1986 Iowa Turfgrass Research Report

Cooperative Extension Service
Iowa State University
Ames, Iowa 50011

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Introduction

The following research report is the sixth 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, and 1985 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 seventh season. The area has been expanded every year and by 1983 there were 4.2 acres of irrigated and approximately 3.0 acres of non-irrigated research area. Funding was obtained in 1983 to add 2.7 acres of irrigated research plots to the exiting site. This construction was completed in the spring of 1985. Several new studies were initiated on this area in the 1985 and 1986 seasons and a map showing the location of these studies can be found in this report.

The expansion which 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 newly formed Iowa Turfgrass Producers and Contractors (ITPAC) organization.

We would also like to acknowledge Kenneth Diesburg, Young Joo, Michael Gaul, Zachary Reicher, Jim Walser, Rob Demuth, Dan Weidemeir, Pat Gradoville, Mike Null, Richard Moore, Paul Johnson, and all the others who have been employed at the field research area in the past year for their efforts in building the program.

Edited by Nick Christians, associate professor, turfgrass science; Michael Agnew, assistant professor, turfgrass extension; and Gene Hettel, extension communications specialist.

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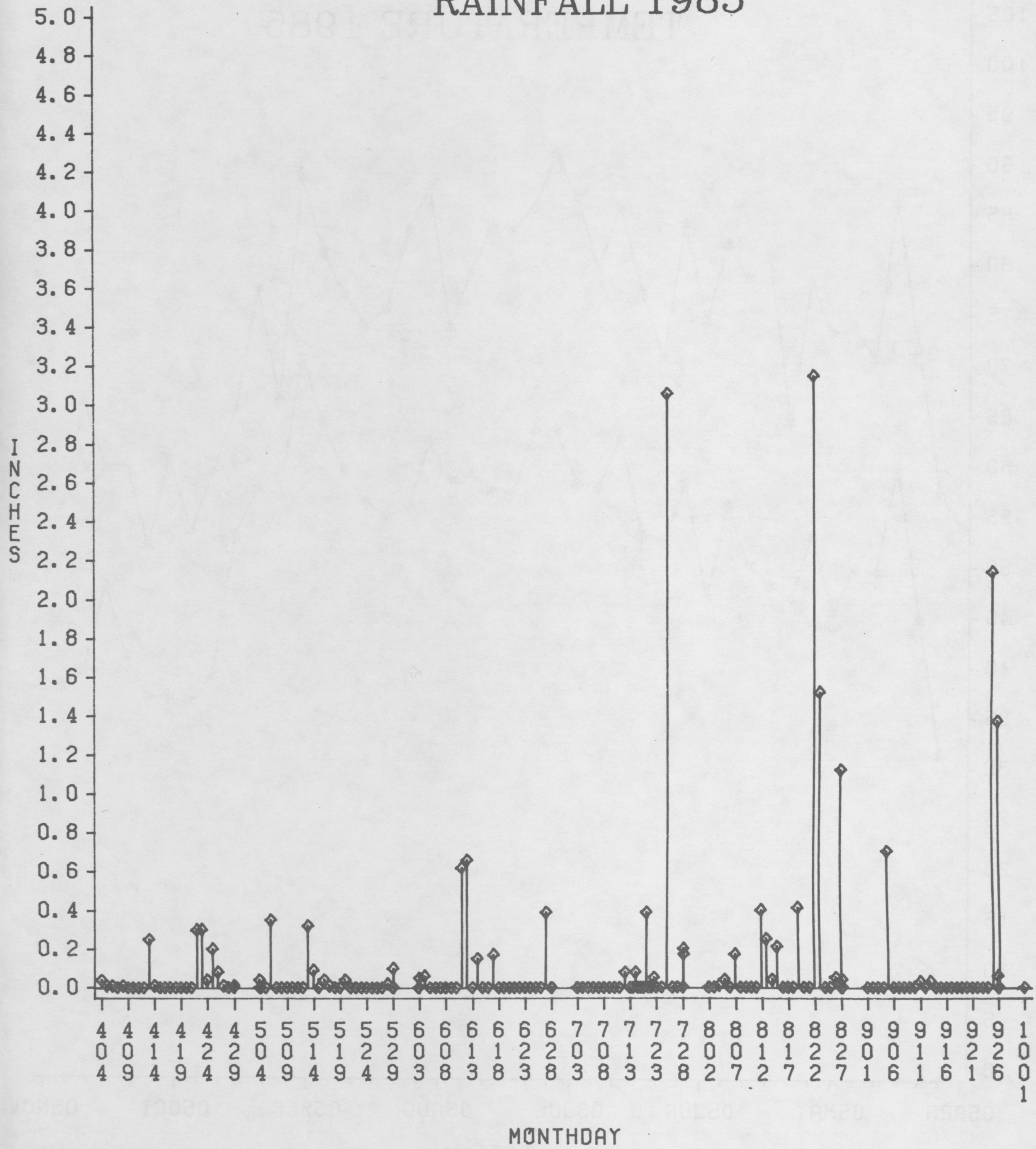
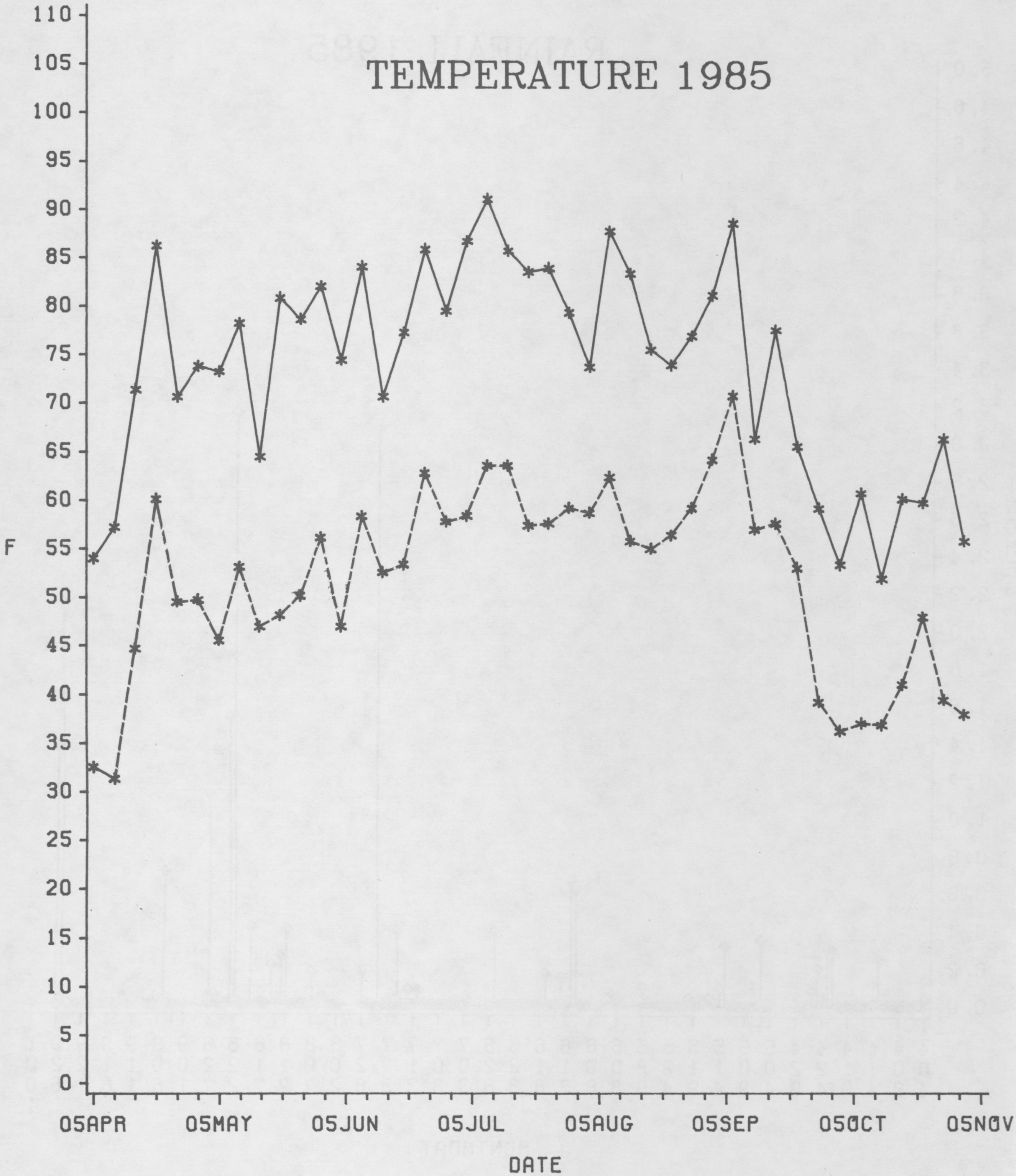
RAINFALL 1985



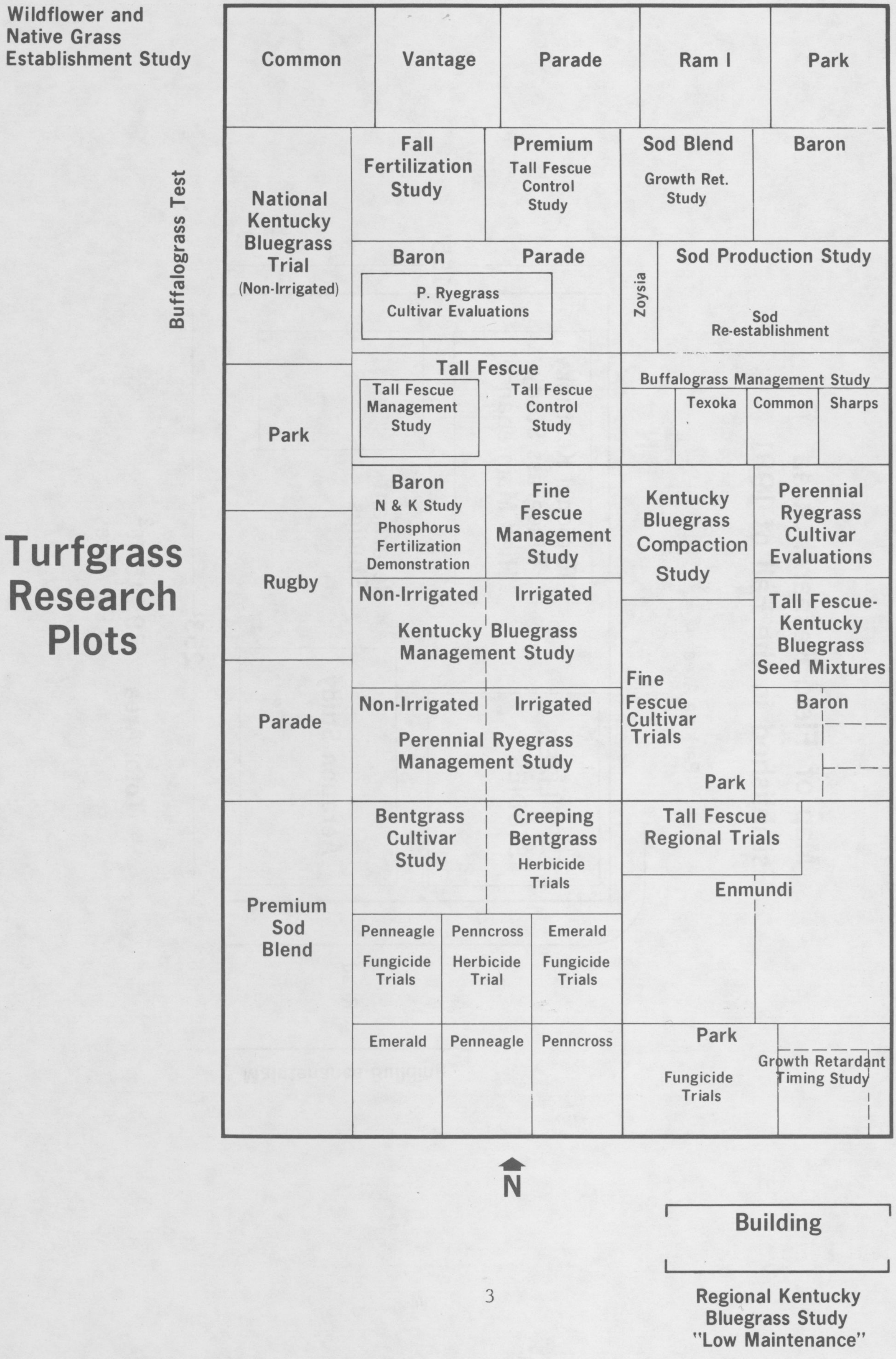
AMES



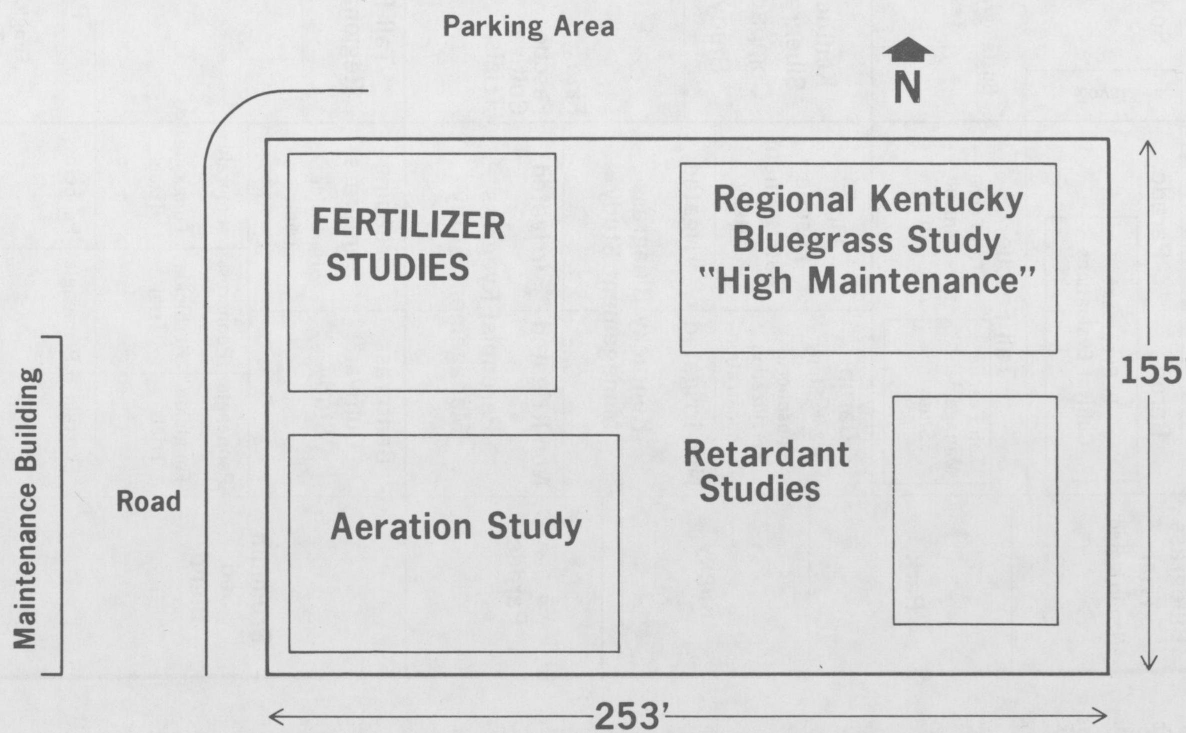
MAXIMUM EQUALS STAR SYMBOL
MINIMUM EQUALS DASHED LINE

AMES-5 DAY AVERAGES

Turfgrass Research Plots

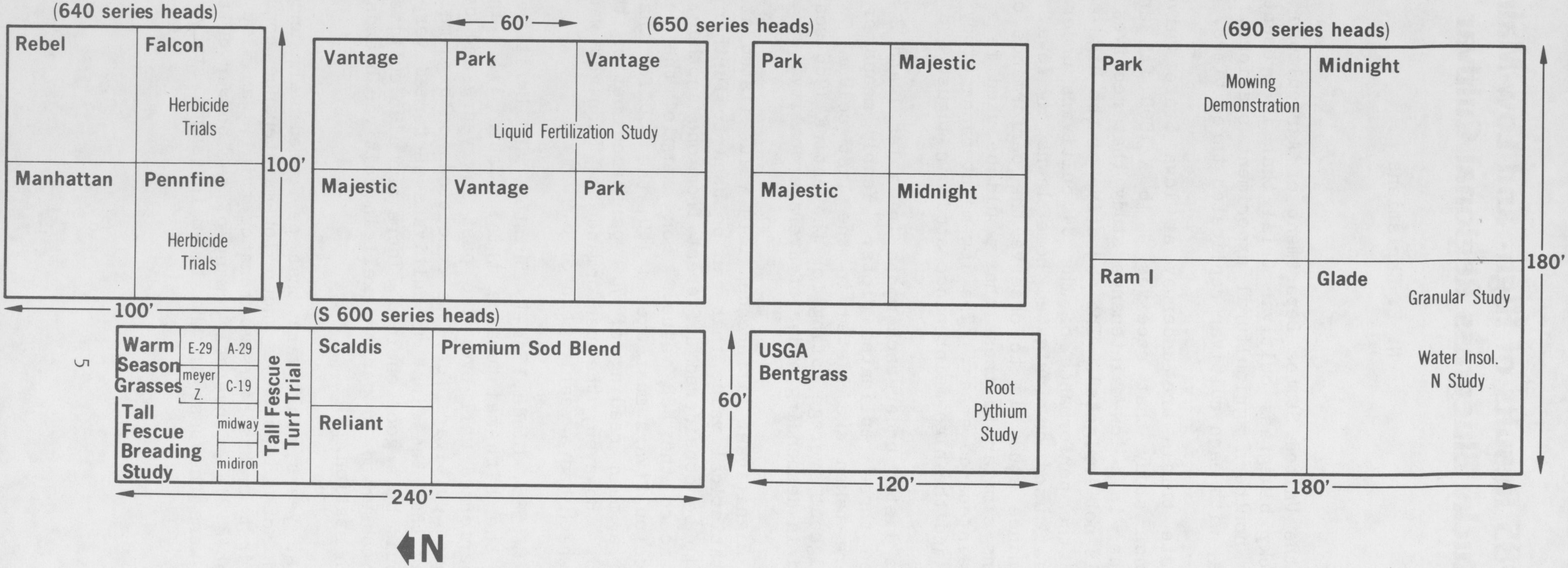


Map of Field Research Area Established in the Fall of 1981



Total Area 39,215 ft^2
0.90 Acres

1984 Expansion of the Turfgrass Research Area



Total Area = 2.7 acres

The 1985 Results of High- and Low-Maintenance Kentucky Bluegrass Regional Cultivar Trials

N. E. Christians

In 1980, the United States Department of Agriculture (USDA) initiated a regional Kentucky bluegrass cultivar trial that is presently being conducted at most of the northern agricultural experiment stations. The test consists of 84 cultivars, with each cultivar replicated three times.

