1984 Iowa Turfgrass Research Report

Cooperative Extension Service
Iowa State University
Ames, Iowa 50011

FG 450 July 1984

The following research report is the fourth 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 and 1983 field days.

The first cultivar and management studies at the field research area were seeded in August of 1979, and many of these investigations are now in their fifth season. The area has been expanded each year and by 1983 there were 4.2 acres of irrigated and approximately 3 acres of non-irrigated research area. Funding was obtained in 1983 to add 2.7 acres of irrigated research plots to the existing site. This construction should be completed in the 1984 season.

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, and the Iowa Golf Course Superintendent's Association and we would like to thank each of those who have helped to develop the program over the past five years.

We would also like to acknowledge Kenneth Diesburg, Brian Maloy, Dorothy Larocque, and the others who have been employed at the field research area in the past year for their efforts in building the program.

Nick Christians and Norman Hummel
Editors

February, 1984

T A B L E   O F   C O N T E N T S

HERBICIDE STUDIES

GROWTH RETARDANT INVESTIGATIONS

TURFGRASS DISEASE RESEARCH

Environmental Data

The next three pages contain information on temperature, rainfall, and growing degree days (GDD) at the Horticulture Research Station in the 1983 season.

The growing season of 1983 began with unseasonably cool, wet weather in April, May, and June. The months of July and August were characterized by hot days and very warm nights. This was an ideal season for the development of turfgrass diseases and some severe infestations of Brown Patch were observed on the experimental golf course green at the station.

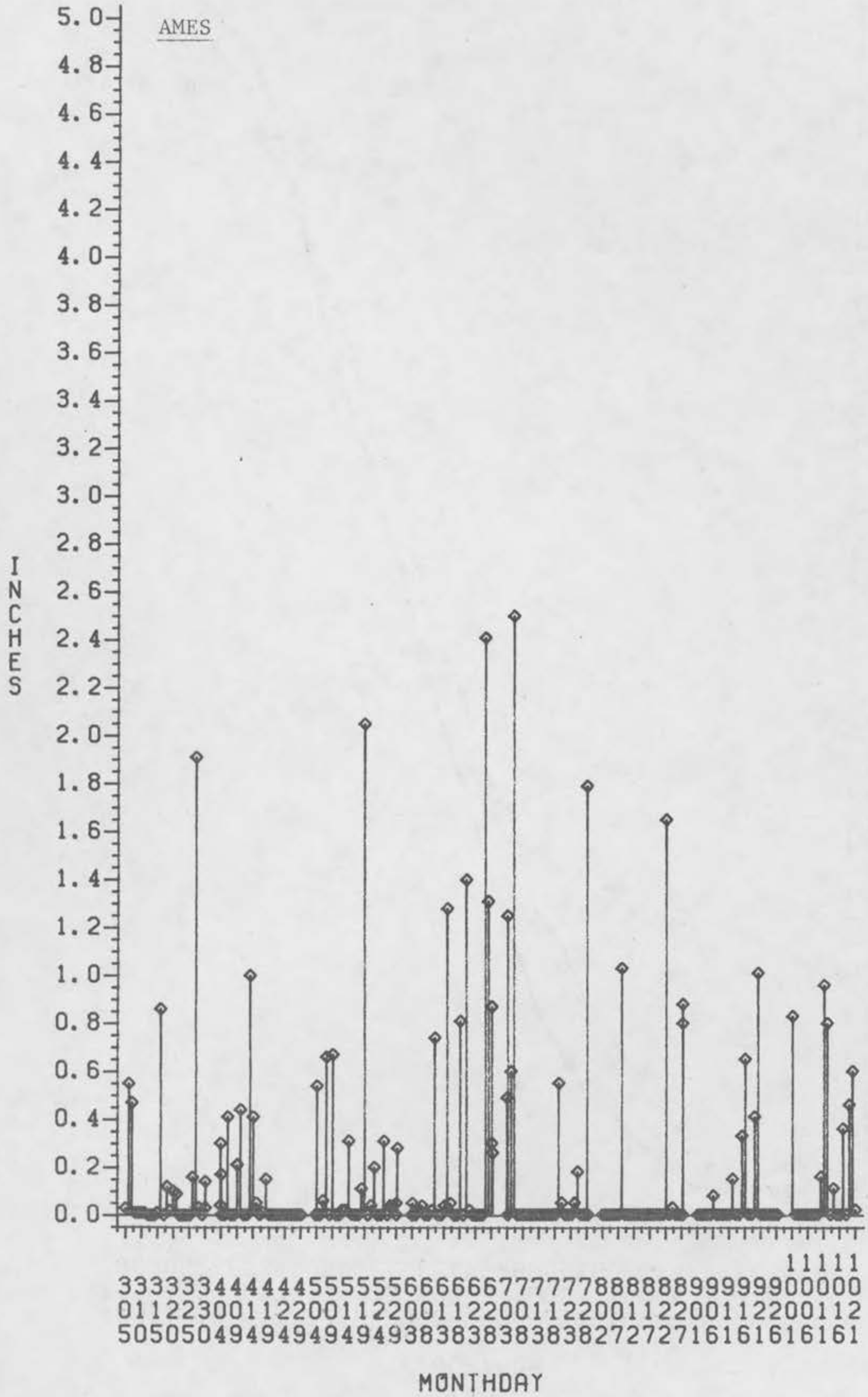
July, August, and September were very dry months for much of Iowa. Some heavy localized thunderstorms at the research station during these months prevented the drought from being too severe (Table A), although these thunderstorms were generally followed by extended periods of dry weather during which irrigation became necessary.

