to 1; 9 = no damage, 6 = acceptable damage, 1 = dead turf.

Table 33. The effect of herbicides on rooting of Kentucky bluegrass sod measured in pressure needed to break the roots from the soil.

Treatment	Rate (lb/A)	Timing of application	Pulling pressure (kPa) 1986 4 wks	1986 8 wks	1987 4 wks	1987 8 wks
Control	----	----	814	1235	2505	1076
Acclaim	0.18	28 days prior	573	1463	2553	1277
Acclaim	0.25	28 days prior	---	----	3229	1249
Acclaim	0.36	28 days prior	1176	863	3036	1366
Acclaim	0.18	14 days prior	1007	1449	2367	1035
Acclaim	0.25	14 days prior	---	----	1932	1145
Acclaim	0.36	14 days prior	1235	1227	1973	1194
Betasan	7.50	at sod laying	1035	987	2277	1035
Dacthal	10.50	at sod laying	538	1635	2387	1076
Pendimethalin	1.50	at sod laying	731	1290	2988	1352
Acclaim	0.18	14 days after	748	1145	2663	1400
Acclaim	0.25	14 days after	---	----	2436	1138
Acclaim	0.36	14 days after	425	690	1794	800
Acclaim	0.18	28 days after	---	1339	----	900
Acclaim	0.25	28 days after	---	----	----	1387
Acclaim	0.36	28 days after	---	635	----	1063
LSD 0.05			N.S.	449	N.S.	N.S.

Solvent Effects on Plant Response to Preemergence Herbicides on Tissue Culture Media

Z. J. Reicher and N. E. Christians

The objective of this experiment was to observe the effects of preemergence herbicides on rooting of Kentucky bluegrass on tissue culture media under sterile conditions (*in vitro*). Preemergence herbicides have very low water solubility that limits their study in a water based tissue culture media. To increase their water solubility and facilitate their use in a water based media, the herbicides can first be dissolved in a non-toxic solvent before addition to the media. Two solvents often used are ethanol and dimethyl sulfoxide (DMSO). Before selecting the solvent for use with the herbicide study on bluegrass, the solvents were screened for possible adverse effects on plant growth. Because of their rapid germination and growth, oats were used to screen the solvents.

The preemergence herbicides bensulide (Betasan), DCPA (Dacthal), pendimethalin, and prodiamine were used in this experiment. The relatively high water solubility of bensulide enabled the use of water, ethanol, and DMSO as solvents while ethanol and DMSO were the only solvents used with the other herbicides. Technical grade herbicides were dissolved in the solvents for four hours. The dissolved herbicides were added to the warm media in four concentrations of each material. Additional DMSO and ethanol were added to bring their final concentration to 0.1 percent (v/v). The media was poured into petri dishes and allowed to cool. Pregerminated oat seedlings were placed in the petri dish and their roots gently pressed into the media. The original position of the primary roots was marked on the petri dish cover. The dishes were angled 30 from vertical to force the roots to grow through the media. The new position of the roots was marked every six hours in a 30 hr experiment. At the termination of the study, the distances between successive marks was measured to the nearest millimeter.

The rooting responses with the solvents was not consistent among the herbicides. There was a large difference in rooting responses among the solvents with bensulide and DCPA but little difference in response with pendimethalin and prodiamine. Overall, DMSO used as a solvent consistently produced shorter roots than when ethanol was used. Ethanol as a solvent also inhibited rooting slightly compared to water. For this reason, ethanol was used as the solvent for the bluegrass study, but the final ethanol concentration was reduced to 0.5 percent (v/v).

Kentucky Bluegrass Study

The procedure used in the bluegrass study closely resembled that used in the oat study. Rather than measuring roots once every six hours for 30 hr, the roots of the slower growing bluegrass were measured after 12 days. The concentrations of bensulide, DCPA, pendimethalin, and prodiamine were used in ratios determined by their recommended field rates.

All herbicide treatments inhibited rooting compared to the control (Table 34). Root growth was inhibited more with increasing rates of bensulide, pendimethalin, and prodiamine. This was not the case with DCPA where root length actually increased with increasing concentration, but all concentrations still produced shorter roots than the control.

DCPA is the safest of the preemergence herbicides used under these conditions. Even though the herbicides were used in concentrations based on their respective field recommendations, the results do not directly relate to field conditions. The concentrations of herbicides used in this study were often at a maximum based on their water solubilities and considerably higher than expected under field conditions. This study does demonstrate though that these preemergence herbicides do have the capacity to inhibit rooting of Kentucky bluegrass.

The technique used in this experiment to study preemergence herbicides was very effective. This method may be difficult to relate to field conditions but is still useful for comparison of various herbicides. One can rapidly screen a large number of herbicide treatments in a relatively small area.

Table 34. Mean primary seminal root length of Kentucky bluegrass after 12 days.

Herbicide	Rate moles/liter	Rate length (mm)
Control	----	6.9
DCPA	5.0×10^{-7}	4.6
DCPA	1.0×10^{-6}	4.8
DCPA	1.5×10^{-6}	5.1
Bensulide	3.8×10^{-7}	4.4
Bensulide	7.5×10^{-7}	4.4
Bensulide	1.1×10^{-6}	2.0
Pendimethalin	7.5×10^{-8}	4.9
Pendimethalin	1.5×10^{-7}	4.2
Pendimethalin	2.3×10^{-7}	3.6
Prodiamine	2.5×10^{-8}	4.7
Prodiamine	5.0×10^{-8}	3.7
Prodiamine	7.5×10^{-8}	2.8
LSD (0.05)		1.2

Poa annua Control Study -- 1986-87

N. E. Christians and Z. J. Reicher

The objectives of this study were to determine the effectiveness of RSW 0411 70 WP (an experimental material from Mobay Chemical Company), Prograss (a labeled *Poa annua* control for NOR-AM Chemical Company), and Embark (a growth regulating compound from PBI Gordon Inc.) as controls of *Poa annua* in a creeping bentgrass golf course green and to observe any phytotoxicity of the compounds on creeping bentgrass.