Two separate trials are underway at Iowa State University. One is a high-maintenance study that receives 4 lb N/1000 ft^2 and is irrigated as needed; the other is a low-maintenance study that receives 1 lb N/1000 ft^2 in September and 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 low-maintenance study was established in September 1980 and the high-maintenance study in August 1981.

The values listed under each month in Tables 1 and 2 are the averages of ratings made on three replicated plots. Yearly means of all the months in which data were taken are listed in the last column. The first cultivar received the highest average rating for the entire 1985 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 1.0, the LSD for that column (Table 1). Midnight with a mean reading of 7.9 performed better than Enmundi with a reading of 6.8. However, the performance of Midnight was statistically the same as Merit which had a yearly mean of 6.9.

Midnight, N 535, Glade, Ram-I, Bristol, and Merit were the best of the cultivars in the high-maintenance trial (Table 1). These cultivars 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. It should be noted that the first 43 cultivars performed very satisfactorily and any of them would be a good choice. There are also cultivars in the lower 50% that have been observed to perform well in cultivar blends in other locations at the research station.

As in past years, cultivars that performed well under high-maintenance conditions did not do as well under low-maintenance conditions. Midnight, which ranked first in the high-maintenance trial, was 51st in the low-maintenance trial (Table 2). Conversely, many of the poorer cultivars in high-maintenance areas were the best in the low-maintenance study. Cultivars K3-162, S.D. Common, S-21, and Vantage, which performed best in the low-maintenance trial, ranked 82, 78, 83, and 79, respectively, in the high-maintenance trial.

Surprisingly, Ram I which has done very well under both high- and low-maintenance conditions, fell to 53rd place in the low-maintenance trial, in 1985. Ram I will be evaluated further in the spring of 1986 to determine if there was some unusual disease or insect damage on this cultivar last year.

Table 1. The 1985 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	8.0	8.0	7.3	9.0	6.7	8.3	7.9
2.	N 535	7.3	7.0	7.3	8.0	7.3	9.0	7.7
3.	Glade	7.3	8.0	6.7	7.7	6.0	8.0	7.3
4.	Ram-I	6.3	8.0	6.0	8.3	7.7	7.7	7.3
5.	Majestic	6.7	7.3	7.3	7.3	7.0	7.7	7.2
6.	Bristol	6.7	6.3	6.7	7.7	7.3	7.7	7.1
7.	Merit	6.0	7.7	6.7	6.7	7.0	7.7	6.9
8.	243	6.7	5.7	5.7	7.0	7.7	8.0	6.8
9.	Enmundi	6.3	6.7	6.3	8.0	6.3	7.0	6.8
10.	MLM-18011	7.0	6.0	6.0	7.3	7.7	7.0	6.8
11.	CEB VB 3965	7.0	6.0	5.7	7.0	7.7	7.3	6.8
12.	WW Ag 478	6.3	5.7	6.3	6.7	7.7	8.0	6.8
13.	Vanessa	6.3	6.3	6.0	7.3	7.0	7.3	6.7
14.	Mosa	6.3	6.7	6.3	7.0	7.3	6.7	6.7
15.	Bonnieblue	6.0	6.7	6.7	6.3	7.0	7.3	6.7
16.	Charlotte	4.7	7.0	6.7	7.3	6.7	7.7	6.7
17.	Eclipse	6.0	6.0	5.7	7.3	6.7	7.7	6.6
18.	Kimono	5.3	6.7	6.7	6.3	6.3	7.7	6.5
19.	SV-01617	5.3	7.0	6.0	6.3	6.3	8.0	6.5
20.	Eclipse	5.7	6.3	6.3	7.7	6.7	5.7	6.4
21.	Barblue	6.0	5.7	5.3	7.3	6.7	7.3	6.4
22.	PSU-150	5.3	6.7	6.3	6.0	7.3	6.0	6.3
23.	Aspen	5.3	5.3	5.7	7.3	7.3	7.0	6.3
24.	Mer pp 300	6.3	6.3	5.3	6.3	6.7	7.0	6.3
25.	K3-178	6.0	4.7	6.0	6.7	6.7	7.7	6.3
26.	Birka	5.7	7.3	6.7	6.0	5.7	6.0	6.2
27.	Fylking	4.7	7.3	6.3	6.3	5.7	6.7	6.2
28.	ISU-190	4.7	7.3	6.3	6.3	5.7	6.7	6.2
29.	Trenton	6.7	4.3	5.0	7.0	6.7	7.3	6.2
30.	Columbia	6.3	4.0	5.0	7.3	7.3	7.0	6.2
31.	Victa	6.7	5.7	5.7	6.7	6.0	6.7	6.2
32.	BA-61-91	6.3	5.7	6.3	6.0	6.0	7.0	6.2
33.	Cheri	5.7	6.3	5.3	5.7	6.7	6.7	6.1
34.	Nugget	6.0	6.0	5.7	6.3	6.3	6.3	6.1
35.	Baron	5.7	6.3	7.0	5.3	5.3	7.0	6.1
36.	Dormie	5.3	4.3	6.3	6.7	7.3	6.7	6.1
37.	Shasta	5.7	4.7	5.3	7.3	6.0	7.3	6.1
38.	Enoble	6.0	5.0	5.3	7.0	6.0	7.3	6.1
39.	Admiral	6.0	5.3	5.3	6.0	6.7	7.3	6.1
40.	PSU-173	5.0	6.0	6.0	6.3	7.0	5.7	6.0
41.	Holiday	5.3	5.0	5.0	7.0	7.7	6.0	6.0
42.	Sydsport	5.7	5.7	5.7	6.0	6.7	6.3	6.0
43.	Bayside	6.3	5.0	5.3	6.7	6.3	6.3	6.0
44.	239	5.3	4.0	5.3	7.0	6.7	7.0	5.9
45.	Touchdown	4.7	5.3	6.3	6.3	6.0	6.7	5.9

Table 1. The 1985 quality ratings for the high-maintenance regional Kentucky bluegrass test established in the fall 1981. (continued)

	Cultivar	May	June	July	Aug.	Sept.	Oct.	Mean
46.	Welcome	4.7	6.0	5.3	6.0	6.0	7.3	5.9
47.	K3-179	5.7	6.0	5.3	6.3	7.3	5.0	5.9
48.	Parade	5.3	4.7	5.0	7.0	6.0	7.0	5.8
49.	Rugby	5.7	4.0	4.3	6.7	7.3	7.0	5.8
50.	Geronimo	4.7	6.0	6.3	5.7	6.0	6.0	5.8
51.	WW Ag PS 463	5.7	4.3	5.0	6.3	6.0	7.3	5.8
52.	Bono	5.0	5.3	6.3	5.7	5.3	7.3	5.8
53.	A20-6	6.3	4.3	4.0	6.7	7.7	6.0	5.8
54.	Apart	5.7	5.3	6.0	5.3	6.3	6.3	5.8
55.	Mystic	4.7	6.0	5.3	6.0	6.3	6.7	5.8
56.	Adelphi	6.0	5.0	4.7	7.0	6.7	5.0	5.7
57.	Banff	5.7	4.0	4.7	6.7	7.0	6.3	5.7
58.	A 20	6.3	4.3	4.0	6.3	7.3	6.0	5.7
59.	A 20-6A	6.3	4.0	4.0	6.7	7.0	6.3	5.7
60.	Mona	6.0	4.0	5.0	6.7	5.7	6.7	5.7
61.	225	6.0	4.3	5.0	5.3	6.7	7.0	5.7
62.	K1-152	5.3	4.7	4.3	6.0	6.3	7.3	5.7
63.	Harmony	5.7	5.0	5.0	6.0	5.0	6.7	5.6
64.	Mer pp 43	5.3	5.7	5.3	6.3	5.0	6.0	5.6
65.	NJ 735	4.3	6.0	5.7	5.7	6.0	6.0	5.6
66.	WW Ag 480	5.0	4.7	4.7	6.3	5.7	6.7	5.5
67.	I-13	5.3	4.0	4.0	7.0	7.3	5.3	5.5
68.	America	5.0	4.3	3.7	6.3	7.3	6.0	5.4
69.	Cello	5.7	3.7	4.3	6.3	6.3	6.3	5.4
70.	A-34	4.7	4.3	4.7	6.0	6.7	6.0	5.4
71.	Merion	5.3	5.3	4.3	6.0	6.0	5.7	5.4
72.	Argyle	4.3	4.7	5.0	6.0	6.3	5.3	5.3
73.	Plush	5.3	4.3	4.3	5.7	6.3	5.3	5.2
74.	H-7	5.3	4.0	4.0	5.7	6.3	6.0	5.2
75.	SH-2	4.3	4.0	4.7	6.3	6.0	6.0	5.2
76.	Kenblue	3.3	3.0	5.7	6.3	7.0	5.3	5.1
77.	Piedmont	3.7	4.3	5.3	6.0	5.3	6.0	5.1
78.	S. D. Common	3.7	5.0	5.3	6.0	5.7	4.7	5.1
79.	Vantage	4.0	5.3	4.7	5.3	5.7	5.0	5.0
80.	Monopoly	4.7	4.7	4.7	5.7	4.7	5.0	4.9
81.	Wabash	3.7	4.3	4.0	5.7	6.0	6.0	4.9
82.	K3-162	3.3	3.7	5.0	6.3	5.3	5.3	4.8
83.	S-21	3.3	4.3	5.0	5.3	5.3	5.0	4.7
84.	Lovegreen	4.0	4.3	4.0	4.7	4.0	5.0	4.3
	LSD 0.05	1.3	1.5	1.4	1.3	1.4	1.5	1.0

Quality ratings are based on a scale of 9-1; 9 = best quality, 6 = acceptable quality, 1 = poorest quality.

Table 2. The 1985 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	6.7	5.3	6.7	7.3	6.0	6.3
2.	S. D. Common	6.7	6.0	5.0	6.0	7.0	5.3	6.0
3.	S-21	6.3	6.3	4.3	5.7	6.0	5.7	5.7
4.	Vantage	6.0	7.0	4.0	5.7	6.3	5.0	5.7
5.	Argyle	5.0	6.3	4.3	5.3	6.7	5.7	5.6
6.	Parade	5.0	5.0	3.7	6.0	7.3	5.3	5.4
7.	Ken blue	5.0	6.0	5.0	4.7	6.3	5.0	5.3
8.	Bono	5.3	4.7	4.0	5.3	6.0	5.7	5.2
9.	Plush	5.0	5.0	3.3	5.7	6.3	5.0	5.1
10.	PSU-17	5.0	5.0	3.7	5.0	6.0	5.3	5.0
11.	Piedmont	5.0	5.0	4.3	4.7	6.3	4.7	5.0
12.	Fylking	5.7	4.7	3.0	4.7	5.7	5.7	4.9
13.	Wabash	5.3	3.3	3.7	5.7	6.7	4.7	4.9
14.	PSU-190	5.7	5.3	3.7	4.7	5.7	4.7	4.9
15.	Dormie	4.3	4.3	4.0	5.0	6.3	5.7	4.9
16.	Vanessa	6.0	4.3	4.0	4.7	5.3	5.0	4.9
17.	Escort	4.0	4.0	3.7	5.0	6.7	6.0	4.9
18.	Monopoly	4.7	5.3	3.7	4.7	5.3	5.0	4.8
19.	Harmony	4.3	4.0	3.7	5.0	6.3	5.7	4.8
20.	A-34	4.8	4.3	3.5	4.8	6.5	5.3	4.8
21.	Bayside	4.0	3.7	3.3	6.0	6.0	6.0	4.8
22.	Cheri	4.7	4.0	4.0	4.7	6.0	4.7	4.7
23.	Kimono	5.0	4.3	3.3	4.7	6.0	5.0	4.7
24.	Geronimo	5.0	4.3	3.7	5.0	6.0	4.3	4.7
25.	N 535	3.7	4.0	3.7	4.3	6.3	6.0	4.7
26.	PSU-150	4.0	4.0	3.3	5.0	6.3	4.7	4.6
27.	Mer pp 43	4.0	3.7	4.0	4.7	5.3	5.7	4.6
28.	Birka	3.0	4.0	3.7	5.0	6.0	5.3	4.5
29.	Cello	4.7	4.0	3.3	4.7	5.3	5.0	4.5
30.	Victa	6.0	4.3	3.7	3.7	4.7	4.7	4.5
31.	Glade	3.0	3.3	3.0	5.0	6.0	6.0	4.4
32.	Baron	4.7	4.3	3.7	4.0	5.0	4.7	4.4
33.	Trenton	3.7	3.7	3.3	4.3	6.3	5.0	4.4
34.	Holiday	3.3	3.0	3.0	5.0	6.7	5.7	4.4
35.	Majestic	4.3	3.0	3.3	5.0	5.7	5.3	4.4
36.	Shasta	3.7	3.7	3.3	4.7	6.0	5.3	4.4
37.	NJ 735	5.3	4.3	4.0	3.3	5.3	4.3	4.4
38.	Eclipse	4.3	4.7	3.7	4.3	5.3	4.3	4.4
39.	K3-178	4.7	4.0	3.7	4.0	5.3	5.0	4.4
40.	MLM-18011	4.3	3.7	3.3	4.0	5.3	5.3	4.3
41.	WW Ag 463	5.7	4.3	3.3	3.0	4.7	4.7	4.3
42.	H-7	4.7	4.0	4.3	4.0	4.7	4.3	4.3
43.	Enable	4.0	4.7	3.7	4.0	5.0	4.3	4.3
44.	SH-2	3.7	4.3	3.0	4.7	5.7	4.7	4.3
45.	Merion	4.3	3.7	4.0	4.0	5.7	4.0	4.3

Table 2. The 1985 quality ratings for the low-maintenance regional Kentucky bluegrass test established in the fall 1980. (continued)

	Cultivar	May	June	July	Aug.	Sept.	Oct.	Mean
46.	Nugget	4.0	3.0	3.3	4.0	5.3	5.3	4.2
47.	239	4.3	3.3	4.0	4.0	4.7	5.0	4.2
48.	Enmundi	3.0	4.0	3.7	4.0	6.0	4.3	4.2
49.	Touchdown	5.7	3.7	3.3	3.3	5.0	4.3	4.2
50.	Mosa	4.3	4.0	3.7	4.0	5.3	4.0	4.2
51.	Midnight	4.3	3.7	3.0	4.3	5.0	5.0	4.2
52.	Mer pp 300	4.0	3.7	3.7	4.0	5.3	4.7	4.2
53.	Ram-I	5.3	5.0	3.7	2.7	4.0	4.0	4.1
54.	243	3.7	3.3	3.7	4.3	5.0	4.7	4.1
55.	A20-6	3.7	3.7	3.3	3.7	5.3	5.0	4.1
56.	225	4.0	4.0	3.0	3.7	5.3	4.3	4.1
57.	Admiral	4.3	3.7	3.3	4.0	5.0	4.3	4.1
58.	K3-179	3.7	4.3	3.3	3.7	5.0	4.3	4.1
59.	Barblue	4.0	3.7	3.3	4.0	4.7	5.0	4.1
60.	America	2.7	3.7	3.3	4.0	5.3	5.0	4.0
61.	A20-6A	4.0	3.0	3.3	4.0	5.0	4.7	4.0
62.	Adelphi	3.3	2.7	3.0	4.0	6.0	4.3	3.9
63.	Aspen	4.0	3.7	3.0	3.7	4.7	4.7	3.9
64.	WW Ag 480	5.0	3.7	3.7	3.0	4.0	4.0	3.9
65.	Merit	4.0	3.3	3.3	3.7	5.0	4.3	3.9
66.	I-13	4.0	3.3	3.0	4.0	5.0	4.3	3.9
67.	K1-152	3.3	3.7	3.3	4.0	5.3	4.0	3.9
68.	Rugby	3.0	3.0	3.0	3.7	5.7	4.3	3.8
69.	Banff	4.7	4.0	3.7	2.7	4.0	3.7	3.8
70.	CEB VB 3965	4.3	3.3	3.3	3.3	4.3	4.3	3.8
71.	Apart	4.0	3.3	2.7	4.0	4.3	4.3	3.8
72.	Sydsport	5.0	4.3	3.3	2.7	4.3	3.0	3.8
73.	Bristol	4.5	4.0	3.0	3.0	4.0	4.0	3.8
74.	BA-61-91	3.3	3.3	3.0	3.7	5.0	4.7	3.8
75.	Mystic	4.0	3.0	3.3	3.7	5.0	4.0	3.8
76.	Mona	4.0	3.7	3.7	2.7	4.3	4.0	3.7
77.	Lovegreen	4.0	3.7	3.7	3.0	4.3	3.3	3.7
78.	Bonnieblue	3.7	2.7	3.3	3.7	4.7	3.3	3.6
79.	Charlotte	3.7	4.0	3.0	3.3	4.3	3.3	3.6
80.	A20	3.0	3.0	3.0	4.3	4.7	3.7	3.6
81.	Columbia	3.3	3.3	3.3	3.0	4.7	4.0	3.6
82.	SV-01617	2.7	3.0	3.0	3.3	4.7	3.7	3.4
83.	Welcome	3.7	3.7	2.7	3.0	3.7	4.0	3.4
84.	WW Ag 478	3.0	3.0	2.7	3.3	4.3	4.3	3.4
	LSD 0.05	1.8	1.4	1.1	1.6	1.7	1.8	1.1

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

Regional Perennial Ryegrass Cultivar Evaluation

K. L. Diesburg and N. E. Christians

This is the third year of data from the trial established in fall 1982 in conjunction with several identical trials across the country coordinated by the USDA. The purpose 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 4 lb N/1000 ft^2 through the growing season and is irrigated when needed to prevent drought. Preemergence herbicide is applied once in the spring and broadleaf herbicide is applied once in September to control weeds.

The summer of 1985 was cooler than normal. It is possible the usual ranking of cultivars shifted against those that tolerate heat. Also, the monthly experiment means in Table 3 are higher in 1985 than in previous years, indicating that the cultivars as a group performed better in the cooler conditions.

Disease symptoms typical of those caused by Drechslera siccans occurred at a low level of severity in September. Four cultivars had the symptoms in two or three of their three replications: WWE 19, Omega, Cockade, and NK 79309.

Most of the cultivars have allowed the encroachment of Kentucky bluegrass since 1982. Those having no bluegrass seedheads in May were: HE-168, BT-1, Manhattan II, Birdie, WWE 19, and Gator. Those having heads in only one of their three replications were: GT-II, Palmer, Cupido, Omega, Cockage, LP 210, LP 792, NK 80389, and Cigil. This implies less than optimal establishment in the one replication. All other cultivars had seedheads in two or three of their three replications. This could imply either lack of competitiveness to or compatability with Kentucky bluegrass. Those with a significant level of bluegrass invasion were: Regal, Premier, Barry, Crown, Citation, NK 79307, Cowboy, NK 79309, and Linn.