Table A. Rainfall averages during the 1983 growing season at the Horticulture Research Station, Ames, Iowa.

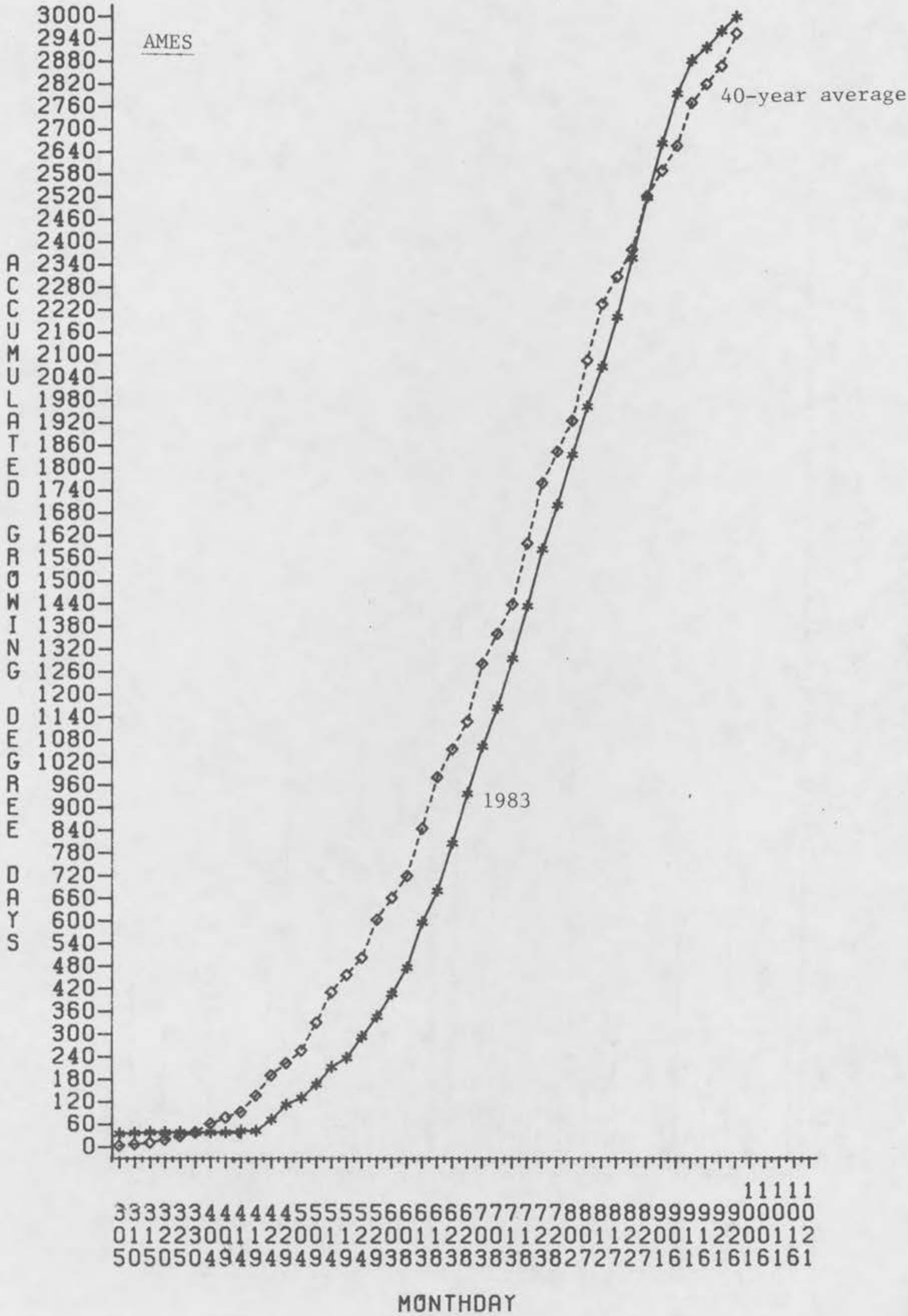
	Rainfall		
Month	1983	Normal	Deviation from Normal
		inches	
April	3.19	3.19	0
May	5.40	4.50	+0.90
June	9.62	5.80	+3.82
July	7.46	3.24	+4.22
August	4.39	3.60	+0.79
September	2.63	3.20	-0.57