The practice green at Veenker Memorial Golf Course in Ames was used as the test site. This green was constructed in 1974 on a Coland clay loam (fineloamy, mixed, mesic, cumulic, Haplaquoll) soil with a pH of 7.7, 19 ppm P, 116 ppm K, and 5.3 percent organic matter.

Treatments were applied at the rates and times outlined in table 1 in the equivalent of 175 gal water/A. Each plot measured 5 ft by 5 ft and the study was replicated three times. The treated area was not watered for 24 hours following application.

The RSW 0411 70WP reduced the quality of creeping bentgrass following the May and September treatments, but not after the July treatment (Table 35). The damage from the May treatments lasted through July. The damage following the September treatment lasted into the fall, but no damage was observed in the spring of 1987 on plots treated with this material. *Poa annua* was also discolored by the RSW 0411 70WP; however, it tended to recover more quickly than the creeping bentgrass.

Poa annua measurements were taken on April 21, 1987. Measurements were made by randomly throwing a 6 inch by 6 inch grid divided into nine 2-inch divisions on three locations in each plot. The data on percent *Poa annua* listed in table 35 were based on measurements from the grid. No reductions in *Poa annua* population were observed on any of the plots treated with the RSW 0411 70WP.

Embark applied at 0.25 lb ai/A did not discolor either *Poa annua* or creeping bentgrass and did not reduce *Poa annua* infestation.

Prograss did not discolor either species in the fall. In the spring, this material had reduced the *Poa annua* population from 59 percent cover in the control to 19 percent in the treated plot. There was no visible damage to the bentgrass in the spring. Germination of *Poa annua* into Prograss treated plots was observed in late April 1987.

The Prograss appears to have potential as a *Poa annua* control in close mowed creeping bentgrass. More work on application rates and timing of application will be needed before recommendations for the use of this material on greens can be made. Prograss is presently not labeled for use on close mowed bentgrass. There is data from studies at other locations that would indicate a risk of damage to bentgrass with Prograss and caution should be exercised in the use of this material.

Table 35. Phytotoxicity ratings and percent *Poa annua* infestation in treated areas.

Treatment	Rate lb ai/A	Date of Application May	Jul	Sep	Oct	Nov	Phytotoxicity Ratings Jun 13	Jul 23	Aug 1	Sep 21	Oct 3	Oct 10	Percent Poa annua
1. Control	---						9	9	9	9	9	9	59
2. RSW 0411 70WP	1.30	X					6	6	9	9	9	9	47
3. RSW 0411 70WP	1.75	X					5	4	9	9	9	9	57
4. RSW 0411 70WP	1.30		X				9	9	8	9	9	9	55
5. RSW 0411 70WP	1.75		X				9	9	9	9	9	9	50
6. RSW 0411 70WP	1.30			X			9	9	9	9	5	5	53
7. RSW 0411 70WP	1.75			X			9	9	9	9	5	4	58
8. Prograss (1.5 lb ai/gal)	0.75			X	X	X	9	9	9	9	9	9	19
9. Embark	0.25				X		9	9	9	9	9	9	48
LSD 0.05							1*	1	1	1	1	1	19

* All LSD values were averaged to the nearest whole number.

Preemergence Herbicide and Core Cultivation Study

G. M. Peterson, M. L. Agnew, and N. E. Christians

With the intense amount of traffic that athletic fields receive, there is intense pressure from crabgrass and knotweed invasion. Compacted soils on athletic fields also require core cultivation in the spring. However, weather conditions may not allow cultivation prior to the application of preemergence herbicides. Recent research suggests that core cultivation will not affect crabgrass germination. However, these studies were not aerified with the intensity of that done on athletic fields.

The purpose of this study was to determine the effectiveness of four preemergence herbicides when followed by three levels of cultivation. This study was established in the spring of 1987 on the Newton High School practice football field. This area was chosen for its high percentage of crabgrass and severe soil compaction conditions.

The treatments include four preemergence herbicides and three cultivation treatments. The preemergence herbicides and rates are listed in table 36. The cultivation treatments were applied with a Ryan Lawn Aire IV. Treatments include 0, 2, and 4 passes with the aerator.

Crabgrass populations were determined on July 23, 2987, (Table 36). There were no differences in crabgrass counts between cultivation treatments or herbicide/cultivator interactions. There was, however, a difference in the effectiveness of herbicides. Team 2G at 2 lb ai/A, Dacthal and Prodiamine at 0.5 lb ai/A provided less crabgrass control than other herbicide treatments.

This study will be repeated in 1988.

Table 36. The effect of core cultivation on the effectiveness of preemergence herbicides.

Herbicide	Rate ai/A	Core cultivation	Crabgrass count	Percent crabgrass control
None	----	0	233	0
		2	227	0
		4	227	0
Team 2G	2.0	0	33	85
		2	17	92
		4	51	77
Team 2G	3.0	0	10	96
		2	14	94
		4	15	94
Dacthal 75WP	10.5	0	41	82
		2	36	84
		4	20	91
Prodiamine 65WDG	0.5	0	37	84
		2	28	88
		4	23	90
Prodimaine 65WDG	0.75	0	17	92
		2	6	98
		4	6	98
Pendimethalin 60WDG	1.5	0	13	94
		2	18	92
		4	13	94
Pendimethalin 60WDG	3.0	0	2	99
		2	1	99
		4	3	98
LSD (0.05) (Herbicide)			15	6

Cultivation Intensity Study

M. L. Agnew, N. E. Christians, and R. W. Moore

In the spring of 1986, a cultivation study was initiated on two areas, a one-year-old stand of Midnight Kentucky bluegrass and a four-year-old stand of Premium Sod Blend. The purpose of this study is to investigate the effects of core cultivation and grooving on thatch preventive and thatch removal.

The turfgrass is maintained at a 2-inch mowing height with clippings returned to the soil. The area is fertilized with 4 lb N/1000 ft^2/growing season using sulfur coated urea.

Thatch depth was measured on May 23, 1987. Measurements were taken by pulling a 6-inch diameter core from each plot. The thatch was compressed using a 1 kg weight and the depth was measured in mm. Two 7.5 cm diameter samples of the thatch layer were collected, and dry and ash weights were determined. The organic component was calculated as the percentage of the thatch layer that is organic matter [dry wt - ash wt/ash wt) x 100].