The 48 cultivars can be divided into eight groups in decreasing level of turf quality:

1. Excellent throughout the growing season

SWRC-1	Palmer	IA 728
Ranger	Diplomat	Fiesta

2. Slow spring green-up and excellent thereafter

Repell	BT-1	282
LP 702	Manhattan II	M 382
HE 168	Blazer	HE 178

3. Fair in spring and fall and good otherwise

Pennfine	Derby	Acclaim
Regal	Yorktown II	

4. Fair to poor through July and good thereafter

Pennant	Crown	LP 736
HR-1	Citation	Cowboy
2 ED		

5. Sensitive to environmental fluctuations

Birdie	Gator	Delray
Manhattan	Cockade	Cupido
Prelude		

6. Fair throughout the growing season

WWE 19	Barry	LP 792
Omega	Elka	NK 80389
Premier	LP 210	NK 79307

7. Good only in August and September

Dasher	Cigil

8. Poor throughout the growing season

Pippin	NK 79309	Linn

Table 3. Turf quality[a], Kentucky bluegrass invasion, and disease ratings[b] of perennial ryegrass cultivars.

	Ratings										Blue-grass
Cultivar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Mean[c]	Disease	%
SWRC-1	6.7	7.7	9.0	8.0	9.0	8.7	8.7	7.3	8.1	9.0	7
LP 702	6.0	6.7	9.0	7.7	8.7	9.0	8.3	8.3	8.0	9.0	7
Repell	6.3	6.3	7.7	9.0	9.0	9.0	8.0	8.3	8.0	9.0	3
HE-168	6.3	6.3	9.0	7.0	9.0	8.3	9.0	7.7	7.8	9.0	0
Ranger	6.0	7.7	8.7	7.7	8.7	8.3	8.3	7.0	7.8	9.0	7
Palmer	6.7	7.7	8.0	7.0	8.7	9.0	7.3	7.3	7.7	9.0	3
Diplomat	6.7	7.7	8.3	7.7	8.7	7.3	7.7	7.7	7.7	6.3	10
Tara	5.3	6.3	7.7	8.7	9.0	8.7	8.0	7.7	7.7	9.0	0
Blazer	6.3	6.7	8.7	7.3	8.0	8.7	7.7	7.3	7.6	9.0	10
Manhattan II	5.0	6.3	8.7	7.3	8.3	9.0	8.7	7.7	7.6	9.0	0

Citation II	5.0	6.7	8.7	8.0	8.7	8.7	8.0	7.0	7.6	9.0	13
M 382	5.3	6.3	8.3	7.3	8.3	9.0	8.0	7.0	7.5	9.0	10
All Star	5.0	7.0	8.0	8.3	8.7	8.7	7.3	7.0	7.5	9.0	3
HE 178	4.7	6.3	7.3	7.0	8.3	9.0	8.3	8.3	7.4	9.0	7
Fiesta	6.0	7.0	8.0	7.0	7.7	9.0	8.0	6.7	7.4	9.0	10
Pennant	5.0	6.3	8.7	6.7	8.3	8.7	7.7	7.3	7.3	9.0	10
Pennfine	5.7	7.3	8.7	7.7	8.3	8.0	6.7	6.3	7.3	6.3	10
HR-1	5.0	6.3	6.3	7.0	8.7	9.0	8.0	7.0	7.2	9.0	10
Regal	5.3	6.0	8.0	7.7	8.0	8.3	7.7	6.3	7.2	6.3	50
Derby	6.0	6.3	8.0	7.3	8.7	7.7	7.0	6.3	7.2	6.3	13
Birdie	6.7	8.0	7.7	6.7	8.0	8.3	6.3	5.7	7.2	9.0	0
WWE 19	7.0	6.7	7.3	6.7	7.3	6.7	7.7	7.3	7.1	3.7	0
Manhattan	6.7	6.7	8.0	7.0	7.7	5.7	7.3	8.0	7.1	6.3	7
Omega	6.7	7.3	6.7	7.0	7.7	6.7	8.0	7.0	7.1	3.7	7
Birdie II	5.0	6.0	7.3	6.7	8.7	9.0	7.3	7.0	7.1	9.0	7
Premier	6.7	6.7	7.0	6.7	7.7	9.0	7.0	6.0	7.1	9.0	27
Prelude	5.7	6.0	7.0	6.3	8.3	9.0	7.3	6.3	7.0	9.0	13
Barry	5.7	6.7	7.7	6.3	7.0	8.3	8.0	6.7	7.0	9.0	23
Yorktown II	6.0	6.0	7.7	7.3	7.7	8.0	6.7	6.7	7.0	9.0	7
Gator	6.3	6.7	7.3	6.3	8.3	8.7	6.3	5.7	7.0	9.0	0
Crown	6.7	5.7	7.0	5.7	7.3	8.3	7.3	7.0	6.9	9.0	20
Acclaim	4.3	6.7	7.0	7.3	7.7	8.3	7.3	6.7	6.9	9.0	13
Cockade	6.3	6.7	8.3	6.7	7.7	5.7	7.0	6.7	6.9	1.0	13
Elka	6.0	6.3	6.3	6.3	8.3	7.3	7.7	6.7	6.9	9.0	7
Citation	6.7	6.7	5.7	5.7	7.3	7.7	7.3	7.0	6.8	6.3	37
Delray	5.7	7.0	8.0	6.3	8.3	8.3	6.0	5.0	6.8	9.0	17
LP 210	5.3	6.0	8.0	6.7	6.7	7.0	7.0	6.7	6.7	6.3	7
LP 792	5.3	6.3	7.0	6.0	7.3	7.7	7.3	6.7	6.7	9.0	7
NK 80389	5.7	6.0	7.0	6.3	7.0	8.3	6.7	6.7	6.7	9.0	3
NK 79307	3.7	7.0	7.0	6.7	8.3	8.0	7.0	5.7	6.7	9.0	53
Ovation	5.7	6.0	6.7	5.7	7.0	8.3	7.0	6.7	6.6	9.0	10
Cupido	5.7	5.7	8.7	7.0	8.0	4.0	7.3	6.7	6.6	6.3	3
Dasher	5.7	5.7	6.3	6.3	8.3	8.0	6.7	5.3	6.5	9.0	13
Cigil	6.3	5.3	6.3	6.0	7.7	7.7	6.3	5.7	6.4	9.0	3
Cowboy	4.0	4.3	6.3	6.0	7.7	8.3	7.0	7.0	6.3	6.3	23
NK 79309	5.0	5.0	6.0	5.3	8.0	5.7	5.7	5.3	5.8	1.0	43
Pippin	5.0	5.0	6.7	4.7	6.0	5.7	6.3	7.0	5.8	9.0	23
Linn	3.0	3.0	3.0	3.7	5.0	3.7	5.0	4.7	3.9	9.0	40
Experiment Mean	5.7	6.4	7.5	6.8	8.0	7.9	7.3	6.8	7.0	7.9	13
LSD 0.05	1.5	1.3	2.0	1.7	1.3	1.2	1.4	1.3	0.8	3.5	25

[a] Ratings based on a scale of 1 - 9; 9 = best, 6 = acceptable, 1 = worst quality.

[b] Ratings based on 9 = no disease and 1 = disease present in all replications.

[c] Average of monthly quality ratings.

Perennial Ryegrass Cultivar Evaluations

N. E. Christians

The 22 perennial ryegrass cultivars in this trial were among the first plots to be established after the renovation of the field research area in 1979. The study has been maintained since that time 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.

Belle, Fiesta, Blyes, and Diplomat received the highest overall quality ratings in 1985. The first 16 cultivars received satisfactory ratings (Table 4). NK-100 and Linn received the lowest ratings in 1985.

Table 4. The 1985 quality ratings for 22 perennial ryegrass cultivars established in 1979.

		Quality Ratings						
	Cultivar	May	June	July	Aug	Sept	Oct	MEAN
1.	Belle	6.7	6.3	8.0	7.3	8.0	7.0	7.2
2.	Fiesta	6.3	7.0	7.7	6.3	7.3	7.7	7.1
3.	Blyes	6.0	5.7	7.0	6.7	7.7	8.3	6.9
4.	Diplomat	6.0	6.3	7.7	7.0	7.3	6.7	6.8
5.	Derby	5.7	7.0	6.7	7.0	5.7	8.3	6.7
6.	Yorktown	6.7	5.7	7.0	5.7	7.0	8.0	6.7
7.	Loretta	5.7	7.0	6.3	5.3	7.3	7.7	6.6
8.	Citation	6.3	7.0	6.3	6.0	6.7	7.0	6.6
9.	Delray	6.0	7.3	6.7	7.3	5.7	6.3	6.6
10.	Elka	6.3	7.7	5.3	5.7	5.7	7.7	6.4
11.	Caravelle	6.3	6.7	7.0	6.3	5.7	6.3	6.4
12.	K5-94	6.0	6.3	7.0	6.3	6.3	6.7	6.4
13.	Pennfine	6.0	7.3	7.3	6.3	5.7	5.7	6.4
14.	K5-88	5.3	5.7	7.0	7.3	6.3	6.3	6.3
15.	Manhattan	5.7	6.0	7.0	6.3	5.3	7.3	6.3
16.	Med North	6.0	6.0	6.3	6.7	5.3	6.3	6.1
17.	Goalie	6.0	5.7	6.3	5.7	6.0	6.0	5.9
18.	Regal	5.0	6.7	6.0	6.0	4.3	5.7	5.6
19.	J186 R24D	5.0	5.7	5.7	5.7	4.0	4.3	5.1
20.	NK-200	5.3	5.7	5.7	6.0	3.7	4.3	5.1
21.	NK-100	5.0	6.3	4.7	5.7	4.3	4.7	5.1
22.	Linn	4.0	5.0	4.0	4.7	3.0	4.3	4.2
	LSD 0.05	NS	NS	1.8	NS	1.4	1.2	1.0

Fine Fescue Cultivar Trial

K. L. Diesburg and N. E. Christians

This is the third year of data from the trial established in fall 1982. The purpose is to identify regional adaptation of the 32 cultivars and blends tested. 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 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.

Disease is usually a problem at this site during the summer. At that time, the necessary conditions of hot days, warm nights, high humidity, and moist soil from irrigation combine to allow pathogens to thrive. The summer of 1985 was cooler than normal and irrigation was not used as much. Consequently, disease was not a problem.

Experiment means in Table 5 indicate the average performance of all cultivars. Fine fescues in central Iowa generally have lower turf quality in August and best turf quality in October. The influence of the cooler summer in 1985 is seen again, where the cultivars as a group did best in June, averaging an 8.4 rating. Their worst performance was during April and November when all cool-season grasses are close to winter dormancy.

Many of the cultivars have allowed the encroachment of Kentucky bluegrass since 1982. Tournament, Duar, NK 80348, NK 80347, NK 80345, and Scaldis had 20-100% Kentucky bluegrass in two or three of their replications. FOF-WC and Waldina have 100% Kentucky bluegrass in only one of their three replications. This implies poor establishment in that replication.

The 32 cultivars can be divided into eight groups in decreasing level of turf quality:

1. Excellent throughout the growing season

   Checker, Jamestown, Atlanta, Banner, Ensylva

2. Excellent the first half and good the second

   Shadow

3. Slow spring green-up and excellent thereafter

   Dawson, Aurora, Biljart, Scaldis/Atlanta, Dawson/Pennlawn

4. Good throughout the growing season

Barfalla	Waldina	Koket

5. Slow spring green-up and good thereafter

Scaldis	Highlight	FOF-WC

6. Poor in spring and fall and good otherwise

Banner/Checker	Fortress	NK 79189
NK 79190	NK 80345	NK 80346

7. Fair throughout the growing season

Agram	Wintergreen

8. Fair to poor throughout the growing season

Pennlawn	Ruby	Duar
Tournament	NK 79191	NK 8037
NK 80348		

Table 5. Turf quality ratings of fine fescue cultivars and blends.

Cultivar		Turf quality[a]									Blue-Grass %
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Mean[b]	
Checker	C[c]	7.3	8.0	9.0	9.0	8.0	8.0	8.7	8.0	8.3	0
Shadow	C	9.0	8.7	9.0	9.0	7.7	7.7	8.0	6.7	8.2	0
Atlanta	C	7.3	9.0	9.0	7.7	8.0	8.0	8.0	8.3	8.2	0
Dawson	CR	5.3	8.3	9.0	9.0	8.3	7.3	9.0	8.7	8.1	0
Banner	C	8.3	7.3	8.3	8.7	8.3	7.7	8.3	7.7	8.1	7
Jamestown	C	8.0	7.3	8.7	8.3	7.7	8.0	8.0	8.0	8.0	17
Ensylva	CR	7.7	8.0	8.7	8.0	7.7	7.3	8.0	8.0	7.9	7
Barfalla	C	7.0	8.3	9.0	8.3	7.3	7.7	8.0	7.3	7.9	0
Scaldis/Atlanta		6.3	8.0	9.0	7.7	8.0	8.3	8.0	7.7	7.9	0
Biljart	H	6.0	6.3	8.3	8.7	8.3	8.0	8.3	7.7	7.7	20
Aurora	H	5.3	6.7	9.0	8.3	8.0	7.7	8.0	8.0	7.6	17
Banner/Checker		7.7	8.0	9.0	8.0	7.3	7.3	7.7	5.7	7.6	0
Fortress	CR	6.7	7.0	8.3	8.0	8.3	7.3	8.0	6.7	7.5	17
NK 80345	CR	5.3	7.3	9.0	8.7	8.3	7.3	8.0	6.0	7.5	43
Koket	C	7.7	8.0	9.0	7.3	6.7	7.0	7.3	7.3	7.5	0
Dawson/Pennlawn		5.3	7.3	8.3	8.0	7.7	7.3	8.3	7.3	7.5	3
Waldina	H	6.0	7.0	8.3	7.0	8.0	7.7	8.0	7.3	7.4	33
Scaldis	H	5.3	7.0	8.7	8.0	8.0	7.0	8.0	7.3	7.4	40
NK 79189	CR	4.7	8.7	9.0	7.7	7.0	8.3	7.3	6.7	7.4	7
NK 80346	CR	6.3	7.3	9.0	8.0	7.0	7.3	7.3	6.7	7.4	3
FOF-WC	S	4.7	8.0	9.0	7.3	7.7	7.0	7.7	7.3	7.3	33
Highlight	C	6.7	7.7	8.3	7.0	7.0	7.3	7.3	7.0	7.3	3
Agram	C	7.3	7.0	8.7	8.0	6.0	7.7	7.7	6.3	7.3	7
NK 79190	CR	4.7	8.0	8.7	7.3	7.0	7.3	7.7	6.7	7.2	20
Wintergreen	C	6.3	7.0	8.7	7.0	6.3	6.7	7.7	7.3	7.1	0
Pennlawn	CR	7.3	6.7	8.0	6.3	7.7	7.0	7.0	5.7	7.0	13
NK 79191	CR	5.0	7.0	8.0	7.3	7.7	7.0	6.7	5.0	6.7	27
NK 80348	CR	4.7	6.0	7.7	7.3	7.7	7.0	6.0	6.0	6.5	40
Tournament	H	5.0	5.0	7.3	7.0	6.7	7.0	7.0	6.0	6.4	63
NK 80347	CR	5.0	6.3	8.0	7.0	6.7	6.7	5.0	5.7	6.3	40
Ruby	CR	5.3	6.3	7.3	7.0	6.7	6.7	5.3	4.3	6.3	7
Duar	H	4.3	3.3	4.7	6.3	7.0	7.0	6.0	5.0	5.5	63
Experiment Mean		6.2	7.2	8.4	7.8	7.5	7.4	7.5	6.9	7.4	17
LSD = 0.05		1.0	1.2	0.8	1.5	1.3	1.1	1.0	0.9	0.6	35

[a] Quality rated on a scale of 1 - 9; 9 = best and 1 = worst.

[b] Average of monthly quality ratings.

[c] Chewings (C), creeping red (CR), sheep (S), or hard fescue (H).

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

The quality ratings in Table 6 are the means of monthly ratings taken on replicated plots from May to October. Reliant and Scaldis Hard Fescue were the only two grasses of the 10 included in this study to maintain a satisfactory overall quality mean for the entire season.

At the 2-inch mowing height, none of the cultivars maintained a satisfactory quality rating at the 1 lb N/1000 ft^2/yr fertility rate, although Reliant and Scaldis were both very close to an acceptable rating of 6. At the 3 lb N/1000 ft^2/yr rate Reliant, Scaldis, Atlanta, Jamestown, Ensylva, Dawson, and K5-29 maintained a satisfactory quality.

At the 1-inch mowing height, again none of the grasses maintained a satisfactory quality at the 1 lb N/1000 ft^2/yr rate. Reliant, Scaldis, Jamestown, and Atlanta were the best cultivars at the 3 lb N/1000 ft^2/yr rate. This study has now been in progress for six 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 performed well consistently during the study. The difference between poorly rated cultivars and acceptable cultivars is large and the choice of fine fescue cultivars for this region should be made carefully. Many are not well adapted to Iowa conditions.

Table 6. The effects of mowing height and nitrogen fertilizer on the quality of 10 fine fescues.

	Mowing Height 1 inch N Rate 1 lb[a]	Mowing Height 1 inch N Rate 3 lb	Mowing Height 2 inch N Rate 1 lb	Mowing Height 2 inch N Rate 3 lb	Overall Mean
1. Pennlawn Red Fescue	3.9[b,c]	5.2	4.6	5.9	4.9
2. Scaldis Hard Fescue	5.2	6.9	5.7	7.4	6.3
3. Ruby Red Fescue	3.4	4.5	4.1	5.3	4.3
4. Atlanta Chewings Fescue	4.6	6.1	4.8	6.4	5.5
5. K5-29 Red Fescue	3.7	5.1	4.7	6.1	4.9
6. Dawson Red Fescue	4.7	5.7	4.9	6.2	5.4
7. Reliant Hard Fescue	5.7	7.6	5.9	7.9	6.8
8. Ensylva Red Fescue	4.3	5.6	4.5	6.3	5.3
9. Highlight Chewings Fescue	3.0	3.8	3.3	3.8	3.5
10. Jamestown Chewings Fescue	4.6	6.2	4.9	6.5	5.5

[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 ratings are based on a scale of 9-1; 9 = best quality, 6 = acceptable quality; and 1 = poorest quality.

Tall Fescue Management Study

K. L. Diesburg and N. E. Christians

This is a report of the second year of data from the experiment. It is designed to compare the response of Falcon, Houndog, Kentucky 31, Mustang, and Rebel tall fescue at 0, 2, and 4 lb N/1000 ft^2/yr and cutting heights of 2 and 3 inches. One pound of N was applied once during each month of May and September for the 2-lb treatment and 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 x 3 block within each cultivar with the five cultivars replicated three times. A single application each of DCPA in the spring and a phenoxy herbicide in the fall is sufficient to control weeds.

Cultivar means in the last column of Table 7 show that the turf-type cultivars were similar to each other and superior to Kentucky 31 over all managements. Monthly means show that Mustang and Houndog had better turf quality than Falcon and Rebel in June, July, and August while in September, Mustang alone was superior to all other cultivars.

Highest quality turf was obtained with all cultivars at the 2-inch cutting height and 4-lb N level. Greater improvement was shown from 0 to 2 lb than from 2 to 4 lb N/yr. The difference in quality between the 2- and 3-inch cutting heights became greater with each increment in applied N.