TEMPERATURE 1983

RAINFALL 1983

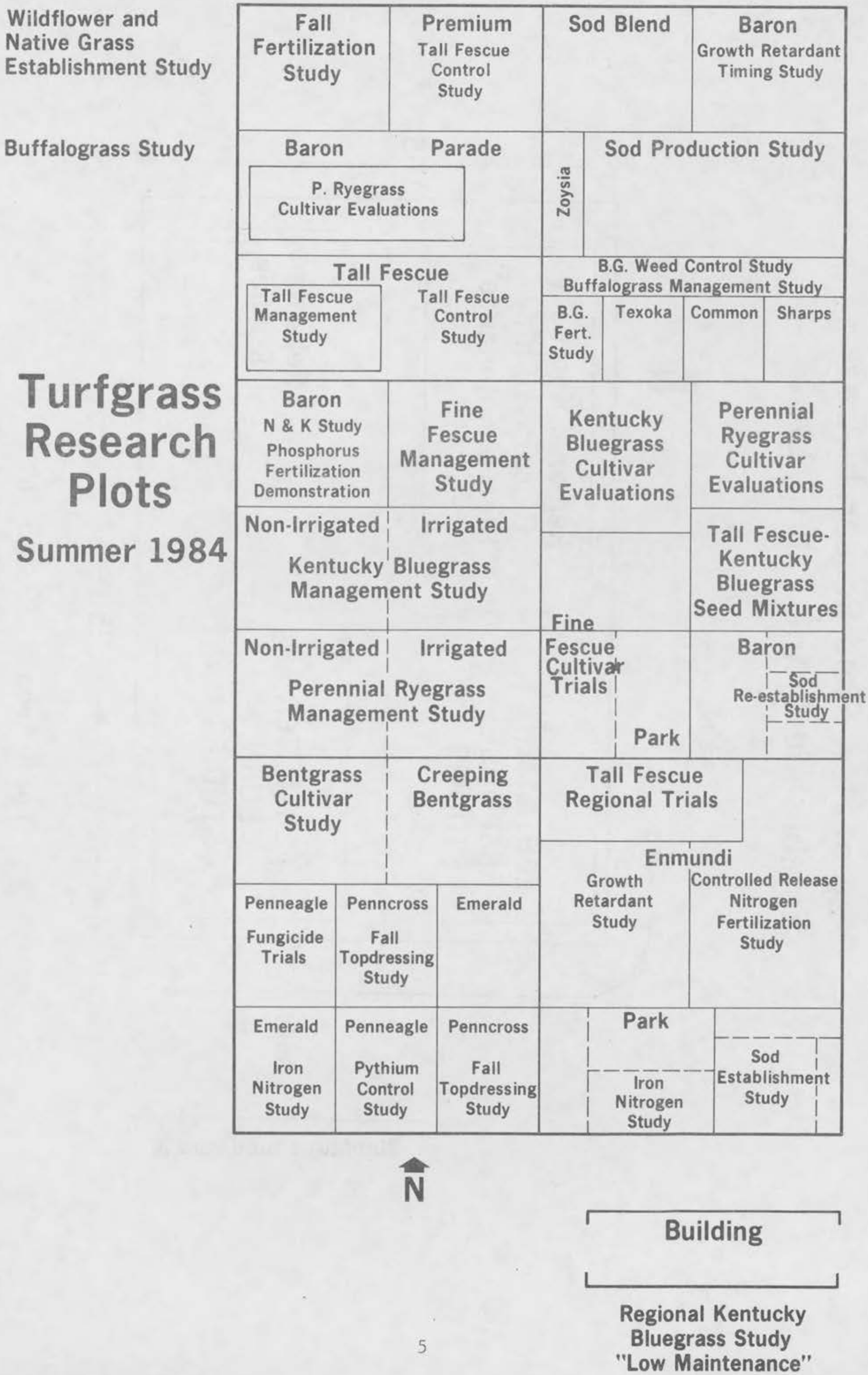


1983 GDD COMPARED TO 40 YEAR AVERAGE

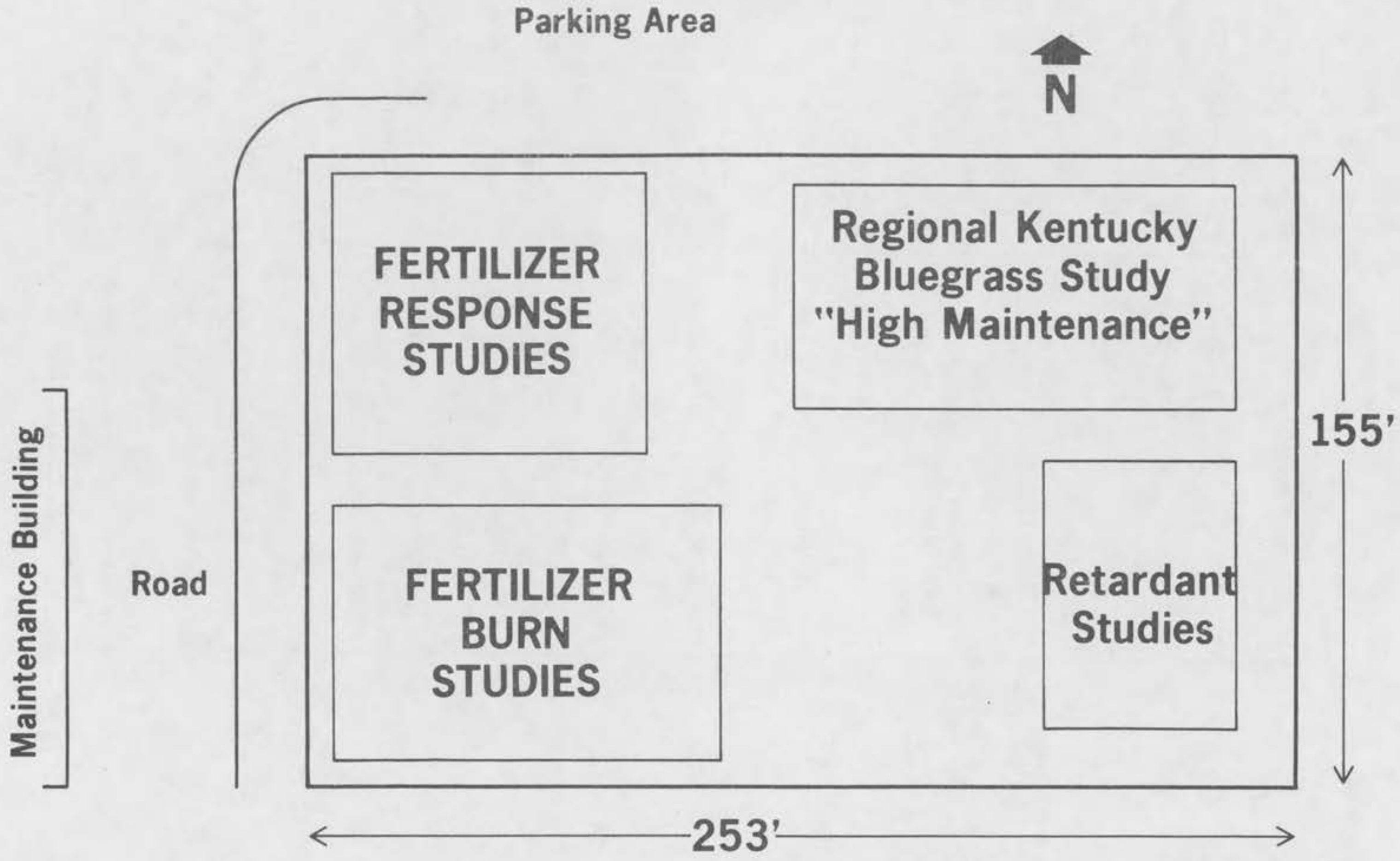


Turfgrass Research Plots

Summer 1984



Map of New Field Research Area Established in the Fall of 1981



Total Area 39,215 ft^2
0.90 Acres

The 1983 Results of High and Low Maintenance Kentucky Bluegrass Regional Cultivar Trials

Nick Christians

In 1980, the United States Department of Agriculture (USDA) initiated a regional Kentucky bluegrass cultivar trial which 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 which receives 4 lbs. N/1000 ft^2/yr and is irrigated as needed, and 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 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 which would be used in a park, school yard or other low maintenance area. The low maintenance study was established in September, 1980, and the high maintenance study in August, 1981.

There were some unusually severe infestations of leaf spot on Kentucky bluegrass observed in the spring of 1983 in central Iowa. At the research station, it was apparent that these infestations were much worse on some