Visual quality and weed counts were made on September 17, 1987. Quality is based on a scale of 1 to 9, with 9 = best quality, 6 = acceptable quality, and 1 = dead turf.

After one full year of treatments, compressed thatch depth was measured on May 23, 1987. For Midnight Kentucky bluegrass, only grooving on May, September, and on May, July, September reduced or prevented an accumulation of thatch (Table 37) while there was no difference in thatch accumulation in Premium Sod Blend (Table 38).

Quality ratings were affected by treatments for both turfgrass areas. It should be noted that the grooving treatment was more severe than what normally would have been used. The intent was to remove thatch, unfortunately, the turfgrass was severely thinned. By the spring of 1988, the turfgrass in the grooved areas had not filled back in completely. Thatch determination will be done in May 1988. Grooving decreased the quality of Midnight Kentucky bluegrass by as much as 50 percent (Table 39) and Premium Sod Blend by as much as 30 percent (Table 40). Multiple groovings decreased quality the most. In addition, grooving caused an increase in weed invasion.

Table 37. Effects of cultivation equipment and timing of application on thatch development of Midnight Kentucky bluegrass.

Cultivation equipment	Dates of application[a]	Thatch depth (mm)	Organic component[b] (percent)	Thatch accumulation[c] (mm)
None	None	23.3	30.2	8.3
Core aeration	M	22.8	28.2	4.4
Core aeration	S	23.7	30.5	5.3
Core aeration	M, S	22.0	35.0	8.7
Core aeration	M, J, S	23.7	36.1	3.7
Grooving	M	22.4	31.7	7.4
Grooving	S	21.4	32.0	3.1
Grooving	M, S	20.1	31.5	0.1
Grooving	M, J, S	18.2	28.4	-0.1
LSD 0.05		2.8	N.S.	5.8

[a] M = May, J = July, S = September.
[b] Organic component is the percentage of the thatch layer that is organic matter. The remaining portion of the thatch layer is made up of soil.
[c] Thatch accumulation is the thatch depth on May 23, 1987, less the original thatch depth.

Table 38. Effects of cultivation equipment and timing of application on thatch development of Premium Sod Blend Kentucky bluegrass.

Cultivation equipment	Dates of application[a]	Thatch depth (mm)	Organic component[b] (percent)	Thatch accumulation[c] (mm)
None	None	23.3	24.7	2.3
Core aeration	M	26.2	26.4	3.8
Core aeration	S	27.7	38.0	-0.7
Core aeration	M, S	30.7	30.5	4.0
Core aeration	M, J, S	22.7	25.7	-0.7
Grooving	M	27.2	24.6	3.8
Grooving	S	26.3	28.8	-3.7
Grooving	M, S	27.8	28.4	1.1
Grooving	M, J, S	26.8	26.0	1.4
LSD 0.05		N.S.	N.S.	N.S.

[a] M = May, J = July, S = September.
[b] Organic component is the percentage of the thatch layer that is organic matter. The remaining portion of the thatch layer is made up of soil.
[c] Thatch accumulation is the thatch depth on May 23, 1987, less the original thatch depth.

Table 39. Effects of cultivation equipment and timing of application on quality and weed invasion of Midnight Kentucky bluegrass. (9/17/87)

Cultivation equipment	Dates of application[a]	Visual quality[b]	Grass Weeds	Broadleaf Weeds
None	None	9.0	0.0	0.0
Core aeration	M[c]	9.0	0.0	0.0
Core aeration	S	9.0	0.0	0.0
Core aeration	M, S	9.0	0.7	0.0
Core aeration	M, J, S	9.0	0.0	0.0
Grooving	M	8.7	8.7	6.0
Grooving	S	5.3	0.0	0.0
Grooving	M, S	5.3	5.7	11.7
Grooving	M, J, S	4.3	9.7	9.3
LSD 0.05		0.9	5.4	9.7

[a] M = May, J = July, S = September.
[b] Visual quality was rated on a scale of 1 to 9, with 9 = best quality, 6.0 as the minimum acceptable level, and 1 = dead turf.
[c] Thatch accumulation is the thatch depth on May 23, 1987, less the original thatch depth.

Table 40. Effects of cultivation equipment and timing of application on quality and weed invasion of Premium Sod Blend Kentucky bluegrass. (9/17/87)

Cultivation equipment	Dates of application[a]	Visual quality[b]	Grass weeds	Broadleaf weeds
None	None	8.0	0.0	0.0
Core aeration	M[c]	8.0	0.0	0.0
Core aeration	S	8.0	0.0	0.0
Core aeration	M, S	7.7	0.0	0.0
Core aeration	M, J, S	8.0	0.0	0.0
Grooving	M	5.3	1.3	9.3
Grooving	S	8.0	0.0	0.0
Grooving	M, S	6.3	1.0	5.7
Grooving	M, J, S	5.7	0.3	3.3
LSD 0.05		1.1	N.S.	5.4

[a] M = May, J = July, S = September.
[b] Visual quality was rated on a scale of 1 to 9, with 9 = best quality, 6.0 as the minimum acceptable level, and 1 = dead turf.
[c] Thatch accumulation is the thatch depth on May 23, 1987, less the original thatch depth.