Mustang had a slower start in April than the other four cultivars. From May through September, however, it was the only cultivar to have the best turf quality at all fertility levels. It continued as the best cultivar at the 4-lb level through November. Rebel was comparable to Mustang the entire season at the 4-lb level, and Houndog was comparable to Mustang where no fertilizer was applied. Houndog was the only cultivar to perform the best at the 2-lb level the entire season. Falcon did well at the 2- and 4-lb levels during April, May, June, August, and September. At 0-lb, however, it did just a little better than Kentucky 31. Kentucky 31 was comparable to the other cultivars at 2- and 4-lb levels in April but was inferior the rest of the season at all fertility levels.

All cultivars produced higher quality turf at the 2-inch clipping height. Kentucky 31 had poor turf quality throughout the growing season, but its ratings did not drop as much as those of the turf-type cultivars going from the 2-inch to 3-inch clipping height.

Improvement of turf quality at higher fertility levels for all cultivars was due primarily to better color resulting from higher chlorophyll content and less yellowing from disease. The turf-type cultivars also responded very well to the 2-inch cutting height showing finer leaf texture and higher leaf density. Kentucky 31 responded with finer leaves, but leaf density decreased with a net small improvement of turf quality.

A 3- to 3 1/2-inch cutting height is traditionally recommended for Kentucky 31 tall fescue turf. This cultivar was released in 1943 for forage and land reclamation purposes. It is not as well adapted for turf as are the turf-type cultivars. The initial response of all perennial grasses to lower clipping height is more diminutive growth giving a finer texture. Only those adapted to the stress of close clipping will persist over many years. Data from future years will allow assessment of the persistence level of each cultivar.

Table 7. Means of turf quality ratings (9 = best) for tall fescue cultivars at two clipping heights and three fertility levels.

Cultivar	Clip Hgt (")	N lb/ 1000^2	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Mean
Mustang	2	0	2.3	5.0	4.3	5.0	5.0	5.3	4.7	3.0	4.3
	2	2	3.7	6.0	7.3	6.7	5.3	6.3	6.0	4.3	5.7
	2	4	5.0	7.7	8.0	7.7	8.0	7.7	7.3	5.3	7.1
	3	0	2.0	4.3	3.7	4.0	4.3	5.0	4.0	2.7	3.8
	3	2	2.3	5.0	6.0	5.7	5.0	5.3	4.7	3.7	4.7
	3	4	3.0	6.0	7.0	6.7	7.0	6.7	6.0	5.3	6.0
	Average		3.1	5.7	6.1	5.9	5.8	6.1	5.4	4.1	5.3
Houndog	2	0	2.3	4.3	5.3	4.7	4.3	4.7	5.0	3.3	4.3
	2	2	4.7	6.3	7.3	6.0	5.3	5.7	6.7	4.7	5.8
	2	4	6.0	7.3	7.7	7.3	7.7	7.0	6.0	3.7	6.6
	3	0	2.0	3.7	4.3	4.0	3.7	4.0	4.3	3.0	3.6
	3	2	3.0	5.0	6.7	5.0	5.0	5.0	6.3	5.0	5.1
	3	4	3.7	6.3	6.7	6.0	6.7	6.0	4.7	4.0	5.5
	Average		3.6	5.5	6.3	5.5	5.4	5.4	5.5	3.9	5.2
Rebel	2	0	3.0	4.7	4.0	4.0	4.0	4.3	5.3	3.3	4.1
	2	2	5.0	6.0	6.7	6.0	5.0	5.3	6.3	4.3	5.6
	2	4	5.7	7.7	7.7	7.3	8.0	7.0	6.7	5.0	6.9
	3	0	2.0	3.7	2.7	3.0	3.3	4.0	4.3	3.7	3.3
	3	2	3.0	4.7	5.7	5.0	5.0	5.3	4.7	4.7	4.8
	3	4	3.3	6.0	6.7	6.3	6.7	6.3	5.3	5.7	5.8
	Average		3.7	5.4	5.6	5.3	5.3	5.4	5.4	4.4	5.1
Falcon	2	0	2.3	4.3	4.0	4.0	4.0	4.3	5.0	3.0	3.9
	2	2	4.3	6.0	6.7	6.0	5.0	5.7	6.7	4.3	5.6
	2	4	5.0	7.3	7.7	7.0	8.0	7.0	6.3	4.7	6.6
	3	0	2.0	3.7	3.0	3.0	3.3	3.7	4.0	2.7	3.2
	3	2	3.7	5.0	5.3	5.0	5.0	5.0	5.3	4.0	4.8
	3	4	3.7	6.0	6.7	6.0	7.0	6.3	5.3	4.3	5.7
	Average		3.5	5.4	5.6	5.2	5.4	5.3	5.4	3.8	5.0
Kentucky 31	2	0	2.3	3.0	2.7	3.3	3.3	3.7	3.3	2.0	3.0
	2	2	4.0	4.7	6.0	4.7	4.3	4.0	5.3	3.7	4.6
	2	4	5.3	6.0	6.3	5.3	6.3	6.0	6.0	5.0	5.8
	3	0	2.0	3.0	2.3	3.3	3.0	3.3	3.0	2.0	2.8
	3	2	3.3	4.0	5.0	4.0	4.0	4.3	5.0	4.0	4.2
	3	4	3.7	5.0	5.3	4.7	6.0	5.3	6.0	5.3	5.2
LSD cultivar averages			0.7	0.4	1.1	0.6	0.4	0.5	0.4	0.6	0.3
LSD managements			0.9	0.6	0.6	0.4	0.6	0.8	0.6	0.7	0.4

Bentgrass Management Study

N. E. Christians

The bentgrass management study was established in the fall 1980. It includes the following species and cultivars:

Species	Cultivar
1. *Agrostis stolonifera* Creeping Bentgrass	Emerald
2. *Agrostis canina* Velvet Bentgrass	Kingstown
3. *Agrostis stolonifera* Creeping Bentgrass	Penncross
4. *Agrostis stolonifera* Creeping Bentgrass	Penneagle
5. *Agrostis stolonifera* Creeping Bentgrass	Prominent
6. *Agrostis stolonifera* Creeping Bentgrass	Seaside

Each cultivar planting is split into three fertility levels: 0.5, 0.8, and 1.2 lb N/1000 ft^2/growing month. This results in a total N application rate of 3.5, 5.6, and 8.4 lb N/1000 ft^2/year. The area was managed as a golf course green, with a 3/32-inch mowing height and with applications of insecticides and fungicides as needed. Each cultivar is replicated four times.

Penncross ranked first in the trials again this year, but is so close to Penneagle in yearly mean quality that they can be considered to be equal (Table 8). Emerald ranked third, but it was statistically the same as Penncross and Penneagle.

Kingstown moved up one position from last year's ranking, but this is due to the fact that much of the Kingstown velvet bentgrass has died and surrounding bentgrasses have begun to take over these plots. Prominent and Seaside have survived the past five seasons, but both have performed poorly.

Quality of bentgrass increased with each increment of applied nitrogen (Table 9). This is surprising because of the high N rates (8.4 lb N/1000 ft^2/year) that are being applied to some plots. When the study was begun, it was anticipated that the high rate would be excessive and that plot quality would deteriorate with time. After five seasons, we find that the 3.5 lb N/1000 ft^2/yr is too low and that the best grass is found at higher fertility levels.

The trend in the past few years has been to go to lower and lower fertility levels on bentgrass greens. I still agree with the overall concept involved in reduced N levels for bentgrass, but the research results from this area would bring into question some of the things we have heard lately about low-N programs.

Table 8. The 1985 quality ratings[a] for six bentgrass cultivars with data averaged over four replications and three fertility levels.

Cultivar	May	June	July	Aug	Sept	Oct	MEAN
1. Penncross	6.2	3.8	5.5	6.6	6.8	6.5	5.9
2. Penneagle	5.2	3.7	5.8	6.5	7.2	6.3	5.8
3. Emerald	5.8	4.3	5.2	5.5	6.2	5.6	5.4
4. Kingstown	5.4	3.8	5.1	5.1	5.1	4.9	4.9
5. Prominent	4.7	3.6	4.9	4.8	5.3	5.3	4.7
6. Seaside	4.2	3.3	4.7	4.1	5.1	4.8	4.4
LSD 0.05	1.1	0.9	1.0	1.1	1.0	1.1	0.6

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

Table 9. The effects of fertility level on the quality of six bentgrass cultivars.

Cultivar	lb N/growing season		
	0.5	0.8	1.2
1. Emerald	4.5	5.3	6.3
2. Kingstown	4.2	4.8	5.8
3. Penncross	5.0	5.9	6.9
4. Penneagle	5.0	5.8	6.5
5. Prominent	3.9	4.9	5.4
6. Seaside	3.5	4.3	5.4

LSD 0.05 for comparison of fertility levels within cultivar = 1.0.

Nitrogen X Potassium Study

K. L. Diesburg and N. E. Christians

This study was initiated to observe the effects of nitrogen (N) and potassium (K) on turf quality and vegetative growth of Kentucky bluegrass and to evaluate the interactions between these two nutrients.

The area was seeded with 'Baron' Kentucky bluegrass in September 1979. At the time of establishment, 1 lb P_2O_5/1000 ft^2 (as triple super phosphate) and 0.5 lb N/1000 ft^2 (as ammonium nitrate) were applied. The area is maintained in lawn condition including 2-inch mowing height, pre- and postemergent weed control, and irrigation as needed. No insecticides or fungicides have been applied.

The study is arranged in a complete factorial with four levels of N and K each at 0, 2, 3, and 4 lb/1000 ft^2/yr. A randomized complete block design is used with 16 treatments and three replications. Urea is the N source and KCl is the source of K. Treatments are split over April, May, late August, and September.

Monthly ratings of turf quality and fresh weights of clippings are presented in Tables 10 and 11, respectively. Benefit from K was not as great as that from comparable amounts of N. The beneficial effect from increasing N application levels was highly significant throughout the season for both turf quality and clipping weight. Increases occurred between the 0- and 2-lb treatments and the 2- and 3-lb treatments but not between the 3- and 4-lb treatments. Higher levels of applied K seemed to cause slightly better turf quality and clipping weights but the differences were not significant. Increases seemed to occur between the 0- and 2-lb treatments but not any others.

The need for a proper balance of N and K can be seen in Table 10. Although there was little interaction between N and K, optimum improvement of turf quality from increments of applied N seemed to occur at 2 lb K/1000 ft^2. Likewise, optimum stimulation of grass growth and turf quality from increments of applied K seemed to occur at 2 lb N/1000 ft^2.

Turf quality was reduced to such an extent at low N levels that Kentucky bluegrass stands were thin enough to allow germination and establishment of crabgrass (Table 11).

Table 10. Turf quality ratings[a] of Kentucky bluegrass in response to N and K treatments.

N lb/1000	K ft²/year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Mean
4	4	3.0	7.3	8.3	8.7	7.7	7.3	7.3	5.7	6.9
4	3	4.0	7.3	8.7	8.3	8.0	7.0	5.0	4.0	6.5
4	2	4.0	7.0	9.0	7.7	7.3	8.3	7.0	5.7	7.0
4	0	3.7	7.3	8.7	7.7	7.3	8.3	7.7	6.3	7.1
3	4	4.3	6.0	8.0	8.0	8.0	8.3	7.0	5.0	6.8
3	3	4.0	6.3	8.3	8.0	7.7	7.0	7.0	6.0	6.8
3	2	3.7	6.3	8.0	7.7	7.7	7.0	6.0	4.0	6.3
3	0	4.7	5.7	7.7	7.0	6.7	7.7	7.0	5.3	6.5
2	4	4.0	5.7	7.0	7.3	5.0	5.0	5.3	4.7	5.5
2	3	4.3	5.3	7.3	6.3	4.7	5.0	5.0	4.3	5.3
2	2	4.0	5.7	7.7	7.7	5.7	6.0	6.3	4.7	6.0
2	0	4.0	4.7	6.7	4.7	4.7	4.0	4.7	4.3	4.7
0	4	2.7	4.0	3.7	3.0	3.3	4.3	5.3	4.7	3.9
0	3	2.7	3.3	3.3	3.3	3.3	4.7	5.7	4.3	3.8
0	2	2.3	3.0	3.0	2.7	2.7	3.3	4.0	3.0	3.0
0	0	2.0	3.7	3.3	3.3	3.0	4.7	4.7	3.7	3.5
Experiment Mean		3.6	5.5	6.8	6.3	5.8	6.1	5.9	4.7	5.6
LSD = 0.05		0.5	0.6	0.6	0.8	0.8	1.0	1.2	1.1	0.6

[a] Ratings based on a scale of 1-9; 9 = best, 6 = acceptable, 1 = worst quality

Table 11. Mean effects of N and K on vegetative growth of Kentucky bluegrass and crabgrass infestation.

N	K	Fresh Clipping Weights (grams)					Crab-grass
lb/1000 ft²/year		Aug 5	Aug 28	Sep 20	Oct 16	Mean	%
4	4	74	78	70	45	67	0
4	3	95	83	46	39	66	10
4	2	46	50	48	31	44	0
4	0	57	62	50	41	53	0
3	4	66	93	73	54	71	0
3	3	72	78	64	42	64	3
3	2	79	83	52	47	65	10
3	0	38	46	59	38	46	10
2	4	28	13	17	10	17	13
2	3	19	11	18	12	15	3
2	2	73	42	47	35	49	7
2	0	15	9	9	8	10	27
0	4	2	1	15	3	5	53
0	3	4	2	11	2	5	40
0	2	5	2	11	2	5	70
0	0	6	3	12	2	6	57
Experiment Mean		42	41	38	26	37	19
LSD = 0.05		28	23	16	12	19	12

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

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

In this study, eight granular N sources are being evaluated for maintenance fertilization. The turf is Glade Kentucky bluegrass which was established in September 1984 and is maintained at a cutting height of 2 inches. A randomized complete block design with three replications is being used. Plot size is 3.5 X 7 ft.

The treatments include seven slow-release N sources applied at 4 lb N/1000 ft^2/year split into two equal applications of N. In addition, one urea treatment was applied at 4 lb N/1000 ft^2/year split into four equal applications. The dates of fertilizer applications are May 1 and August 15. The additional urea treatments were applied on June 1 and September 15.

Measurements to be taken include, monthly visual quality with particular attention to disease development, density of turf, and color of turf.

Table 12. List of treatments.

Treatment Number	Fertilizer Source	Date of N Application	lb N per 1000 ft^2
1	Urea	May 1	1
		June 1	1
		August 15	1
		September 15	1
2	IBDU (Estech)	May 1	2
	(31-0-0)	August 15	2
3	SCU (Andersons, CIL)	May 1	2
	(32-0-0)	August 15	2
4	SCU (Lakeshore, TVA)	May 1	2
	(37-0-0)	August 15	2
5	Methylene Urea (OMS)	May 1	2
	(41-0-0)	August 15	2
6	UF (Blue Chip)	May 1	2
		August 15	2
7	PCU (Estech)	May 1	2
	(100 day release-rate)	August 15	2
8	Azolone (Noram)	May 1	2
	(38-0-0)	August 15	2

Data taken during the summer of 1985 are listed in Table 13. While the data are representative of an establishment year, there were several differences. Urea, SCU/CIL, SCU/TVA, and Methylene urea consistently demonstrated better visual quality.

The differences in clipping yield and shoot density were very small and inconsistent. This would not be surprising since the test area had not completely filled in until August 1985. The field area had sustained severe winter damage during the winter of 1984-85 prior to the onset of treatment.

Further data will be collected in 1986, 1987, and 1988.

Table 13. Effects of granular sources on short density, clipping yield, and visual quality.

Nitrogen Source	Shoot Density Sept.	Clipping Yield June	Aug	Sept	Visual Quality June	July	Aug	Sept	Oct	Mean
Urea	62.0	33.2	17.8	20.2	6.9	7.2	8.2	7.6	9.0	7.8
IBDU	56.0	49.3	19.7	14.7	7.4	7.4	7.7	7.7	6.2	7.2
SCU/CIL	72.0	54.3	26.7	23.2	7.6	7.5	8.3	7.7	7.4	7.7
SCU/TVA	62.0	51.3	30.2	24.7	7.8	7.5	8.5	7.7	7.3	7.8
Methylene Urea	68.0	46.4	20.2	26.7	7.3	7.6	8.5	7.7	7.2	7.7
UF	54.0	33.5	22.1	15.0	6.4	7.3	7.4	7.5	6.1	6.9
PCU	58.0	39.6	29.3	14.7	7.2	6.8	7.8	7.8	7.8	7.5
Azolone	53.0	37.3	22.1	16.8	7.1	7.4	7.5	7.2	6.2	7.1
LSD 0.05	N.S.	14.2	N.S.	9.1	0.6	N.S.	0.4	0.2	0.3	0.3

Summer Slow-Release Nitrogen Sources Comparison Study

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 which was established in September 1984. Treatments were initiated in the spring 1985 and will continue for several years. Individual treatment plots measured 5 X 5 ft and they 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 20 and September 10. One additional treatment, which included combinations of Powder Blue and urea, was added for comparison (Table 14).

During the summer of 1985, visual quality was taken on a monthly basis, shoot density was taken in September, and clipping yield was taken in June, August, and September. The data from summer 1985, as listed in Table 15, shows that there was no difference in the response of each of the nitrogen sources.

1985 is considered an establishment season. Further data will be collected in 1986, 1987, and 1988.

Table 14. List of treatments.

Treatment Number	Date of N Application	lbs N per 1000 ft^2	N Carrier
1	April	1	Urea
	May	1	Powder Blue
	August	1	Powder Blue
	September	1	Urea
2	April	1	Urea
	May	1	FLUF
	August	1	FLUF
	September	1	Urea
3	April	1	Urea
	May	1	Formolene
	August	1	Formolene
	September	1	Urea

4	April	1	Urea
	May	1	Slo-Release
	August	1	Slo-Release
	September	1	Urea
5	April	1	Urea
	May	1	IBDU
	August	1	IBDU
	September	1	Urea
6	April	1	Urea
	May	1	SCU - TVA
	August	1	SCU - TVA
	September	1	Urea
7	April	1	Urea
	May	1	SCU - CIL
	August	1	SCU - CIL
	September	1	Urea
8	April	1	Urea
	May	1	Azolone
	August	1	Azolone
	September	1	Urea
9	April	1/4 - 3/4	Powder Blue/Urea
	May	1/2 - 1/2	Powder Blue/Urea
	August	1/2	Powder Blue
	September	3/4 - 3/4	Powder Blue/Urea

Table 15. Comparison of slow-release nitrogen sources in summer fertilization.

Nitrogen Source	Shoot Density	Clipping Yield			Visual Quality					
		June	Aug	Sept	June	July	Aug	Sept	Oct	Mean
Powder Blue	64.0	34.6	12.4	11.0	7.5	7.3	7.7	7.4	8.5	7.7
Fluf	71.0	32.7	12.4	6.7	7.6	7.5	8.1	7.2	8.6	7.8
Formolene	62.0	28.1	11.7	12.2	7.4	7.4	7.9	7.3	8.1	7.6
Slo-Release	66.0	27.4	15.0	14.5	7.6	7.2	8.3	7.5	8.3	7.8
IBDU	67.0	38.9	13.6	10.7	7.6	7.5	8.3	7.5	8.2	7.8
SCU/TVA	71.0	30.9	15.0	11.0	7.4	7.5	8.2	7.5	8.3	7.8
SCU/CIL	64.0	37.6	17.8	11.7	7.8	7.7	8.3	7.6	8.7	8.0
Azolone	69.0	34.4	15.8	9.5	7.6	7.6	7.5	7.4	7.8	7.6
Powder Blue/ Urea	61.0	29.2	11.0	9.5	7.4	7.5	7.6	7.3	7.5	7.5
LSD 0.05	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

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 1985 and will continue for several years. 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 4 lb N/1000 ft^2/growing season. The balanced program required 1 lb N/1000 ft^2 in each of the months of April, May, August, and September. The heavy May program required 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 1985 include visual quality and clipping weight. In future years, carbohydrate reserves, root density, and thatch development will also be measured.

The field was seeded in the fall 1984 and sustained substantial winter damage. Therefore, the turfgrasses were not ready for ratings until late summer and early fall. In addition, early snows in 1985 prevented ratings in November.

In comparison of the cultivars (Table 16), the visual quality ratings were generally better for Majestic than Vantage or Park; however, Majestic produced only half as much clipping weight as Vantage or Park. This difference is not surprising, since Majestic is a prostrate-growing cultivar.

In comparison of programs (Table 17), the balanced and heavy May applications demonstrated better overall quality and shoot growth. The heavy May and balanced programs produced greater shoot growth than the late fall program. The lower quality of clippings from the late fall program is not surprising, since only 1/2 lb N was applied in August while the other two programs received 1 lb each. In the future, clippings will be measured on a monthly basis.

The individual fertilizer ratings suggest the widest difference of any of the data taken. Urea demonstrated the best visual quality followed by Formolene, Fluf, and Powder Blue (Table 18). Clipping yields indicated the same results with Urea producing the highest yield and Powder Blue the lowest. Urea is a very quick release nitrogen source and Powder Blue a slow or delayed release type nitrogen.

In summary, 1985 was an establishment year for this study. The data reflect only the effects on establishment. As the turfgrass matures and the study progresses, more conclusive results will be obtained.

Table 16. The 1985 visual quality ratings of three Kentucky bluegrass cultivars.

Cultivar	Ratings[a] July	August	September	October	Mean	Clipping Yield[b] September
Vantage	6.4	7.3	7.2	7.7	7.2	35.8
Park	6.5	6.9	7.0	7.5	7.0	30.8
Majestic	7.4	7.6	7.3	7.8	7.6	15.6
LSD = 0.05	0.07	0.29	0.09	0.13	0.11	3.10

a Ratings based on a scale of 1 - 9; 9 = best visual quality, 1 = poorest visual quality.

b Clippings collected in September are in grams per 1.63 m^2.

Table 17. The 1985 visual quality ratings of three liquid fertilizer programs.

Program	Ratings[a] July	August	September	October	Mean	Clipping Yield[b] September
Balanced	6.8	7.4	7.2	7.7	7.3	29.0
Heavy May	6.8	7.7	7.3	7.7	7.3	29.9
Late Fall	6.8	6.8	7.1	7.6	7.1	23.3
LSD = 0.05	NS	0.29	0.09	NS	0.11	3.14

a Ratings based on a scale of 1 - 9; 9 = best visual quality, 1 = poorest visual quality.

b Clippings collected in September are in grams per 1.63 m^2.

Table 18. The 1985 visual quality ratings of four fertilizers.

Fertilizer	Ratings[a] July	August	September	October	Mean	Clipping Yield[b] September
Urea	6.8	7.8	7.3	8.6	7.6	32.5
Powder Blue	6.8	6.7	7.1	7.6	7.0	21.9
Fluf	6.8	7.1	7.1	7.2	7.1	24.7
Formolene	6.8	7.6	7.2	7.4	7.3	30.4
LSD = 0.05	NS	0.33	0.11	0.15	0.13	3.62

[a] Ratings based on a scale of 1 - 9; 9 = best visual quality, 1 = poorest visual quality.

[b] Clippings collected in September are in grams per 1.63 m^2.

1985 Preemergence Crabgrass Control Study

N. E. Christians and M. L. Agnew

The treatments of the 1985 preemergence crabgrass control trials were applied on April 23, 1985, with follow-up applications for some treatments applied on May 25. All treatments were immediately watered in. The treatments included Betasan 4E-LF, Betasan 2.2S, and Betasan/Devrinol from Stauffer Chemical; SN594 from Nor-Am; Ronstar 50WP, Ronstar 2G, and Ronstar/Modown from Rhone-Poulenc; Dacthal from SDS BioTech; Team from Elanco; and Pendimethalin 60WDG from O. M. Scott.

Spring 1985 was mild and crabgrass had germinated by the first week of May. The mild spring was followed by extremely dry conditions in late spring through the end of July. The Kentucky bluegrass on this area went into summer dormancy by late May due to the dry conditions and much of the early crabgrass died because of lack of moisture. The area was irrigated in mid-July to bring the bluegrass out of dormancy; there was a second germination of crabgrass in late July. Crabgrass counts were made on the plot area on August 29, 1985.

The only treatments to completely control crabgrass were the Betasan 4E-LF at 12.5 lb ai/A, both Betasan/Devrinol treatments, the Ronstar 50WP at 8 lb ai/A, Dacthal at 10.5 lb with a 7.5 lb ai/A follow-up treatment, and Pendimethalin 60WDG at 3 lb ai/A. All of the treatments with the exception of SN594 at the 1 lb/A rate significantly reduced crabgrass as compared to the control. The SN594 was less effective than many of the other materials at the 2-lb/A rate but was found to be effective at the 4- and 6-lb/A rates. The Ronstar materials, Dacthal, Team, and Pendimethalin products were all quite effective in controlling crabgrass at all rates tested (Table 19).

Damage ratings were performed on the bluegrass at two weeks, one month, two months, and four months following treatment. There was no visible damage from any of the treatments in the first 10 days after application. By the second week, SN594 at the 6-lb/A rate and Ronstar 50WP at 4- and 6-lb/A rates were observed to have a detrimental effect on the bluegrass (Table 19). Only the Ronstar 50WP was observed to produce unacceptable damage after two weeks. At the 1-month rating, only the Ronstar 50WP was observed to have a detrimental effect. All other plots had recovered. At two months, all plot areas were dormant. By the fourth month, all plots had recovered from drought damage. There was no visible damage to any of the plots as they recovered from drought stress nor was there any apparent damage at the fourth month rating.

Table 19. Results of the 1985 preemergence weed control trials.

Treatment	Rate lb ai/A	Crabgrass[a]	Phytotoxicity[b] 2 wks	1 mon	4 mon
1. Control	---	26	9.0	9.0	9.0
2. Betasan 4E-LF	8	1	9.0	9.0	9.0
3. Betasan 4E-LF	8 + 4[c, d]	1	9.0	9.0	9.0
4. Betasan 4E-LF	12.5	0	9.0	9.0	9.0
5. Betasan 2.2S	7.5	7	8.5	9.0	9.0
6. Betasan 2.2S	12.5	2	9.0	9.0	9.0
7. Betasan/Devrinol (7.5/1.5G)	4.875/0.975	0	9.0	9.0	9.0
8. Betasan/Devrinol (7.5/1.5G)	7.5 /1.5	0	9.0	9.0	9.0
9. SN594	1	33	9.0	9.0	9.0
10. SN594	2	10	8.5	9.0	9.0
11. SN594	4	2	9.0	9.0	9.0
12. SN594	6	7	7.5	9.0	9.0
13. Ronstar 50WP	2	2	8.5	9.0	9.0
14. Ronstar 50WP	4	1	7.5	9.0	9.0
15. Ronstar 50WP	8	0	5.0	5.0	9.0
16. Ronstar 2G	3	1	9.0	9.0	9.0
17. Ronstar/Modown	2/3	2	9.0	9.0	9.0
18. Ronstar/Modown	4/6	1	9.0	9.0	9.0
19. Dacthal	10.5	1	9.0	9.0	9.0
20. Dacthal	10.5 /7.5[c]	0	9.0	9.0	9.0
21. Team	1.5	3	9.0	9.0	9.0
22. Team	2.0	5	9.0	9.0	9.0
23. Pendimethalin 60WDG	1.5	1	9.0	9.0	9.0
24. Pendimethalin 60WDG	3.0	0	9.0	9.0	9.0
LSD 0.05		9	1.1	0.2	N.S.

a Number of crabgrass plants in a 5' X 5' plot.
b Phytotoxicity is rated on a scale of 9 to 1; 9 = no damage, 6 = acceptable, 1 = severe damage. Plots measure 5 X 5 ft; four replications liquids applied in 4 gal water/1000 ft^2.
c Applied four weeks after the first treatment.
d Follow-up treatments were made on May 25 for numbers 3, 7, 8, and 20.

1985 Preemergence Annual Grass Timing Control Study

M. L. Agnew and N. E. Christians

The purpose of this study was to investigate the effectiveness of three preemergent herbicides when applied at five different times during the spring. The herbicides used (Dacthal, Benefin, and Bensulide) were applied during the first and third weeks of March and April and the first week of May. The area chosen for the study was a lawn area on the ISU campus which is infested with crabgrass and kotweed. Individual plots measured 5 X 5 ft. There were three replications.

The environmental conditions recorded during summer 1985 were not typical. The summer began with a very dry period which inhibited crabgrass germination in the Ames area. Crabgrass germination did not take place for the most part until midsummer.

On August 27, both percentage of knotweed coverage and number of crabgrass plants per plot were recorded. Crabgrass germination was spotty between replications. However, trends demonstrated that knotweed was reduced by early applications of Dacthal, while all treatments reduced crabgrass numbers (Table 20).

This study will be continued in future years at a new location which should provide more uniform crabgrass germination.

Table 20. Weed control in the 1985 preemergence annual grass timing control study.

Herbicide	Month	Week	Percent Knotweed	Crabgrass Numbers
Dacthal	March	1	1.7	14
Dacthal	March	1	1.7	3
Dacthal	April	1	1.7	4
Dacthal	April	3	25.0	7
Dacthal	May	1	40.0	1
Benefin	March	1	35.0	4
Benefin	March	3	6.7	20
Benefin	April	1	24.7	3
Benefin	April	3	35.0	8
Benefin	May	1	63.3	3
Bensulide	March	1	63.3	4
Bensulide	March	3	45.0	1
Bensulide	April	1	13.3	2
Bensulide	April	3	45.0	5
Bensulide	May	1	43.3	8
Control			27.0	31

The Effect of Preemergence Herbicides on Root Inhibition of Kentucky Bluegrass (*Poa pratensis*)

Z. J. Reicher and N. E. Christians

Preemergence herbicides for the control of annual weeds are becoming increasingly important to the turfgrass industry. According to Lawn Care Industry (9(6):1, 20-21, 1985), lawn care companies alone were estimated to have spent more than $43 million on these herbicides. The most widely used of these herbicides include: Dacthal (DCPA), Balan (benefin), Betasan (bensulide), and Ronstar (oxadiazon).

These herbicides are very effective in controlling annual weeds and thus improving aesthetics; but, these chemicals may also have detrimental effects on the turf. As reported in Agronomy Journal (67:563-565, 1975), studies done at the University of Illinois showed that repeated treatments of the same herbicide resulted in increased leaf spot disease, higher wilting tendencies, reduced shoot growth, and increased thatch development. Reductions in rhizome weight and length and also, reduced overall turf quality in some species, due to applications of various preemergence herbicides, have been reported in HortScience (17(6):911-912, 1982). As indicated in HortScience (14:282-283, 1979), rooting of transplanted sod was decreased when preemergence herbicides were applied either to the sod or sod bed. The objective of the following study was to measure the effects of seven preemergence herbicides on root inhibition of Kentucky bluegrass (Poa pratensis).

The study was divided into high-maintenance and low-maintenance trials. The high-maintenance trial received 4.0 lb of N yearly and was irrigated to prevent moisture stress. The area was mowed at 2.25 inches. The low-maintenance trial was mowed at 1.5 inches and received only 1.5 lb N yearly and no irrigation.

The high-maintenance trial consisted of four preemergence herbicides applied at the recommended high and low rates and replicated four times. Herbicide treatments (expressed as active ingredients) were Dacthal 75 WP at 10.5 and 15 lb/A, Ronstar 2 G at 2.0 and 3.5 lb/A, Betasan 4 EC at 7.5 and 14 lb/A, and Balan at 2 and 3 lb/A. (Note: Pendimethalin 60 WDG was mistakenly applied at an excessive rate in this trial and was dropped from the study). The herbicides were applied on April 20, to a 3-year old stand of Kentucky bluegrass cv 'Endmundi'. The soil on this area is a Nicollett (fine loamy mixed mesic Typic Hapludoll) soil having a pH of 7.5, 20 lb/A phosphorus concentration, 160-lb/A potassium concentration, and 2.3% organic matter content. The herbicides were thoroughly watered in with 2 inches of water after application.

On June 5, eight samples, 20 cm deep, were taken from each treatment in each replication. The vegetation and thatch were removed and the plugs were divided into four depths, 0-5, 5-10, 10-15, and 15-20 cm. The roots were then washed free of any soil, oven dried, and weighed.

The low-maintenance trial consisted of four herbicides, all applied at the recommended low rate and two of these applied at the high rate. The treatments (expressed in active ingredient) were Bensulide 4 ELF at 8 and 12.5 lb/A, Pendimethalin 60 WDG (pendimethalin) at 1.5 and 3.0 lb/A, Ronstar 2 G at 3 lb/A, Dacthal 75 WP at 10.5 lb/A. This study was also replicated four times. The chemicals were applied on April 25, and thoroughly watered in. This was on an old golf course fairway on a Webster (fine loamy mixed mesic Typic Hapludoll) soil having a pH of 7.5, 59 lb/A phosphorus concentration, 196 lb/A potassium concentration, and 5% organic matter.

On June 25, and again on August 8, samples were taken as in the high-maintenance trial, but divided into three depths; 0-5, 5-10, and 10-15 cm. These samples were washed, dried, and weighed as in the other trial. In addition, these samples were ashed and the ash weights subtracted from the oven dry weights to give the final results.

An analysis of variance was performed on the data at the termination of the study. The findings of the June sampling of the low-maintenance trial were highly variable as demonstrated by the Ronstar having more root weight than the control. This is quite surprising because in Agronomy Journal (67:563-565, 1975), A. J. Turgeon reported oxadiazon to be quite damaging to turf. This could be due to the variability in the old golf course soils. The only herbicide that significantly inhibited rooting was the Pendimethalin which was 18% lower at the low rate than the control and 20% lower at the high rate (Table 21).

The August samplings in the low-maintenance trial showed less variability and no significant differences among the herbicides. But again, the Ronstar treatment was rather high and the Pendimethalin treatments were low.

The high-maintenance study showed no significant differences among the herbicides and the rates at which they were applied (Table 22).

There were considerable differences between the high- and low-maintenance trials with the low-maintenance trial showing more damage. This could be due to a number of reasons, the first being, preemergent herbicides break down faster with high-moisture than low-moisture conditions. Thus, if the herbicides degraded quickly in the high-maintenance trial, they had little time to do any damage to the roots. Another explanation is based on the faster recovery ability of the turf in the high-maintenance trial. So, even if the turf was damaged to a certain extent, it recovered before it could be detected.

Preemergence herbicides can cause damage to turf under certain conditions. More research should be done to delineate exactly which conditions, herbicides, and rates produce the damage. Simpler and more accurate methods must be established to check root inhibition caused by these herbicides. Currently, to obtain more conclusive results, the authors are undertaking an in vitro study to investigate these effects.

It is very important to remember that these are the results of only one year's data on two locations. Much more work will be required before conclusions can be drawn concerning the effects of the herbicides on rooting. At this time, this information should not be used to make herbicide selection decisions.

Table 21. Mean weights of low-maintenance rooting samples.

Treatment	kg ai/ha	Ash weights (mg) June	Ash weights (mg) August
1. Control	---	97.37	118.04
2. Betasan 4 EC	8.0	86.08	101.05
3. Betasan 4 EC	12.5	91.28	114.11
4. Ronstar 2 G	3.0	107.07	112.71
5. Dacthal 75 WP	10.5	96.90	111.52
6. Pendimethalin 60 WDG	1.5	79.68	96.53
7. Pendimethalin 60 WDG	3.0	78.25	99.97
LSD = 0.05		17.54	N.S.

Table 22. Mean weights of high-maintenance rooting samples.

Treatment	lb ai/A	weight (mg)
1. Control	---	241.04
2. Dacthal 75 WP	10.5	210.43
3. Dacthal 75 WP	15.0	207.31
4. Ronstar 2 G	2.0	190.64
5. Ronstar 2 G	3.5	189.55
6. Betasan 4 EC	7.5	180.58
7. Betasan 4 EC	14.0	240.71
8. Balan 2 G	2.0	213.64
9. Balan 2 G	3.0	199.24
LSD = 0.05		N.S.

1985 Postemergence Annual Weed Control Study

N. E. Christians and M. L. Agnew

The 1985 postemergence annual weed control study was conducted between the 7th and 8th fairways of Homewood Golf Course located on the east side of Ames, Iowa. This area was established more than 50 years ago and no preemergence herbicides have been used on the site. The crabgrass population on the area is generally quite high.

The treatments included Acclaim from American Hoechst Corporation, MSMA (Daconate 6), Tridephane from Dow Chemical Company, and two experimentals from PBI Gordon - EH 795 and EH 805.

The materials were originally to be applied at times through spring and early summer to correspond to 1) the one- to two-leaf stage, 2) the first-tiller stage, and 3) the mature stage of crabgrass. Due to the very dry spring and summer, however, the later treatments were shifted to midsummer (July 29) and late summer (August 20). These times of application corresponded to the appropriate stages of late-germinating crabgrass.

The May 28 treatments of Acclaim and MSMA were not effective in controlling crabgrass (Table 23). This is likely due to the extended dry period in the summer of 1985 that began in late May and extended through late July. The high crabgrass counts were likely due to a second germination of crabgrass in late July. Much of the crabgrass that had germinated in May died in all plot areas during the summer drought.

Tridephane, applied on May 28, was not effective in controlling crabgrass at 1.0 lb ai/A, but did reduce crabgrass populations at the 1.5- and 2.0-lb/A rates, although these reductions were not significantly lower than the control. Tridephane applied at 1.0 lb/A on May 28, and 1.0 lb/A on July 29, completely eliminated crabgrass from plot areas.

The EH 795 was not effective in controlling crabgrass when applied at a single application rate of 5 oz/1000 ft^2. However, in plots where follow-up treatments were made with EH 795 10 days later, crabgrass counts were reduced from 22 to 7 plants. Single applications of EH 805 were as effective as the repeated applications of EH 795. Control was not improved by repeat applications of EH 805 (Table 23).