Summer Stress Survival Study of Kentucky Bluegrass Cultivars

M. G. Burt and N. E. Christians

Kentucky bluegrass (*Poa pratensis* L.) cultivars are known to vary in their response to environmental stresses and cultural practices. Great variability has been observed over many seasons in the USDA Kentucky bluegrass cultivar evaluations at the Iowa State University Horticulture Station. The low-maintenance Kentucky bluegrass cultivar evaluation was established in September 1980. It receives a September application of 1 lb N/1000 ft^2/yr and is nonirrigated. The high-maintenance cultivar evaluation was established in August 1981, and this area receives 4 lb N/1000 ft^2/yr and supplemental irrigation as needed. The most recent Kentucky bluegrass cultivar evaluation was established in August 1985. This area receives 4 lb N/1000 ft^2/yr and is nonirrigated. The first data were collected from this cultivar trial during the 1987 growing season. Data from these three trials are summarized in the annual *Iowa Turfgrass Research Report.*

The past data show the Kentucky bluegrass cultivars that perform well in the low-maintenance cultivar evaluation tend to perform poorly in the high-maintenance cultivar evaluation. Likewise, the Kentucky bluegrass cultivars that perform well in the high-maintenance cultivar evaluation tend to perform poorly in the low-maintenance cultivar trial. Five Kentucky bluegrass cultivars were chosen that have consistently performed well in the low-maintenance trial. These 'low-maintenance' cultivars are K3-162, Kenblue, Vantage, S. D. Common, and S-21. Conversely, five cultivars were chosen that consistently perform poorly in the low-maintenance trial. These 'high-maintenance' cultivars are Bonnieblue, A20, Columbia, Lovegreen, and I-13. These ten cultivars will be used throughout this research, and seed of these cultivars was obtained from the USDA National Turfgrass Evaluation Program.

The objectives of this research are: **1)** to determine if certain root, shoot, and growth characteristics are common to cultivars grouped in the high- or low-maintenance classification. **2)** To simulate drought conditions in the greenhouse and to monitor the cultivars' response to and recovery from this imposed water stress. **3)** To relate information from this and the research of others to Kentucky bluegrass cultivar response to environmental stresses and cultural practices as a means to explain why these cultivars perform as they do.

The Kentucky bluegrass characterization studies will be done using field data, greenhouse studies, and microscope techniques. All field data will be collected from the low-maintenance cultivar trial. The greenhouse experiments use a clear polyethylene tube in PVC pipe system to closely monitor root and shoot growth of individual Kentucky bluegrass cultivar seedlings grown for 10 to 12 weeks in a fritted clay media plus slow release fertilizer. The microscope study will characterize the Kentucky bluegrass cultivars by looking specifically at leaf stomatal distribution and number. The microscope also will be used to study Kentucky bluegrass crown tissue that has been subjected to water stress to try to determine what may be common to crown tissue that survives prolonged drought conditions.

The greenhouse drought simulation study will use a modification of the polyethylene tube in PVC pipe system. The slow drying fritted clay has been replaced by a medium-fine sand, and required plant nutrients are supplied by a plant nutrient solution. Kentucky bluegrass seedlings are grown in the tubes until they are well-tillered and deeply rooted. Water will be withheld for various lengths of time and response to and recovery from this imposed water stress will be monitored and recorded.

No data has been analyzed yet from the greenhouse drought simulation study. However, preliminary experimentation shows fairly even drying and recovery of the Kentucky bluegrass plants grown in these sand columns. Likewise, no data have been generated from the microscope work. The greenhouse characterization study has yielded some interesting results. the low-maintenance cultivars have significantly narrower leaves and more leaf folding, longer sheaths, less leaf angle from vertical, and fewer leaves per tiller. The low-maintenance cultivars had significantly greater weekly clipping weights. The low-maintenance cultivars had a greater percentage of their fresh weight as dry weight. This indicates that the low-maintenance cultivars hold proportionally less water in their tissues. The low-maintenance cultivars had a lower shoot to root ratio. The low-maintenance cultivars had greater total root weights in all three experiments. The high-maintenance cultivars had a significantly greater percentage of their total root weight in the top seven inches of the root profile, whereas the low-maintenance cultivars had a significantly greater percentage of their total root weight in the 7 to 14 inch section of the root profiles. Little rooting occurred in the 14 to 21 inch section of the root profiles, so significant rooting differences were not found. The low-maintenance cultivars also tended to root deeper. Even though the tillering data was quite variable, the low-maintenance cultivars generally produced more tillers.

This preliminary data indicate that certain Kentucky bluegrass cultivars may possess adaptations that enable them to better tolerate low-maintenance culture. Subsequent research may generate more data to further substantiate the variability that exists between cultivars, and this research could help to explain why such variability occurs.

Comparative Effectiveness of Insecticides Against Annual White Grubs - 1987

D. L. Lewis and N. E. Christians

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

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

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

Grub damage was apparent throughout the plot vicinity at the time of insecticide application. The insecticide treatments were applied on August 18, 1987. A second application of Diazinon AG500 and Diazinon 14G (the 'split' treatments) was applied a week later on August 26. Grub population counts were made September 10, 1987.

The experimental design consisted of 13 treatment plots and one untreated check plot, randomly assigned in each of three replications. Each plot consisted of a 5 ft by 5 ft area (25 square feet). All insecticides were applied at the rate specified on the manufacturer's label or product guidelines. Liquid insecticides were applied with a compressed gas, backpack sprayer, connected to a hand-held, three-nozzle boom. The boom covered a 5-foot wide area, and diluted insecticide spray was applied to the test plots with alternating perpendicular passes over the treatment plot. The amount of water applied to each plot was the equivalent of 175 gal/A. Granular insecticides were premeasured into round, cardboard containers and applied uniformly over the plot by shaking through a perforated lid. The insecticides were watered into the turfgrass immediately after the first application with approximately 1/2 inch of irrigation. The 'split' treatment applications were applied during a light rain that continued to fall after the applications.

Annual white grub population counts were made three weeks after treatment by randomly selecting four 6-inch square sample sites within each plot, cutting the sample with a sharp knife, removing the sod, and counting all live white grubs found. The sod was lifted from the cut area, and the root mass carefully cut apart and examined for living grubs. The soil beneath the cut sod was scratched loose to a depth of two inches and similarly examined. The total number of white grubs found in each sample was recorded. Population counts in the samples were converted to number of white grubs per square foot for analysis and reporting. Population counts in the samples were converted to number of white grubs per square foot for analysis and reporting.

The insecticides used in this project, the formulation, rate of application, and mean number of white grubs per square foot are given in table 41. Significant differences among treatments and between treatments and the untreated check were determined by analysis of variance.

In five years of conducting white grub insecticide screening trials, this was our best study. The study site was ideal in that a large, uniform population of white grubs was present over a sufficiently large area. The treatments were applied without difficulty and watering (both natural and irrigation) was timely and plentiful.