The July 29 applications of Acclaim at both 0.12 and 0.18 lb/A completely eliminated crabgrass in all treated plots. The MSMA reduced crabgrass numbers but was not completely effective (Table 23). Acclaim and MSMA applied to mature crabgrass on August 20 reduced crabgrass numbers but the treatments were not as effective as those applied at the first tiller stage of crabgrass on July 29.

The August 20 application of Acclaim appeared to damage treated Kentucky bluegrass plots (Table 23). Close examination of damaged plants indicated no direct damage to mature grass leaves but the material appeared to inhibit tillering and growth of new plants from rhizomes which resulted in thinning of plots. This was the only time during the season that any damage to the plots was observed in response to herbicide treatments.

Table 23. Results of the 1985 postemergence annual weed control study.

	Treatment	Rate	Date of Application May 28	July 29	Aug 20	Crabgrass[a]	Phytotoxicity[b] Aug 29, 1985
		lb ai/A					
1.	Control	----				25	9
2.	Acclaim	0.12	X			26	9
3.	Acclaim	0.18	X			32	9
4.	MSMA	2.0	X			24	9
5.	Acclaim	0.12		X		0	9
6.	Acclaim	0.18		X		0	9
7.	MSMA	2.0		X		4	9
8.	Acclaim	0.12			X	2	8
9.	Acclaim	0.18			X	3	5
10.	MSMA	2.0			X	7	9
11.	Tridephane	1.0	X			39	9
12.	Tridephane	1.5	X			8	9
13.	Tridephane	2.0	X			14	9
14.	Tridephane	1.0/1.0	X			0	9
15.	EH 795	5 oz/1000 ft^2	X			22	9
16.	EH 795	5 oz/5 oz	X			7	9
17.	EH 805	5 oz	X			7	9
18.	EH 805	5 oz/5 oz	X			7	9
	LSD 0.05					23	0.7

[a] Number of crabgrass plants in a 5 X 5 ft plot on August 29, 1985.

[b] 9 = no damage, 6 = acceptable. 1 = worst damage.

1985 Broadleaf Weed Control Study

N. E. Christians and M. L. Agnew

The 1985 broadleaf weed control study was conducted at Brookside Park in Ames, Iowa. The Kentucky bluegrass turf area chosen had never been treated with herbicides and was heavily infested with broadleaf weeds including the following species: dandelion (Taraxacum officianale), broadleaf plantain (Plantago major), field bindweed (Convolvulus arvensis), black medic (Medicago lupulina), prostrate knotweed (Polygonum oviculare), ladysthumb (Polygonum persiconia), Canadian thistle (Cirsium arvense), and prostrate spurge (Euphorbia maculata). Treatments included XRM-4814, Turflon D, Starane 2, and Formula 40 from Dow Chemical; and Trimec Ester, EH 791 (Turf Ester), EH 680 (Super Trimec), and Trimec from PBI Gordon (Tables 1 and 2).

Treatments were made in three replications to 5 X 10 ft plots on June 20, 1985, in the equivalent of 50 gal water/acre. The temperature was between 75 and 80°F at the time of application and there was no rain in the area for more than 48 hours after treatment. Counts of the number of each weed species per plot were made on July 22 and again on August 29.

By July 22, XRM-4814 had reduced dandelion numbers as compared to the control; however, control at the 2.5-pt/A rate was unsatisfactory (Table 24). The 3.0- and 3.5-pt/A rate provided satisfactory control of dandelion. All rates of XRM-4814 were effective in controlling field bindweed and black medic, but none of the rates were effective in controlling prostrate knotweed. Turflon D was very effective in controlling dandelion, field bindweed, and black medic. This material was effective in reducing prostrate knotweed as compared to the control, but it did not completely eliminate this species. Starane 2 reduced the population of most species of weeds as rates increased, but it was not completely effective in controlling any of them. Formula 40 was effective against dandelions, but did not completely eliminate them. Field bindweed and black medic were completely eliminated. Prostrate knotweed was not reduced by Formula 40.

The EH 791, EH 680, and Trimec at 3.5-pt/A were very effective in controlling dandelion, field bindweed, and black medic. Prostrate knotweed was controlled by EH 791 and EH 680. This species was reduced by Trimec Ester at 2.0 pt/A and Trimec at 3.5 pt/A, but the knotweed was not completely controlled by either material.

The stand of Kentucky bluegrass on the area was thin and by August 29 many weed species had reinfested the plot areas (Table 25). Plots treated with the XRM-4814 at 3.5 pt/A, Turflon D at both rates, the EH 791, and EH 680 had the lowest numbers of dandelions on August 29. Prostrate knotweed populations increased rapidly between July 22 and August 29. Starane 2, the EH 791 (Turf Ester), and EH 680 (Super Trimec) were the most effective materials at limiting reinfestation of knotweed. The ester formulations of Trimec tended to be much more effective than the standard Trimec formulation against this species.

Table 24. The average number of broadleaf weeds in 5 X 10 foot plots on July 22, 1985.

	Material	Rate	Dandelion	Plantain	Field Bindweed	Black Medic	Prostrate Knotweed	Ladysthumb	Canadian Thistle
1.	XRM-4814	2.5 pt/A	18	0	2	0	18	0	3
2.	XRM-4814	3.0 pt/A	4	0	0	0	19	0	1
3.	XRM-4814	3.5 pt/A	4	0	2	0	18	0	0
4.	Turflon D	3.0 pt/A	2	0	2	0	9	3	1
5.	Turflon D	4.0 pt/A	0	0	0	0	10	2	4
6.	Trimec Ester	2.0 pt/A	3	0	0	0	6	0	1
7.	Starane 2	0.25 lb ai/A	21	2	12	0	17	1	0
8.	Starane 2	0.375 lb ai/A	13	2	8	1	8	2	1
9.	Starane 2	0.50 lb ai/A	8	2	9	0	3	0	3
10.	EH 791 (Turf Ester)	3.0 pt/A	0	0	0	0	0	0	2
11.	EH 680 (Super Trimec)	3.0 pt/A	0	0	0	0	1	0	0
12.	Formula 40	3.5 pt/A	4	0	0	0	20	0	3
13.	Trimec	3.5 pt/A	1	0	0	0	8	0	1
14.	Control	---	41	2	28	7	37	0	1
	LSD 0.05		14	N.S.	9	1	25	N.S.	N.S.

5 X 10 foot

N.S. = no significant differences among treatments.

Table 25. The average number of broadleaf weeds in 5 X 10 foot plots on August 29, 1985.

Material	Rate	Dande-lion	Plan-tain	Field Bindweed	Black Medic	Prostrate Knotweed	Ladys-thumb	Canadian Thistle	Prostrate Spurge
1. XRM-4814	2.5 pt/A	27	0	3	0	23	3	0	8
2. XRM-4814	3.0 pt/A	19	0	0	0	32	1	1	4
3. XRM-4814	3.5 pt/A	9	0	4	0	28	0	0	2
4. Turflon D	3.0 pt/A	7	0	4	0	10	5	0	3
5. Turflon D	4.0 pt/A	9	0	5	0	18	2	5	3
6. Trimec Ester	2.0 pt/A	12	0	0	0	12	0	1	4
7. Starane 2	0.25 lb ai/A	31	2	16	0	5	0	0	5
8. Starane 2	0.375 lb ai/A	23	2	8	0	10	0	3	17
9. Starane 2	0.50 lb ai/A	23	2	5	3	4	0	1	6
10. EH 791 (Turf Ester)	3.0 pt/A	7	0	5	0	5	0	2	6
11. EH 680 (Super Trimec)	3.0 pt/A	8	0	4	0	4	0	1	4
12. Formula 40	3.5 pt/A	12	0	5	0	22	1	1	4
13. Trimec	3.5 pt/A	13	0	1	0	31	0	2	3
14. Control	---	50	3	20	7	47	0	1	6
LSD 0.05		16	N.S.	13	N.S.	28	N.S.	N.S.	N.S.

N.S. = no significant differences among treatments.

1985 Phytotoxicity Tests

N. E. Christians

A phytotoxicity test to screen the effects of a variety of herbicides on Penncross creeping bentgrass, Scaldis hard fescue, Pennfine perennial ryegrass, and Falcon hard fescue was applied in a single replication on July 30, 1985. The bentgrass was maintained at a 5/32-inch mowing height. The other three species were maintained at a 2-inch mowing height. Temperatures were between 85-90°F at the time of application.

The creeping bentgrass was very sensitive to all herbicides with the exception of Dacthal, Pendimethalin, Team, and Betasan/Devrinol (Table 26). The SN 594 at 2-lb ai/A and the Acclaim damaged the bentgrass initially, but the turf recovered by September 3, 1985.

The only herbicide to cause unacceptable damage to the hard fescue, the perennial ryegrass, and the tall fescue was Ronstar 50 WP at both the 2- and 4-lb ai/A rates. The only treated plot showing unacceptable damage at the September 3 testing date was the hard fescue treated with Ronstar 50 WP at 4-lb ai/A.

Table 26. Ratings for the 1985 Phytotoxicity Tests for four turfgrass species.

Herbicide	Rate	Creeping Bentgrass			Hard Fescue			Perennial Ryegrass			Tall Fescue		
		8/5	8/10	9/3	8/5	8/10	9/3	8/5	8/10	9/3	8/5	8/10	9/3
	-lb ai/A-												
1. SN 594	2	5[a]	4	9	8	6	9	9	9	9	9	9	9
2. SN 594	4	5	3	5	8	8	9	8	9	9	9	9	9
3. SN 594	5	3	3	9	9	9	9	8	9	9	9	9	9
4. Ronstar 50 WP	2	4	4	4	7	8	9	7	4	9	4	4	9
5. Ronstar 50 WP	4	4	2	2	7	5	5	4	4	9	5	4	9
6. Dacthal	10.5	8	7	6	9	9	9	9	9	9	9	9	9
7. Pendimethalin 60 WP	1.5	6	7	8	9	9	9	9	9	9	9	9	9
8. Acclaim	0.12	4	3	9	7	9	9	9	9	9	9	9	9
9. Tridephane	1.5	5	3	3	9	9	9	9	7	9	9	9	9
10. Turflon D	3.0 (pts/A)	2	2	2	7	9	9	9	9	9	9	9	9
11. Starane-2	0.375	2	1	2	9	9	9	9	9	9	9	9	9
12. XRM-484	3.0 (pts/A)	2	2	2	9	8	6	9	9	9	9	9	9
13. Team	1.5	9	8	9	9	9	9	9	9	9	9	9	9
14. Betasan/ Devrinol	4.9/ 0.98	9	8	9	9	9	9	9	9	9	9	9	9

[a] Phytotoxicity is rated on a scale of 9 to 1; 9 = no damage, 6 = acceptable, and 1 = dead turf.

Plots measured 5 X 5 feet.

All treatments were applied in the eqivalent of 4 gallons water/1000 ft^2.

1985 *Poa annua* Control Study

M. C. Gaul and N. E. Christians

Annual bluegrass (Poa annua) is a weed that has presented turf managers with serious problems for many years. A variety of chemicals, including pre- and postemergence herbicides along with plant growth retardants, has been tested and used for annual bluegrass control. If one word could be used to sum up the results of all these chemicals in controlling annual bluegrass, it would have to be the word "inconsistent." The latest trend in controlling annual bluegrass is the development of programs to successfully manage this species as a turf; however, the search for effective chemical control still continues. Rubigan and chlorsulfuron are two chemicals that have been tested for possible annual bluegrass control in the past two years at Iowa State University. The objectives of this study include determining appropriate rates of both chemicals for controlling annual bluegrass and observing any phytotoxic effects that may occur on the desired turfgrass species in the test area.

Rubigan

Rubigan, produced by the Elanco Company, is a systemic fungicide labeled for controlling many common turfgrass diseases. It has also been observed in some instances to gradually reduce annual bluegrass populations. Elanco states there is no single rate that will effectively control annual bluegrass. They do recommend rates of 0.2 to 0.4-oz/1000 ft^2 applied every 2 to 3 weeks during the summer disease stress period until an accumulative amount of 2-oz/1000 ft^2 has been reached.

This field study was conducted over a 2-year period (1984-1985) at the Iowa State University golf course on the east end of the practice putting green. Treatments, applied beginning in mid-June each year, included rates of 0.05, 0.10, 0.15, 0.20, and 0.25 oz ai/1000 ft^2. Each treatment was applied to a 5 X 5 ft plot and replicated three times. The treatments were applied in 326 ml of water (equivalent to 150 gal/A) at 20 psi using a hand-held boom, operated in four different directions to ensure uniform coverage. Each treatment was applied eight times over a period of 3.5 months until cumulative amounts ranging from 0.40 to 2.0 oz ai/1000 ft^2 were reached.

Data were taken at periodic intervals during the study and included only quality ratings. The quality ratings were determined on a scale from 9 to 1; with 9 = best quality, 6 = acceptable, and 1 = dead turf. Clipping weights were not taken because species were so dispersed throughout the plots that separation would have been impossible. At the termination of the study, final ratios of annual bluegrass to creeping bentgrass were measured to determine if differences among treatments existed.

Response in this study varied with species, treatment rates, and years. In 1984, annual bluegrass showed increasing phytotoxicity (decreasing quality ratings) with increasing rates of rubigan. Similar results were observed on creeping bentgrass. Overall mean quality ratings ranged from 8.3 to 6.3 for annual bluegrass and from 8.6 to 5.5 for creeping bentgrass (Table 27). In

1985, annual bluegrass showed a very slight increase in phytotoxicity (decreasing quality ratings) with increasing rates of rubigan. Overall mean quality ratings ranged from 8.9 to 8.1 for annual bluegrass and from 9.0 to 5.9 for creeping bentgrass (Table 27). As in 1984, creeping bentgrass showed an increase in phytotoxicity with increasing rubigan treatment rates. At the termination of this study, annual bluegrass to creeping bentgrass ratios were measured and no signficant differences were observed between control plots and treated plots.

Results indicated that the annual bluegrass was more tolerant to increasing rubigan treatment rates than was creeping bentgrass. The phytotoxicity that occurred to the creeping bentgrass was a purplish-wilted condition that persisted for up to two months after the final application at some of the higher treatment rates. Also, quality ratings on both species tended to be lower in 1984 than in 1985. This could be because the summer of 1984 was much warmer and drier than the summer of 1985. As a result, additional stress may have been placed on the turf allowing for chemical stress to be more visible.

Several logical reasons can be presented to support the results seen in this study. First, it is important to remember that rubigan is not herbicidal in nature -- it will not kill a plant the way a herbicide will. Rubigan's primary mode of action involves the inhibition of gibberellic acid synthesis in susceptible plants such as annual bluegrass. Gibberellic acid is a plant hormone responsible for cell elongation. As a result, susceptible plants, such as annual bluegrass, will become reduced in size and eventually be crowded out by the more aggressive and nonsuscepitble plants such as creeping bentgrass. One problem may be that such a competitive shift may take several years before any actual reduction occurs. A second reason is that, perhaps in this study, we are dealing with an annual bluegrass biotype that is resistant to rubigan. Such chemical resistances are commonly observed among various annual bluegrass biotypes.

Chlorsulfuron

Chlorsulfuron, produced by the DuPont Company, is a postemergence herbicide used mainly for controlling various broadleaves and annual grasses in cereal crops. It is labeled under the trade names of 'Glean' and 'Telar'. Telar has been labeled for use in low-maintenance turfgrass areas such as roadsides. Brian Maloy, a former ISU graduate student, tested the selectivity of several cool-season turfgrass species to chlorsulfuron in the greenhouse. Maloy could adequately control annual bluegrass with rates of 2-oz ai/A. With these observations, field studies were initiated to see if chlorsulfuron could also control annual bluegrass in the field.

The field study was conducted at two sites -- on the practice putting green of the Iowa State University golf course in Ames and on the third fairway of the Hyperion Field Club in Des Moines. Treatments were applied in 1984 and 1985 at the ISU golf course; Hyperion only received treatments in 1985. Treatments included rates of 0.25, 0.50, 1.0, 2.0, and 4.0-oz ai/A. These were applied only once beginning in mid-June of each year. The methods used to apply the treatments and collect data were identical to those used in the rubigan study.

Responses in this study varied with species, treatment rates, years, and sites. At the ISU golf course, creeping bentgrass appeared more tolerant of chlorsulfuron than did annual bluegrass in both 1984 and 1985. In 1984, overall mean quality ratings ranged from 8.2 to 7.0 for creeping bentgrass and from 7.6 to 6.8 for annual bluegrass (Table 28). In 1985, overall mean quality ratings ranged from 9.0 to 8.7 for creeping bentgrass and from 8.9 to 8.5 for annual bluegrass. Again, 1984 quality ratings are lower than those from 1985. This is probably due to a warmer and drier summer in 1984. Overall there is no significant annual bluegrass reduction at any treatment level of chlorsulfuron.

At the Hyperion site, much more positive results were seen with chlorsulfuron in terms of annual bluegrass control. Increasing phytotoxicity (decreased quality ratings) on annual bluegrass was observed with increasing treatment rates. Overall mean quality ratings ranged from 9.0 at the control level to 2.9 at the highest treatment level. The Kentucky bluegrass that was in the plots showed no phytotoxic effects at all treatment levels.

Unfortunately, one of the problems with this postemergence herbicide is that it lacks the ability to prevent annual bluegrass from growing back into voids left in the turf. This was a slight problem in our study as many of the lower rate plots completely filled back in with annual bluegrass during the cool fall months. Fortunately, however, the higher rate plots were slower to fill back in with annual bluegrass. This created less competition for the existing Kentucky bluegrass and allowed for further establishment that hopefully in the long run would result in the conversion to Kentucky bluegrass.

Several explanations can be offered to help explain why chlorsulfuron controlled the annual bluegrass at Hyperion and not at the ISU golf course. Differences in soil conditions, especially soil pH, can greatly affect herbicide activity. Soil tests revealed pH readings of 7.7 at the ISU golf course and 6.9 at the Hyperion Field Club. This large pH difference between the two sites may account for some of the differences observed. Another factor may be leaching. The putting green tends to contain much more sand and is irrigated more often creating conditions ideal for the leaching of chemicals. This may also partially account for the poor control of annual bluegrass at the ISU golf course. This is a possible avenue of investigation for further research. Finally, perhaps we are dealing with two very different biotypes -- one that is tolerant of chlrosulfuron and one that is susceptible to it.

Table 27. Rubigan quality ratings.

Species	Rate/ Application	1984 Wk 6	1984 Wk 10	1984 Wk 15	1984 Mean	1985 Wk 6	1985 Wk 10	1985 Wk 15	1985 Mean
	(oz ai/1000 ft^2)								
Annual bluegrass	-0-	7.7	8.0	8.6	8.3	9.0	9.0	9.0	8.9
	.05	7.7	7.3	7.7	7.6	8.7	9.0	9.0	8.8
	.10	7.7	7.7	7.7	7.7	8.0	9.0	9.0	8.7
	.15	7.7	7.7	7.7	7.6	7.7	9.0	9.0	8.4
	.20	7.0	7.3	8.0	7.4	7.0	8.3	9.0	8.1
	.25	6.0	6.0	6.3	6.3	8.7	8.0	9.0	8.1
Creeping bentgrass	-0-	8.0	8.7	9.0	8.6	9.0	9.0	9.0	9.0
	.05	7.3	8.3	8.3	7.9	8.7	8.0	9.0	8.6
	.10	7.7	8.0	7.3	7.7	8.3	8.3	8.0	8.5
	.15	7.7	7.3	6.7	7.0	7.0	7.7	8.3	7.9
	.20	7.7	7.0	6.3	7.0	6.3	7.0	7.3	7.3
	.25	6.0	6.3	4.7	5.5	6.0	6.0	6.0	5.9

Table 28. Chlorsulfuron quality ratings.

Site	Rate	Annual Bluegrass Wk 4	Annual Bluegrass Wk 10	Annual Bluegrass Wk 15	Mean	Creeping Bentgrass Wk 4	Creeping Bentgrass Wk 10	Creeping Bentgrass Wk 15	Mean
	oz ai/A								
Veenker 1984	-0-	7.3	7.0	8.0	7.6	8.0	8.3	8.0	8.2
	.25	7.3	7.0	7.3	7.2	8.3	9.0	7.6	8.1
	.50	6.0	7.0	7.3	6.8	8.0	8.7	7.7	7.9
	1.00	6.3	6.3	7.7	6.7	8.3	8.0	7.0	7.7
	2.00	7.0	6.0	7.3	6.4	7.7	8.3	7.3	7.1
	4.00	6.3	6.7	7.7	6.8	8.3	7.7	7.0	7.0
Veenker 1985	-0-	9.0	9.0	9.0	8.9	9.0	9.0	9.0	9.0
	.25	8.3	9.0	8.7	8.5	9.0	9.0	8.7	8.9
	.50	8.3	9.0	9.0	8.9	9.0	9.0	8.7	8.9
	1.00	8.3	8.7	9.0	8.8	9.0	9.0	9.0	9.0
	2.00	7.7	8.7	9.0	8.6	9.0	9.0	8.7	8.9
	4.00	8.3	9.0	9.0	8.8	8.3	9.0	9.0	8.7
Hyperion	-0-	9.0	9.0	9.0	9.0	---	---	---	---
	.25	3.7	8.3	8.7	7.0	---	---	---	---
	.50	3.7	6.7	8.7	6.3	---	---	---	---
	1.00	3.3	7.0	8.3	6.5	---	---	---	---
	2.00	2.3	5.0	7.0	4.9	---	---	---	---
	4.00	2.0	3.0	3.7	2.9	---	---	---	---

Rubigan Bentgrass Cultivar Study

M. C. Gaul and N. E. Christians

Initial field studies using rubigan for Poa annua control on golf course putting greens revealed a discoloration to the desired creeping bentgrass. This discoloration appeared as a purplish-wilted condition that persisted for several months after the final applications were made at higher treatment levels. The purpose of this study was to look at specific bentgrass cultivars and their response to the recommended rate (0.30 oz/1000 ft^2) of rubigan.

The study was intitated on June 20, 1985, at the Iowa State University Turfgrass Research Plots at the ISU Horticulture Research Station, 10 miles north of Ames. Treatments were applied at a rate of 0.30-oz/1000 ft^2, at 2-week intervals beginning June 15 and ending October 1. A total amount of 2.1-oz/1000 ft^2 was applied. Each treatment was applied to a 10 X 7 foot plot and replicated four times. The treatments were applied in 2000 ml/1000 ft^2 of water at 20 psi using a hand-held boom. Cultivars tested included: Emerald, Kingstown, Penncross, Penneagle, Prominent, and Seaside.

The results showed that the treated turf overall had slightly lower quality ratings than the untreated turf but all still had quality ratings above the acceptable level (Table 29). The only severe discoloration that did occur was around 39 days after the initial application and this could probably be attributed to the grass being under some additional stress from the very warm temperatures in late July. Overall, Penncross, Penneagle, Emerald, and Prominent showed the least discoloration response to rubigan treatments. Seaside and Kingstown appeared to be the least tolerant of rubigan treatments, however, the low quality ratings for the Seaside control plots suggest that it may not be the ideal bentgrass cultivar for use in this area.

There were no visible effects of 1985 treatments in the spring of 1986.

Table 29. The response of six bentgrasses to rubigan treatments[a] in the 1985 season.

Cultivar	Days after first application							M^b
	18	39	54	61	77	102	108	
Emerald								
Treated	9.0[c]	6.5	8.0	7.7	8.7	8.7	8.6	8.2
Untreated	9.0	7.7	8.5	8.5	9.0	8.7	8.7	8.6
Kingstown								
Treated	9.0	5.5	7.7	7.2	8.5	8.7	8.0	7.8
Untreated	9.0	7.7	8.2	8.2	9.0	8.7	8.7	8.5
Penncross								
Treated	9.0	7.5	8.2	8.0	8.7	9.0	9.0	8.5
Untreated	9.0	8.2	9.0	8.7	9.0	9.0	9.0	8.8
Penneagle								
Treated	9.0	8.2	7.7	7.7	8.7	9.0	9.0	8.5
Untreated	9.0	9.0	8.5	9.0	8.7	9.0	9.0	8.9
Prominent								
Treated	9.0	7.5	8.2	8.0	8.5	8.5	8.2	8.4
Untreated	9.0	8.5	8.7	8.5	9.0	8.7	8.5	8.7
Seaside								
Treated	9.0	5.2	6.2	6.2	6.5	7.5	6.7	7.7
Untreated	9.0	7.5	7.5	7.5	8.0	8.2	8.0	8.0
LSD = 0.05	N.S.[d]	1.24	.77	.63	.45	.43	.43	.26

[a] Treatments applied June 20, July 8 and 23, August 6 and 21, and September 11 and 30.

[b] M = overall mean.

[c] Each quality rating is the mean from four replications. Quality rating scale: 9 = best quality, 6 = acceptable, and 1 = dead turf.

[d] LSD's compare treatment effects within cultivars and treatment effects among cultivars.

LIMIT: Effects of a High-Concentration at Six Application Dates on Kentucky Bluegrass

K. L. Diesburg and N. E. Christians

Limit was applied to 'Baron' Kentucky bluegrass at 10 lb ai/A on April 30, May 3, 6, 10, 13, and 17, 1985. The rate was four times higher than 2.5 lb ai/A. which is the recommended rate for turf. Treatments were applied to 5 X 5 ft plots through a hand-held boom with three fan jet nozzles passing two feet above the ground via pressurized CO_2 from a tank strapped to the operator's back. The plots were arranged in a randomized complete block design with four replications. The mature turf was growing on a sandy, clay, loam soil receiving 4 lb N/1000 sq ft/yr in the form of 37-0-0 sulphur-coated urea. The only chemicals previously applied to the turf were Trimec on September 27, 1984, and Dacthal on April 22, 1985. Overhead irrigation was supplied to prevent drought stress. All plots were mown until May 9. Mowing did not affect treatments previous to that date since the leaf blades there were no longer elongating. Any further mowing would have removed the heads from subsequently treated plots. After all treatments had been applied, turf quality, canopy height, and heading were recorded on three dates (Table 30). On May 28 the effects of all treatments on heading could be seen. By June 6, heading was fully expressed, while plants in the plots receiving the first two treatments were recovering with renewed growth, and toxicity effects could still be seen in plots receiving the last two treatments. Data from July 4 record long range effects.

Results

Effects on canopy height were straightforward. Limit stopped leaf elongation within 1 to 2 days after application and continued to stop growth for 4 weeks. By July 4, there were no further treatment effects visible and all plots had similar canopy heights.

Toxicity effects were more complex. Turf quality never dropped below the acceptable level. One month after the April 30 treatment, however, the reduction in turf quality was greater than that at a similar time after each of the other treatments. This could be due to the slower growth rate of 'Baron' at that time. It had not yet reached its peak, spring, vegetative vigor. Conversely, two months after the May 10 treatment the reduction in turf quality was less than that at a similar time after each other treatment. This was the only treatment where turf quality never dropped below 8.0. That particular application occurred during a time of Baron's most vigorous vegetative growth.

Heading stopped at the morphogenic stage it had achieved prior to treatment and never resumed regardless of the application date. As a result, head emergence from superposing phytomers was prevented in the April 30 and May 3 treatments while extruded heads were more or less partially hidden by the leaf canopy in the other four treatments. This can be seen by comparing canopy heights with respective head heights in Table 30.

Discussion

The lack of phytotoxicity at such a high rate of application was unexpected. The effects were consistent across application dates. In contrast, previous experiments have shown Limit to be less effective in summer and fall applications. If results similar to this experiment can be obtained in turf at lower levels of nitrogen and/or water, Limit should provide a means of reducing spring labor costs for the turf manager without risking a severe reduction in turf quality.

Table 30. Means of turf quality, canopy height, heading, and head height in response to different dates of Limit treatments at four times the recommended application rate.

Treatment	Canopy Height (cm)			Quality[a]			Head Hgt (cm)		Heading[b]
Date 1985	May 28	Jun 6	Jul 4	May 28	Jun 6	Jul 4	May 28	Jun 6	Jun 6
April 30	6.8	11.2	23.5	6.2	8.5	8.5	5.2	0.0	0.0
May 3	7.0	10.8	23.2	6.8	8.8	8.5	6.0	3.5	0.8
May 6	7.0	9.5	22.5	7.0	8.0	7.8	6.0	6.2	2.8
May 10	9.0	9.2	22.8	8.0	8.0	8.8	6.8	7.2	5.2
May 13	10.0	9.5	21.0	9.0	7.0	8.0	8.5	8.8	7.8
May 17	11.2	10.8	19.5	9.0	7.0	7.2	9.2	9.8	9.0
Control	13.2	20.2	33.8	9.0	9.0	9.0	14.5	26.2	9.0
LSD	0.9	1.7	8.9	0.4	0.9	1.2	0.9	2.5	1.5

[a] Turf quality rated on a scale of 9 - 1; with 9 = best quality, 5 = unacceptable, and 1 = completely brown.

[b] Heading rated on a scale of 9 - 0; with 9 = 100% and 0 = no heads.

Evaluation of Fungicides for Control of Dollar Spot on Penneagle Bentgrass—1985

L. E. Sweets

Trials were conducted on the Turfgrass Research Plots at the Horticulutre Research Station, Ames, Iowa. Fungicides were applied to Penneagle bentgrass maintained at a 5/32-inch cutting height. Fungicides were applied with a modified bicycle sprayer at 30 lb psi and a dilution rate of 5 gallons per 1000 ft^2. The experimental design was a randomized block plan with four replications. The plots were 4 X 5 ft. Fungicides were applied on a 7-, 14-, 21-, or 30-day schedule as indicated in Table 32. Application began on May 29 and continued through September 4. Plots were evaluated for percent diseased turf on July 20 and August 20.

The trial was conducted in an area with a history of dollar spot and Rhizoctonia brown patch. Disease ratings for dollar spot were made by counting the number of dollar spot infection centers per plot (Table 32). May and June were relatively cool, so the development of dollar spot was minimal. Dollar spot began to develop in mid-season, and disease pressure was light to moderate. All plots showed good recovery from dollar spot by September 10. Daconil 2787 at 6.0 oz rate, Banner, Banner + CGA 449, and CGA 449 at the two highest rates gave best control. There were no symptoms of phytotoxicity with these materials.

Table 32. Evaluation of fungicides for control of dollar spot in Penneagle bentgrass.

Treatment	Rate (oz/1000 ft^2 Formulated Product)	Timing (Days)	Disease Rating[a]	
			July 20	August 20
Check			10.00 b	22.50 c
Duosan 75W	3.0	14	2.50 a	2.50 ab
Tersan 1991 50 W	1.0	14	3.25 a	15.00 bc
Dyrene 4F	8.0	14	1.50 a	14.75 bc
Bayleton 25DF	2.0	30	2.75 a	6.75 ab
Bayleton 25DF	1.0	30	3.50 a	11.50 bc
Bayleton 25DF	0.5	14	.50 a	5.50 ab
Chipco 26019 50W	2.0	21	.25 a	4.25 ab
Daconil 2787 4.17F	3.0	7 - 14	2.00 a	3.75 ab
Daconil 2787 4.17F	6.0	7 - 14	1.25 a	2.25 a
Fore 80W	8.0	21	3.25 a	18.00 c
Banner 1.1E/ Mancozeb 80W	3.0	21	.50 a	7.25 abc
Banner 1.1E/ Daconil 2787 4.17F	3.0	21	.50 a	5.25 ab
Banner 1.1E	1.0	21	1.00 a	2.50 a

CGA 449 50 W & Banner 1.1E	.42/0.5	14	1.25 a	2.50 a
CGA 449 50W	.42	14	3.25 a	8.50 bc
CGA 449 50W	.56	14	1.50 a	8.25 bc
CGA 449 50W	.85	14	0.00 a	1.25 a
CGA 449 50W	1.69	14	0.00 a	1.00 a
Vorlan 50W	2.0	14	.74 a	15.00 bc

[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 (DMRT, P = 0.05).

Evaluation of Fungicides for Control of Dollar Spot on Emerald Bentgrass—1985

L. E. Sweets

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station, Ames, Iowa. Fungicides were applied to Emerald bentgrass maintained at a 5/32-inch cutting height with a modified bicycle sprayer at 30 lb psi and a dilution rate of 5 gallons per 1000 sq ft. The experimental design was a randomized block plan with four replications. The plots were 4 X 5 ft. Fungicides were applied on a 7-, 14-, 21-, or 30-day schedule as indicated in Table 33. Applications began on May 29 and continued through September 4. Plots were evaluated for percent diseased turf on July 20 and August 20.

The trial was conducted in an area with a history of dollar spot and Rhizoctonia brown patch. Disease ratings for dollar spot were made by counting the number of dollar spot infection centers per plot. May and June were relatively cool, so the development of dollar spot was minimal. Dollar spot began to develop in mid-season, and disease pressure was light to moderate (Table 33). Rubigan at 0.2 oz on a 7-day schedule, BRC 916/surfactant at a 1.12-oz rate on a 14-day schedule, Prochloraz at both rates and in combination with Actidione TGF, Daconil 2787 at 6.0-oz rate on a 7- to 14-day schedule and Chipco 26019 F at a 2.0-oz rate and 21-day schedule gave the best dollar spot control. All plots showed good recovery from dollar spot by September 10. BRC 916/surfactant at both rates caused a marked greening of plots. Greening was noticed on June 26 (after two applications) and remained evident through remainder of season. There were no symptoms of phytotoxicity with other materials.

Table 33. Evaluation of fungicides for control of dollar spot on Emerald bentgrass.

Treatment	Rate (oz/1000 ft^2 Formulated Product)	Timing (Days)	Disease Rating[a] July 20	Disease Rating[a] August 20
Check			10.25 c	46.25 d
Rubigan 50W	.2	4	0.75 a	4.50 a
Rubigan 50W	1.0	30	5.50 ab	8.25 ab
Rubigan 50W	2.0	SA	5.25 ab	12.75 ab
PP 450	.56	14	0.50 a	21.50 bc
PP 450	1.12	14	0.25 a	10.00 ab
BRC 916 12.55SC/ surfactant	.56	14	0.00 a	16.50 b
BRC 916/surfactant	1.12	14	0.00 a	7.75 a
Prochloraz 40EC	4.5	14	0.00 a	5.00 a
Prochloraz 40EC	6.0	14	0.00 a	6.25 a

Actidione TGF 2.1W	1.0	14	3.00 a	12.50 ab
Prochloraz 40EC + Actidione TGF 2.1W	3.0/1.0	14	0.25 a	4.00 a
Prochloraz 40EC + Actidione TGF 2.1W	4.5/1.0	14	0.75 a	3.75 a
Daconil 2787 4.17F	6.0	7 - 14	1.00 a	3.00 a
Chipco 26019 50W	1.5	21	1.75 a	20.50 bc
Chipco 26019 50W	2.0	21	0.25 a	10.75 ab
Chipco 26019 F	1.5	21	2.25 a	16.50 b
Chipco 26019 F	2.0	21	0.50 a	8.00 a
Daconil 2787 4.17F + Actidione TGF 2.1W	1.5/.34	14	1.25 a	10.50 ab
Tersan 1991 50W	1.0	14	0.25 a	28.50 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 (DMRT, P = 0.05).

Evaluation of Fungicides for Control of *Bipolaris* Leaf Spot on Park Bluegrass—1985

L. E. Sweets

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station, Ames, Iowa. Fungicides were applied to Park bluegrass maintained at a 1 1/2-inch cutting height with a modified bicycle sprayer at 30 lb psi and a dilution rate of 5 gallons per 1000 sq ft. The experimental design was a randomized block plan with four replicates. Plots were 4 X 5 ft. Fungicides were applied on a 7-, 14-, 21-, or 30-day schedule as indicated in Table 34. Applications began on May 29 and continued through September 4. Plots were evaluated for percent diseased turf on July 20 and August 20.

Incidence of leaf spot was light until mid-season but increased from mid-season through September (Table 34). Prochloraz at a 4.5-oz rate, Prochloraz 3.0 oz + Actidione TGF .34 oz schedule, Chipco 26019 50W 2.0 oz and Chipco 26019 F at 2.0 oz, PP 450 at 1.12 oz, Daconil 2787 at 6.0 oz and Duosan at 3.0 oz rate gave the best control. No plots showed phytotoxicity symptoms.

Table 34. Evaluation of fungicides for control of Bipolaris leaf spot on Park bluegrass.

Treatment	Rate (oz/1000 ft^2 Formulated Product)	Timing (Days)	Disease Rating[a] July 20	Disease Rating[a] August 20
Check			12.00 b	36.25 d
Prochloraz 40EC	3.0	14	3.75 a	18.75 c
Prochloraz 40EC	4.5	14	0.00 a	6.50 a
Actidione TGF 2.1W	.34	14	0.00 a	18.50 c
Prochloraz 40EC + Actidione TGF 2.1W	1.5/.34	14	1.25 a	16.25 bc
Prochloraz 40EC + Actidione TGF 2.1W	3.0/.34	14	4.00 a	8.75 a
Chipco 26019 50W	2.0	21	3.75 a	6.25 a
Chipco 26019 F	2.0	21	1.25 a	8.00 a
PP 450	.56	14	3.75 a	15.00 bc
PP 450	1.12	14	8.75 ab	6.00 a
BRC 916/surfactant	.56	14	5.00 a	18.75 c
BRC 916/surfactant	1.12	14	3.75 a	11.25 abc
Banner 1.1EC	1.0	21	5.00 a	9.50 ab
Daconil 2787 4.17F	3.0	7 - 14	3.75 a	14.75 bc
Daconil 2787 4.17F	6.0	7 - 14	2.50 a	6.50 a
Bayleton 25DF	1.0	30	5.00 a	21.50 c
Bayleton 25DF	.5	14	0.00 a	16.25 bc
Tersan 1991 50W	1.0	14	5.00 a	9.75 ab
Vorlan 50W	2.0	14	2.50 a	12.50 b
Duosan 75W	3.0	14	1.25 a	7.25 a

[a] Average of ratings from four replicated plots. Based on a percentage of diseased turf per plot. Means in a column favored by the same letter do not differ significantly (DMRT, $P = 0.05$).