The average population density in the untreated check plots was 27 white grubs per square foot. This exceeds population density thresholds sufficient to cause damage in irrigated, healthy turfgrass. The ANOVA analysis reported in table 41 shows the Dursban products did not significantly reduce grub populations. This is in contrast to results of a similar trial conducted at this golf course last year when the Dursban 4E and ME formulations were effective at both 0.5- and 1.0-lb rates. However, poor performance of Dursban for grub control is a common complaint within the turfgrass industry. 'Low' rates of Turcam in both the wettable powder and granular formulations (2.0 and 2.1 lb ai/A, respectively) did not significantly reduce grub populations, but the 'high' rate of the granular product did. Casual observations of poor performance by Turcam have been reported and Turcam was not effective in our 1986 study. It is uncertain what this indicates, other than that further experimentation and pooling of observations is needed.

Several of the treatments did cause significant reductions in white grub numbers in the treatment plots compared to the check plots. Both diazinon formulations (AG500 and 14G) in both the regular and 'split' treatments produced significant grub reduction. The single application, high rate, diazinon plots had fewer grubs, but the control was not significantly better than in the plots receiving two treatments at the lower rate. The top performing compounds in this study were Diazinon AG500, Mocap 5G, and Triumph 4E.

Table 41. Effects of commercially available insecticides on annual white grubs infesting turfgrass, Polk County, Iowa, 1987.

Insecticide / Formulation	Rate lb ai/A	Mean number white grubs per square foot
Control	---	27 A
Dursban 4E	1.0	25 A
Dursban ME	0.5	22 A B
Turcam 2.5G	2.0	18 A B C
Dursban ME	1.0	17 A B C
Turcam 76WP	2.1	17 A B C
Diazinon AG500 'Split'	2.0 (each application)	10 B C D
Turcam 2.5G	4.0	7 C D
Diazinon 14G 'Split'	2.0 (each application)	7 C D
Oftanol 2E	2.0	6 C D
Diazinon 14G	4.0	5 C D
Diazinon AG500	4.0	2 D
Mocap 5G	5.0	2 D
Triumph 4E	2.0	2 D

* Treatment dates
all products - August 18, 1987
second application in 'split' treatments - August 26, 1987

Population count date - September 10, 1987

Evaluation of Fungicides for Control of Brown Patch on Bentgrass - 1987

M. L. Gleason

Trials were conducted on a bentgrass green at Veenker Memorial Golf Course of Iowa State University, Ames, Iowa. Fungicides were applied to bentgrass maintained at a 5/32-inch cutting height, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized block plan with four replications. The plots measured 4 ft by 5 ft. Fungicides were applied in a 7-, 14-, 21-, or 28-day schedule (Table 42). Applications began on June 5 and continued through August 23. Plots were evaluated for percent of diseased turf on August 15, the only time during the summer when brown patch was evident.

Brown patch development on August 15 was slight to moderate on check plots. A few of the treatments had very slight brown patch evident, but none of the chemical treatments was significantly different from any of the others, and all chemical treatments had significantly less brown patch than the checks. All plots treated with PP 523 showed enhanced green color throughout July and August. No other treatments showed any evidence of phytotoxicity.

Table 42. Evaluation of fungicides for control of brown patch in bentgrass.

Treatment	Rate/ 1000 ft^2	Timing (days)	Disease Ratings[a] (August 15)	
Check	----	--	1.25	a
PP523 0.5 SC/surfactant	4 g a.i.	14	0	b
PP523 0.5 SC/surfactant	6 g a.i.	14	0	b
PP523 0.5 SC/surfactant	8 g a.i.	14	0	b
PP523 10% WG/surfactant	4 g a.i.	14	0	b
PP523 10% WG/surfactant	6 g a.i.	14	0	b
PP523 10% WG/surfactant	8 g a.i.	14	0	b
Apache 50WP	1 oz	14	0	b
Apache 50WP	2 oz	14	0	b
Apache 50WP	3 oz	14	0	b
Apache 50WP	3 oz	21	0	b
Apache 50WP/	1 oz/	14	0	b
Vorlan 50WP	1 oz			
Apache 50WP/	2 oz/	14	0	b
Vorlan 50WP	2 oz			
Apache 50WP/	2 oz/	21	0	b
Vorlan 50WP	2 oz			
Fungo 50WP/	1 oz/	14	0	b
Vorlan 50WP	1 oz			
Fungo 50WP	2 oz/	14	0	b
Vorlan 50WP	2 oz			
Fungo 50WP	2 oz	14	0	b
Banner 1.1E	1 oz	14	0.25	b
SN84364 50WP/surfactant	2 oz	21	0	b
SN84364 50WP/surfactant	4 oz	21	0	b
HWG 1608 1.2EC	0.375 oz a.i.	28	0	b
HWG 1608 1.2EC	0.375 oz a.i.	day 1	0	b
	0.125 oz a.i.	day 1 + 14		
	0.125 oz a.i.	day 1 + 44		
Bayleton 1.0%G	0.5 oz a.i.	28	0.25	b
Rizolex 75WP	1.0 g a.i.	14	0.25	b
Rizolex 75WP	1.5 g a.i.	15	0	b
Rizolex 75WP	2.0 g a.i.	14	0	b
Rizolex 75WP	2.5 g a.i.	14	0	b
Rizolex 75WP	3.0 g a.i.	14	0	b
Chipco 26019 50WP	1.0 g a.i.	14	0	b
Chipco 26019 FLO	3 oz	21	0	b
Chipco 26019 FLO	4 oz	21	0	b
Caddy/	1 oz/	7	0	b
3336/	1 oz/			
Spotrete	2.5 oz			
Caddy	1 oz	7	0	b
Spotrete	2.5 oz	7	0	b

[a] Rating represents mean of disease severity ratings. 1 = light; 2 = moderate; 3 = severe.
Means adjacent to the same letter do not differ significantly (DMRT, P=0.05)

Evaluation of Fungicides for Control of Foliar Diseases on Park Bluegrass - 1987

M. L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to Park bluegrass maintained at a 1-1/2-inch 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 block plan with four replications. Plots measured 4 ft by 5 ft. Fungicides were applied on a 14- or 21-day schedule (Table 43). Applications began on June 3 and continued through August 23. Plots were evaluated for percent diseased turf on July 29 and August 27.