Pythium Root Dysfunction Field Studies

C. F. Hodges

Pythium root dysfunction is caused primarily by P. arrhenomanes and has been found only on reconstructed, high-sand content golf greens on old golf courses. The disease usually occurs the first or second year after establishing the turf on the new greens. Infected plants begin to die during midsummer heat stress in a pattern typical of Pythium blight; however, the Pythium is restricted to the root systems of the plants.

There is no precise explanation for why P. arrhenomanes attacks bentgrass roots only in high-sand content greens. It appears, however, that it is associated with inadequate microbiological competition in the sand. The Pythium species appear to establish rapidly and to coexist with the grass plants under mild growing conditions. Under stress, the infection of the roots results in rapid death of plants. The disease may be severe for 3 to 5 years and necessitate reestablishment of the turf. Eventually, however, the severity of the disease diminishes. It is believed that the gradual establishment of a competitive microbiology in the sand eventually contains the activity of the Pythium.

The primary practical problem in dealing with this disease is that existing fungicides and cultural techniques will not provide control. In an effort to discover a practical approach to controlling the disease, bentgrass plots were established on high-sand content greens at the Horticulture Research Station at Ames (Fig. 2). Prior to seeding the plots, P. arrhenomanes was grown on 500 g of cornmeal in disposable aluminum pans. One hundred pans of infested meal were roto-tilled into the sand. Each of nine plots were planted to Penncross, Emerald, and Penneagle. Sets of three plots each received cornmeal + Pythium, cornmeal alone, or no cornmeal (controls). The plots will be observed for disease development during the 1986 growing season. If the disease is successfully established, the plots will be used for control studies.

Figure 2. Root Pythium Study

Established 1985

2. Penneagle	2. Cornmeal + Pythium	2. Penneagle	3. Cornmeal	1. Penncross	2. Cornmeal + Pythium
3. Emerald		1. Penncross		3. Emerald	
1. Penncross		3. Emerald		2. Penneagle	
1. Penncross	1. Control	3. Emerald	2. Cornmeal + Pythium	2. Penneagle	1. Control
3. Emerald		1. Penncross		3. Emerald	
2. Penneagle		2. Penneagle		1. Penncross	
2. Penneagle	3. Cornmeal	1. Penncross	1. Control	2. Penneagle	3. Cornmeal
3. Emerald		2. Penneagle		1. Penncross	
1. Penncross		3. Emerald		2. Emerald	

Sod Reestablishment Study

N. E. Christians

On September 19, 1980, a sod establishment study that included Glade, Parade, Ram I, Rugby, and Touchdown Kentucky bluegrass was established at the research station. Each cultivar planting measured 20 X 12 ft and the study was arranged in a randomized complete block design with four replications. Data were collected on this study until September 1982 when sod strength measurements were taken, the investigation was terminated, and the results were reported in an earlier research publication. The study area was maintained with 4 lb N/1000 ft^2/yr and mowed at a 2-inch mowing height during the 1983 season.

All sod was removed uniformly from the study area on May 19, 1984, at a cutting depth of 0.5 inches. The area was watered immediately after harvest to prevent desiccation of the severed rhizomes. The entire study area was fertilized with 1 lb N/1000 ft^2 in May, August, and September of 1984 and 1985 and the area was irrigated to prevent drought stress. The objectives of this part of the study are to observe the reestablishment of the five cultivars from rhizomes and to determine if Kentucky bluegrass cultivars differ in their reestablishment rate after harvest.

Parade and Ram I were the slowest to recover in the two seasons following harvest (Fig. 1). Rugby was intermediate through the 1984 season but was equivalent to Parade and Ram I in the 1985 season. Glade and Touchdown recovered most quickly after harvest and maintained their advantage through both 1984 and 1985.

On October 20, 1985, sod tensile strength measurements were determined for each cultivar and replication by attaching 18-inch wide sod strips to a scale and recording the pounds of pull required to break the pieces. Three strips were collected from each plot and the data were recorded as the mean of the three measurements. Three 4-inch wide X 4-inch deep plugs were collected from the plots at the same time. Each plug was evaluated for total number of live plants, total dry weight of above-ground tissue, average number of tillers per plant, average number of rhizomes per plant, and weight of rhizomes per plug.

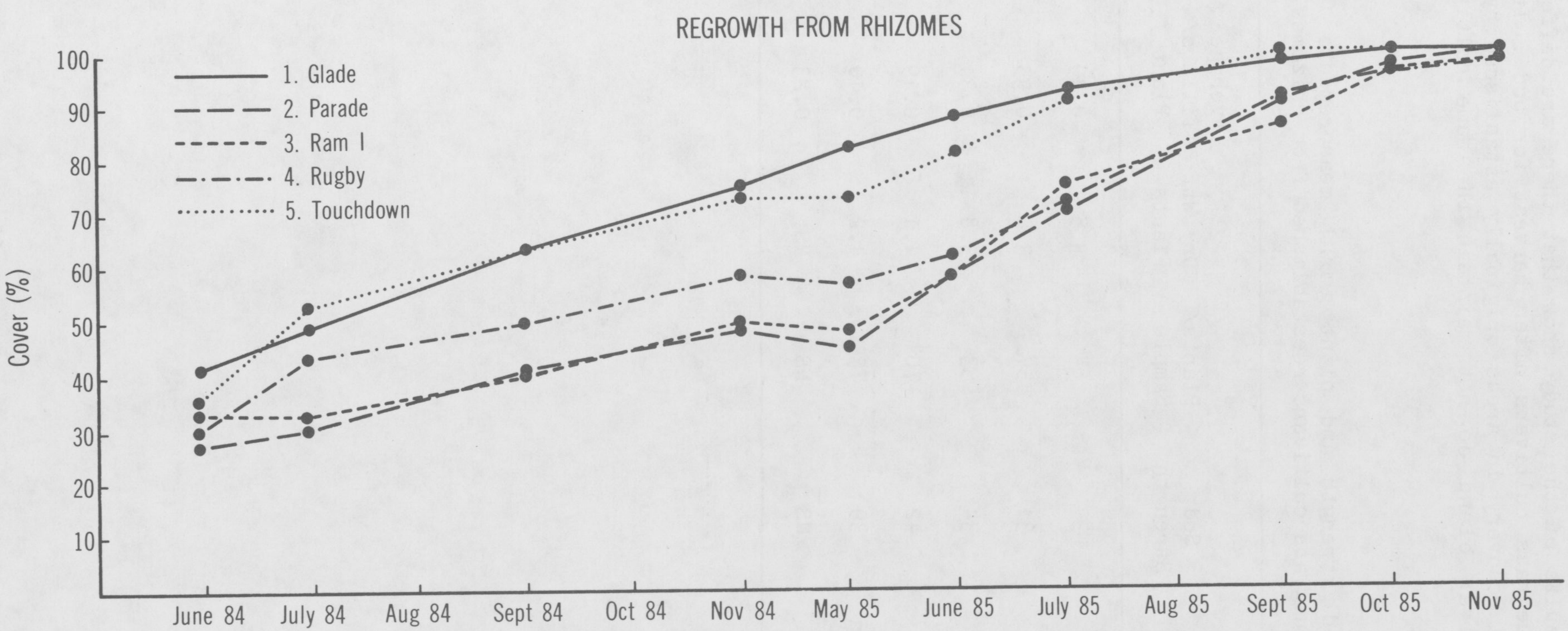
Sod strength, number of plants per sample, and dry weight of plants did not vary among the cultivars (Table 31). The average number of tillers per plant was highest for Parade and Ram I and lowest for Touchdown, Glade, and Rugby. The average number of rhizomes per plant did not vary, although the weight of rhizomes per 4-inch sample was greatest for Glade, followed by Touchdown.

The data collected on plant growth indicate that cultivars that put much of their energy into tiller formation (above ground growth) rather than into rhizomes (below ground growth) such as Parade and Ram I, recover more slowly than cultivars such as Glade and Touchdown that appear to channel more energy into rhizome production.

The results of the study show that there are differences in recovery of Kentucky bluegrass cultivars after harvest for sod. It is likely that this differential recovery in areas originally established by seed to a predetermined cultivar blend do not maintain the same cultivar percentages after regrowth.

Table 31. Sod strength and plant growth measurements for the five Kentucky bluegrass cultivars reestablished from rhizomes.

Cultivar	Sod Strength	Plants/ Sample	Dry Wt Plants	Average Tillers/ Plant	Average Rhizomes/ Plant	Weight Rhizomes/ Sample
1. Glade	33	64	3.5	0.19	1.1	1.7
2. Parade	31	57	3.0	0.35	1.1	1.1
3. Ram I	34	53	3.8	0.31	1.3	1.0
4. Rugby	42	70	4.1	0.19	1.0	0.9
5. Touchdown	39	73	4.2	0.10	1.0	1.2
	NS	NS	NS	0.23	NS	0.5


REGROWTH FROM RHIZOMES
Cover (%)
100
90
80
70
60
50
40
30
20
10
1. Glade
2. Parade
3. Ram I
4. Rugby
5. Touchdown
June 84
July 84
Aug 84
Sept 84
Oct 84
Nov 84
May 85
June 85
July 85
Aug 85
Sept 85
Oct 85
Nov 85

Influence of Soil Compaction on 14 Kentucky Bluegrass Cultivars

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

In the fall of 1979, 49 Kentucky bluegrass cultivars were seeded in section two of the turfgrass research area. In 1985, this cultivar trial was used to evaluate the effects of soil compaction on the growth and development of 14 of the Kentucky bluegrass cultivars.

Soil compaction was applied by a smooth power roller which exerted a static pressure of 2.5 kg cm^{-2} (35.5 16 in^{-2}). Compaction was applied on two dates in 1985 (May 23 and June 19). Each application of compaction consisted of 20 passes with the roller.

Measurements taken in 1985 included initial thatch depth and shoot density (Table 35). The results of the data indicated that the improved cultivars are heavy generators of thatch. In general, the upright growing common types of bluegrass had less thatch. Two exceptions were Majestic and Parade. The percent reduction in shoot densities demonstrated that Ram I and Baron were less affected by soil compaction, while Vantage, Adelphi, Common, Glade, Parade, Victa, Wabash, and Park were most affected.

Further data are scheduled for collection in 1986. The results will appear in the 1987 Field Day Report.

Table 35. The 1985 initial thatch depth and percent reduction of shoot density by soil compaction of 14 Kentucky bluegrass cultivars.

Cultivar	Thatch Depth (mm)	Percent Reduction of Shoot Density[a]
Sydsport	18.7	15.5
Common	15.0	23.9
Touchdown	19.3	17.3
Parade	14.3	21.5
Ram I	22.7	5.7
Park	12.3	20.4
Midnight	24.0	19.2
Baron	15.7	8.9
Victa	24.0	21.4
Majestic	13.7	17.1
Vantage	15.7	24.6
Glade	23.3	21.7
Adelphi	18.3	24.1
Wabash	14.3	21.6
LSD	7.9	12.0

[a] Percent reduction of shoot density is the number of tillers in uncompacted samples minus number of tillers in compacted samples divided by 100.

Turfgrass Cultivation Studies

M. L. Agnew and N. E. Christians

1. Cultivation equipment comparison

In the fall 1985, a cultivation study was initiated on an area (Fig. 3) which contained well over 1 1/2 inches of thatch. The purpose of this study was to compare four core aerators and one vertical mower in their capabilities to remove excessive thatch from a Kentucky bluegrass stand. The machines and their characteristics are included in Table 36. The turf is a Northrup King Premium Sod Blend, which was established in the fall of 1981 and was maintained at a cutting height of 2 inches.

The treatments include five machines and three levels of intensity of application (Table 37). All cultivation will be done in September of 1985, 1986, and 1987. Thatch depth will be measured the following spring.

2. Cultivation intensity studies

In the spring 1986, a cultivation study was initiated on two areas. A 1-year-old stand of Midnight Kentucky bluegrass and the area adjacent to the "Cultivation Equipment Comparison Study." The purpose of this study is to investigate the effects of core aeration and grooving on thatch prevention and thatch removal. The treatments are listed in Table 38.

Table 36. Characteristics of 5 different pieces of cultivation equipment.

Equipment Name	Equipment Description
Ryan Ride-aire	Hollow tine, 3.5 inches center to center spacing, 1/2-inch tine diameter
Ryan Lawn-aire III	Spoon tine, 3 3/4 x 7 inches center to center spacing, 1/2-inch tine diameter
Ryan Lawn-aire IV	Hollow tine, 3 3/4 x 7 inches center to center spacing, 1/2-inch tine diameter
Classen turf plugger	Hollow tine, 7 x 7 inches center to center spacing, 5/8-inch tine diameter
Ryan Ren-O-thin	Flail knives, 1 inch spacing, 1/8 inch blade thickness

Table 37. List of treatments for cultivation equipment comparison.

Treatment Number	Equipment Name	Number of Passes Over Area
1	Ride-aire	0X
2	Ride-aire	1X
3	Ride-aire	2X
4	Lawn-aire III	0X
5	Lawn-aire III	1X
6	Lawn-aire III	2X
7	Lawn-aire IV	0X
8	Lawn-aire IV	1X
9	Lawn-aire IV	2X
10	Turf plugger	0X
11	Turf plugger	1X
12	Turf plugger	2X
13	Ren-O-thin	0X
14	Ren-O-thin	1X
15	Ren-O-thin	2X

Table 38. List of treatments for cultivation intensity studies.

Treatment Number	Cultivation Equipment	Application Timing
1	None	None
2	Core aerator	May
3	" "	September
4	" "	May, September
5	" "	May, July, September
6	Grooving machine	May
7	" "	September
8	" "	May, September
9	" "	May, September, July

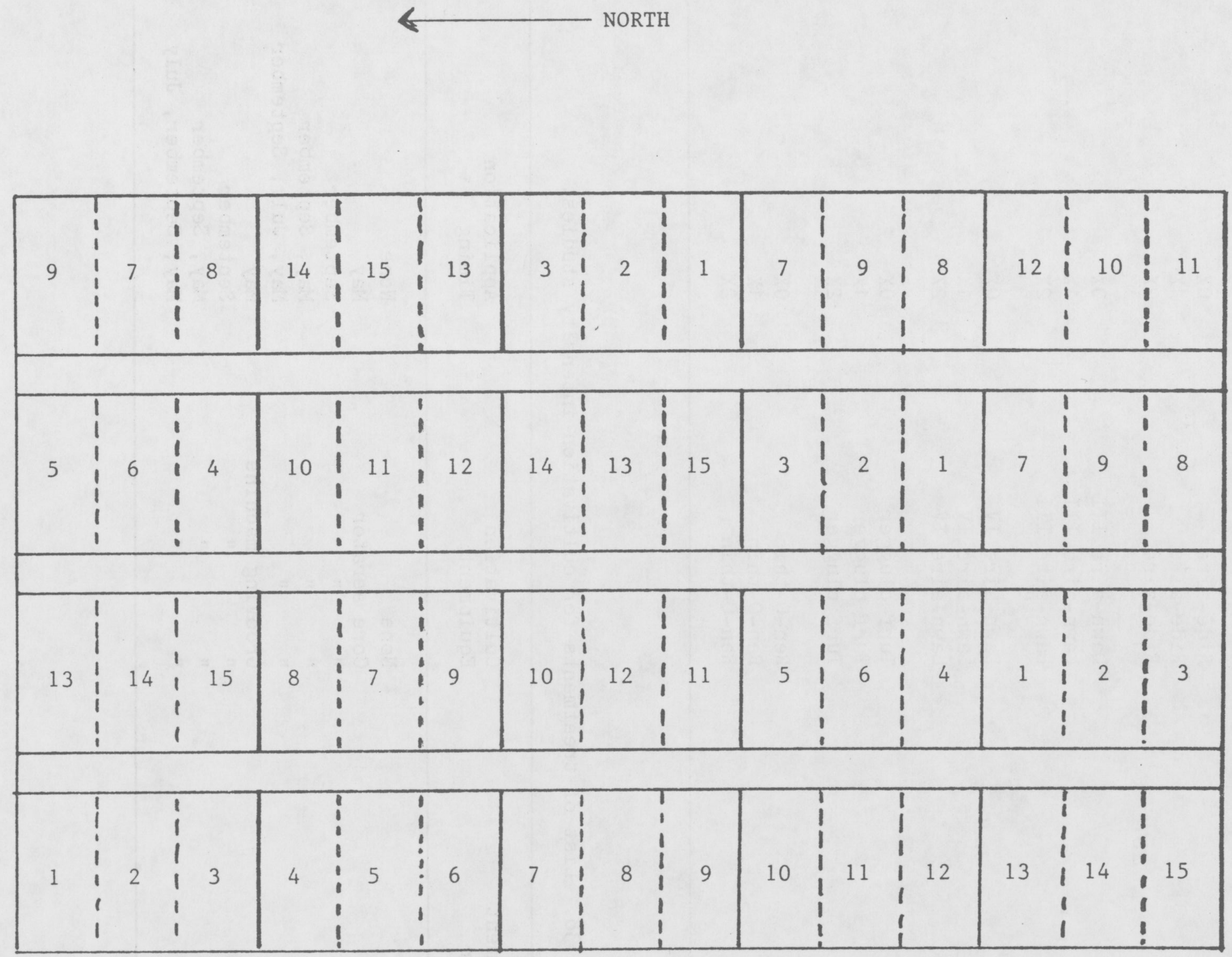


Figure 3. Plot plan for cultivation equipment comparison study.

Introducing the Iowa State University Personnel Affiliated with the Turfgrass Research Program

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DR. NICK CHRISTIANS	Associate Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
MR. KEN DIESBURG	Turfgrass Graduate Student and Research Associate. Horticulture Department Ph.D. (Christians).
MR. MICHAEL GAUL	Turfgrass Graduate Student, Horticulture Department M.S. (Christians).
DR. MARK GLEASON	Assistant Professor, Extension Plant Pathologist. Plant Pathology Department.
MR. ROBERT HARTZLER	Extension Weed Associate, Weed Science Department.
MR. YOUNG JOO	Turfgrass Graduate Student, Horticulture Department Ph.D. (Christians).
DR. DONALD LEWIS	Associate Professor, Extension Entomologist. Entomology Department.
DR. JAMES MIDCAP	Associate Professor, Extension Ornamental Horticulture. Horticulture Department.
MR. RICHARD MOORE	Turfgrass Graduate Student. Horticulture Department M.S. (Christians/Agnew)
MR. ZACHARY REICHER	Turfgrass Graduate Student, Horticulture Department M.S. (Christians)

Companies and Organizations which have made donations to the 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 me so your company name can be added in future reports.

Nick E. Christians

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