This trial was set up, and fungicides were selected, for control of *Bipolaris* leaf spot. However, no leaf spot was detectable all season. Instead, dollar spot was present at low levels. Consequently, development of dollar spot, not leaf spot, was rated.

No plots showed phytotoxicity symptoms. However, dollar spot pressure was so low that conspicuous infection centers did not develop. Although two chemical treatments had significantly lower dollar spot ratings than the check in statistical tests, these differences are probably too small to be definitive.

Table 43. Evaluation of fungicides for control of dollar spot in Park bluegrass, 1987.

Treatment	Rate/1000 ft^2	Timing (days)	Disease Ratings[b] July 17	Disease Ratings[b] August 27
Check	-	-	1.5 a	0.75 a b
Prochloroz 40EC	4.5 oz	14	0.5 a b c	0.75 a b
Prochloroz-MN 50WP	3.75 oz	14	0.75 a b c	0.25 b
FBC 39865 25WP	0.5 oz	14	0.75 a b c	0.75 a b
FBC 39865 25WP	1 oz	14	0.75 a b c	0.75 a b
Banner 1.1E	2 oz	14	0.75 a b c	0.75 a b
Banner 1.1E	3 oz	14	0.75 a b c	0.25 b
Dyrene 4F	4 oz	14	0.75 a b c	1.0 a b
Chipco 26019 FLO	3 oz	21	0.5 a b c	0.5 a b
Chipco 26019 FLO	4 oz	21	0.5 a b c	1.0 a b
Spotless 25U/surfactant	0.4 oz	14	0.25 b c	0.5 a b
Spotless 25U/surfactant	0.4 oz	30	1.0 a b c	0.75 a b
Spotless 25U	0.4 oz	14	0.75 a b c	0.75 a b
Spotless 25U	0.4 oz	30	1.0 a b c	0.75 a b
Caddy/ 3336/ Spotrete	1 oz/ 1 oz/ 2.5 oz	7	0.75 a b c	1.0 a b
Caddy	1 oz	7	1.25 a b	1.25 a
Spotrete	2.5 oz	7	1.0 a b c	1.0 a b
Nustar 20% DF	0.125 oz a.i.	14	0 c	0.5 a b
Nustar 20% DF	0.25 oz a.i.	14	0.5 a b	0.5 a b

[a] Fungicides were selected to test efficacy against another disease, Bipolaris leaf spot. However, leaf spot did not appear in these trials. Instead, infection by dollar spot was evaluated.

[b] Average of ratings from four replicated plots. Based on the following rating scheme: 0 = no disease; 1 = trace only; 2 = slight disease; 3 = moderate disease; 4 = severe disease.

Supplementary Evaluation of Fungicides for Eradication of Dollar Spot on Bentgrass - 1987

M. L. Gleason

Trials were conducted on a bentgrass green at the Veenker Memorial Golf Course adjacent to Iowa State University, Ames, Iowa. Fungicides were applied to bentgrass maintained at a 5/32-inch cutting height, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized block plan with four replications. The plots measured 4 ft by 5 ft. Fungicides were applied in a 7-, 14-, 21-, or 28-day schedule. Applications began on June 5 and continued through August 23.

This trial was designed, and fungicides were selected, to evaluate efficacy in controlling *Brown patch*. Data on control of brown patch during this trial are reported in Table 42. However, a moderate to severe outbreak of dollar spot existed on the site immediately prior to the start of the spray schedule (June 5). Dollar spot development was rated on all plots on June 5 and again on June 25. The number of dollar spot infection centers per plot was counted on both dates. The ability of the treatments to eradicate the dollar spot outbreak was estimated as percent reduction in number of infection centers between the two dates. That is, percent reduction = (number of infection centers on June 5 - number of infection centers on June 25)/number of infection centers on June 5.

Several chemical treatments did not reduce dollar spot significantly more than in check plots (Table 44). These treatments included: SN 84364 50WP at two different rates; HWG 1608 1.2EC at 0.375 oz a.i./1000 ft^2; Fungo 50WP (1 oz/1000 ft^2) plus Vorlan 50WP (1 oz/1000 ft^2), Rizolex 75WP (2 g a.i./1000 ft^2; Apache 50WP, 3 oz rate, at 14- and 21-day spray intervals; Apache 50WP (1 oz) plus Vorlan 50WP (1 oz); and PP523 10% WG at 6 g a.i./1000 ft^2. All other treatments reduced dollar spot as compared to the check plots.

Table 44. Eradication of dollar spot outbreak in bentgrass.[a]

Treatment	Rate/1000 ft^2	Timing (Days)	Percent reduction in disease	
Check	-	-	12.7	d e
PP523 0.5 SC/surfactant	4 g a.i.	14	97.5	a
PP523 0.5 SC/surfactant	6 g a.i.	14	97.8	a
PP523 0.5 SC/surfactant	8 g a.i.	14	93.4	a
PP523 10% WG/surfactant	4 g a.i.	14	93.7	a
PP523 10% WG/surfactant	6 g a.i.	14	67.2	a b c d
PP523 10% WG/surfactant	8 g a.i.	14	89.3	a
Apache 50WP	1 oz	14	87.1	a b
Apache 50WP	2 oz	14	71.9	a b c
Apache 50WP	3 oz	14	65.0	a b c d
Apache 50WP	3 oz	21	67.0	a b c d
Apache 50WP/	1 oz/	14	60.9	a b c d e
Vorlan 50WP	1 oz			
Apache 50WP/	2 oz/	14	90.4	a
Vorlan 50WP	2 oz			
Apache 50WP/	2 oz/	21	87.1	a b
Vorlan 50WP	2 oz			
Fungo 50WP/	1 oz/	14	44.4	a b c d e
Vorlan 50WP	1 oz			
Fungo 50WP/	2 oz/	14	91.5	a
Vorlan 50WP	2 oz			
Fungo 50WP	2 oz	14	95.2	a
Banner 1.1E	1 oz	14	75.2	a b c
SN 84364 50WP/surfactant	2 oz	21	45.6	a b c d e
SN 84364 50WP/surfactant	4 oz	21	7.7	e
HWG 1608 1.2EC	0.375 oz a.i.	28	29.1	b c d e
HWG 1608 1.2EC	0.375 oz a.i.	day 1	98.1	a
	0.125 oz a.i.	day 1+14		
	0.125 oz a.i.	day 1+44		
Bayleton 1.0%G	0.5 oz a.i.	28	71.5	a b c
Rizolex 75WP	1.0 g a.i.	14	83.0	a b
Rizolex 75WP	1.5 g a.i.	14	81.4	a b
Rizolex 75WP	2.0 g a.i.	14	57.0	a b c d e
Rizolex 75WP	2.5 g a.i.	14	90.5	a
Rizolex 75WP	3.0 g a.i.	14	74.4	a b c
Chipco 26019 50WP	1.0 g a.i	14	96.5	a
Chipco 26019 FLO	3 oz	21	99.4	a
Chipco 26019 FLO	4 oz	21	100.0	a
Caddy/	1 oz/	7	97.6	a
3336/	1 oz/			
Spotrete	2.5 oz			
Caddy	1 oz	7	88.1	a
Spotrete	2.5 oz	7	90.8	a

[a] Fungicides in this trial were selected to test efficacy in controlling brown patch rather than dollar spot. However, an outbreak of dollar spot before the spray program began provided an opportunity to evaluate the ability of these fungicides to eradicate dollar spot. Data on control of brown patch are reported in able 42.

Evaluation of Fungicides for Control of Fairy Ring on Bluegrass - 1987

M. L. Gleason

Trials were conducted on a fairy ring, approximately 40 feet in diameter, located in a bluegrass rough at the Veenker Memorial Golf Course adjacent to Iowa State University, Ames, Iowa. The species of fungus causing the fairy ring was not identified. The ring was subdivided into plots measuring 5 ft by 5 ft. The experimental design was a randomized block plan with three replications.

Before fungicides were applied, all plots were thoroughly pierced with pitchforks to a depth of at least 6 inches. Fungicides were applied on June 30, as drenches with recommended amounts of water, from watering cans. The check plots received comparable amounts of water. On June 30 and again on September 22, the radius of the ring was measured as the distance between a point at the center of the ring and the outer perimeter of the ring. Three radial measurements were made within each plot. Growth of the ring within each plot was calculated as the change in the mean radius between June 30 and September 22.

None of the chemical treatments were effective in reducing growth of the ring significantly in comparison to untreated plots (Table 45). In fact, all treatments showed somewhat greater ring expansion than the check, although this difference was not statistically significant.

Table 45. Evaluation of fungicides for control of fairy ring on bluegrass.

Treatment	Rate	Growth of ring (inch)[a]
Check	---------------	12.7 a
Apache 50WP	16 oz/50 gal water/100ft^2	16.3 a
SN 84364 50WP/surfactant[c]	6 oz/1000ft^2	22.0 a
SN 84364 50WP/surfactant[c]	10 oz/1000^2	17.8 a

[a] Numbers are mean change in radius of ring between June 30 and September 22. Means adjacecent to the same letter do not differ significantly (DMRT, P=0.05).

[b] Check plots received 24 gallons of water/100 ft^2 on June 30.

[c] SN 84364 treatments were diluted with 24 gallons of water/100ft^2 when applied on June 30.

Evaluation of Fungicides for Control of Dollar Spot in Emerald Bentgrass - 1987

M. L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to Emerald bentgrass, maintained at a 5/32-inch 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 block design with four replications. The plots measured 4 ft by 5 ft. Fungicides were applied in a 14-, 21-, or 28-day schedule (Table 46). Applications began on June 5 and continued through August 23. Plots were evaluated for percent diseased turf on July 17 and August 27.

Disease ratings for dollar spot were made by counting the number of dollar spot infection centers per plot. Disease development was very slight throughout the season, even in the check plots, although it gradually increased as the season advanced (Table 46). Most treatments had no disease throughout the season. On August 27, plots treated with Chipco 26019 FLO at 3 oz/1000 ft^2 had significantly more dollar spots than all other plots, including the checks. The same chemical at the 4 oz rate gave significantly more infection centers than all plots except the check. There were no symptoms of phytotoxicity with any of the materials tested.

Table 46. Evaluation of fungicides for control of dollar spot in Emerald bentgrass, 1987.

Treatment	Rate/ 1000 ft^2	Timing (days)	Disease Ratings[b] July 17		Disease Ratings[b] August 27	
Check	--	--	2.00	a	2.00	b c
Banner 1.1E	1 oz	21	0.25	a	0	c
Banner 1.1E	2 oz	21	0.50	a	0	c
Prochloraz 40EC	4.5 oz	21	1.25	a	0	c
Prochloraz-MN 50WP	3.75 oz	21	0.50	a	0	c
Prochloraz-MN 50WP	4.5 oz	21	0.50	a	0.25	c
Prochloraz 40EC/ SN596 25DF	1.5 oz/ 0.5 oz	21	1.75	a	0	c
SN596 25DF	0.5 oz	21	2.25	a	0	c
FBC 39865 25WP	1.0 oz	21	0	a	0	c
FBC 39865 25WP	0.5 oz	21	0	a	0	c
HWG 1608 1.2EC	0.125 oz a.i.	28	0	a	0	c
HWG 1608 1.2EC	0.25 oz a.i.	28	0	a	0	c
Bayleton 1%G	0.25 oz a.i.	28	0	a	0	
Chipco 26019 FLO	3 oz	21	0	a	7.25	a
Chipco 26019 FLO	4 oz	21	0.25	a	5.25	a b
Spotless 25U/surfactant	0.4 oz	14	0	a	0	c
Spotless 25U/surfactant	0.4 oz	28	0	a	0.25	c
Caddy/ 3336/ Spotrete	1 oz/ 1 oz/ 2.5 oz	7	0	a	0	c
Caddy	1 oz	7	0	a	0	c
Spotrete	2.5 oz	7	2.25	a	0	c

[a] Average of ratings from four replicated plots. Based on number of dollar spot infection centers per plot.
Means in a column followed by the same letter do not differ significantly.

Effect of Endophyte Infection of Perennial Ryegrass on Growth Under Drought Stress

M. L. Gleason, N. C. Christians, and M. L. Agnew

Cultivars of perennial ryegrass (*Lolium perenne*) with a high level of infection by an endophytic fungus (*Acremonium loliae*) have been promoted by seed companies as being resistant to insect feeding and to "environmental stress." However, there is little experimental evidence to support the claim that high-endophyte cultivars perform better under "environmental stress" than low-endophyte cultivars. A project was initiated at Iowa State University in 1986 to evaluate the role of endophyte infection in tolerance to drought stress. A grant from the Iowa Turfgrass Institute supported this research.

Populations of endophyte-infected and endophyte-free perennial ryegrass plants for this study were derived from the same clones in order to minimize genetic variability among plants. To obtain endophyte-infected and endophyte-free plants, tillers derived from the same mother plants were potted separately. Half of the tillers were treated with a benomyl drench for eight weeks in order to eliminate the endophyte, while the other half of the tillers received no benomyl. This method produced same-clonal plants with or without endophyte.

Plants originally derived from four mother plants were then potted in sandy loam soil amended with 5 g/l of Osmocote 14-14-14. The experiment was conducted in a greenhouse during fall 1986, using the cultivar Repell, and repeated in spring 1987, using Manhattan IIe. Clones were derived from four mother plants for each experiment. Watering treatments corresponded to wet (-0.4 to -0.6 bars), moist (-2.1 to -2.6 bars), or dry (approximately -16 to -20 bars). Each pot was weighed daily, and watered to saturation when it had dried to a weight corresponding to the bar value of the relevant treatment.

After 7-1/2 weeks, plants were washed free of soil, and number of tillers and dry weight of roots, stems, and live and dead blades was measured for all plants.

Results are presented in Table 47. In Experiment 1, growth of endophyte-free and endophyte-infected plants was not significantly different at any of the soil moisture treatments. In Experiment 2, however, dry weights of endophyte-free plants were significantly higher than for endophyte-infected plants for all moisture treatments. This result suggests that, under the conditions tested, endophyte infection hindered rather than increased growth of Manhattan IIe over a wide range of soil moisture availability. The experiment will be repeated a third time, using the cultivar Manhattan IIe, during summer 1988.

Table 47. Growth of endophyte-infected and endophyte-free perenial ryegrass at three levels of soil moisture availability.

EXPERIMENT 1[a]

Soil water potential (-bars)		number of tillers[b]	MEAN DRY WEIGHTS (g) PER PLANT[b] stems	roots	live leaves	dead leaves	total live aboveground biomass	total live biomass
0.4	free[c]	30.2	0.64	0.92	1.00	0.20	1.64	2.56
	infect[d]	30.2	0.62	0.88	1.03	0.15	1.65	2.53
2.6	free	29.4	0.60	0.70	0.95	0.18	1.54	2.25
	infect	25.5	0.54	0.71	0.91	0.15	1.45	2.16
20[e]	free	25.6	0.50	0.60	0.93	0.11	1.43	2.03
	infect	27.3	0.52	0.68	0.90	0.14	1.42	2.10
LSD (0.05)		3.9	0.08	0.13	0.14	0.04	0.20	0.28

EXPERIMENT 2[f]

Soil water potential (-bars)		number of tillers	stems	roots	live leaves	dead leaves	total live aboveground biomass	total live biomass
0.6	free	98.2	2.90	1.84	4.04	NS[g]	6.95	8.79
	infect	88.2	2.27	1.26	3.04	NS	5.31	6.57
2.1	free	90.7	2.76	1.72	3.91	NS	6.67	8.39
	infect	91.9	1.97	1.05	2.80	NS	4.77	5.82
16[e]	free	79.3	1.88	0.98	3.23	NS	5.11	6.09
	infect	79.1	1.37	0.76	2.34	NS	3.71	4.47
LSD (0.05)		7.6	0.27	0.23	0.29	--	0.53	0.65

[a] Plants grown from single tillers in four-inch pots
[b] n = 6
[c] Endophyte-free plants
[d] Endophyte-infected plants
[e] Estimated values
[f] Plants grown from single tillers in six-inch pots
[g] No sample

Introducing
Iowa State University Personnel
Affiliated with the Turfgrass Research Program

Dr. Michael Agnew	Assistant Professor, Extension Turfgrass Specialist. Horticulture Department.
Ms. Mary Boyle	Undergraduate Research Assistant. Horticulture Department (Christians).
Mr. Michael Burt	Turfgrass Graduate Student and Research Associate. Horticulture Department M.S. (Christians).
Dr. Nick Christians	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
Dr. Ken Diesburg	Turfgrass Graduate Student and Research Associate. Horticulture Department Ph.D. (Christians). (Graduated December 1987)
Dr. Mark Gleason	Assistant Professor, Extension Plant Pathologist. Plant Pathology Department.
Ms. Harlene Hatterman-Valenti	Extension Associate. Weed Science Department.
Dr. Clinton Hodges	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
Dr. Young Joo	Turfgrass Graduate Student and Research Associate. Horticulture Department Ph.D. (Christians). (Graduated August 1987 and worked on Postdoctoral Research until February 1988).
Dr. Donald Lewis	Associate Professor, Extension Entomologist. Entomology Department.
Mr. Richard Moore	Turfgrass Graduate Student and Research Associate. Horticulture Department M.S. (Christians/Agnew).
Mr. Gary Petersen	Jasper County Extension Director and Turfgrass Graduate Student.Horticulture Department M.S. (Agnew/Christians).
Mr. Zachary Reicher	Turfgrass Graduate Student and Research Associate. Horticulture Department M.S. (Christians). (Graduated May 1988).
Mr. Grant Spear	Turfgrass Graduate Student and Research Associate. Horticulture M.S. +Christians).

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

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*In the rush to prepare 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 so your company name can be added in future reports.

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