cultivars than others. Ratings were performed on the high maintenance study on April 21, 1983, and the results are listed in Table 1. Kenblue, Nuggett, Baron, Escort, Holiday, and Enoble were observed to be the most severely damaged by the disease. Each of the damaged cultivars had completely recovered from the disease damage by the second week of May.

Majestic received the highest quality ratings in the 1983 season (Table 1). Other cultivars receiving high ratings included 243, Midnight, Glade, N535, Ram-1, and Bonnieblue. These cultivars also did very well in the milder temperature conditions of the 1982 season. Nugget, which was originally selected for cooler climates, ranked fifth out of 84 cultivars in 1982, and 56th in the higher temperature conditions of 1983.

Many of the cultivars which did poorly under high maintenance conditions did well under low maintenance conditions (Table 2). Kenblue ranked 84th under high maintenance and second under low. South Dakota certified, Vantage, and Monopoly also performed relatively better in the low maintenance area. Ram-1 performed well under both maintenance regimes. Notice that these are relative rankings. Kenblue ranked 84th in high maintenance plots but still maintained a better quality than Kenblue with no irrigation and only 1 lb. N/1000 ft^2.

The choice of cultivars clearly depends on the type of care the area is likely to receive after establishment, and proposed use should be carefully considered before cultivars are purchased.

Table 1. The 1983 quality ratings for the high maintenance, regional Kentucky bluegrass test established in Fall 1981.

Cultivar		Disease* Ratings	May**	June	July	Aug	Sept	Oct	Mean
1.	Majestic	7.0	8.3	9.0	8.3	8.3	9.0	8.7	8.4
2.	243	8.3	7.7	7.7	8.7	8.7	8.3	9.0	8.3
3.	Midnight	6.0	8.3	8.7	8.7	9.0	9.0	8.7	8.3
4.	Glade	8.7	7.3	7.7	8.0	8.7	8.0	8.7	8.1
5.	N535	7.3	6.7	8.3	9.0	8.3	8.7	8.3	8.1
6.	RAM-1	7.0	7.7	7.7	8.7	8.3	8.3	8.7	8.0
7.	Bonnieblue	8.0	7.0	8.0	8.0	8.0	8.7	8.7	8.0
8.	Enmundi	8.0	7.7	7.3	8.7	7.3	8.0	8.0	7.9
9.	Bristol	7.3	7.3	7.7	8.7	8.0	8.0	8.3	7.9
10.	Kimono	6.0	8.0	8.0	9.0	8.0	8.7	7.0	7.8
11.	CEBVB3965	5.7	8.3	7.7	8.3	8.3	8.0	8.0	7.8
12.	Eclipse	7.3	6.7	8.3	8.3	7.7	8.3	7.7	7.8
13.	Barblue	8.3	7.3	7.3	8.3	7.3	8.0	7.7	7.8
14.	PSU-150	8.3	7.3	6.7	8.0	7.7	7.7	8.0	7.7
15.	PSU-173	8.7	7.3	7.0	7.7	8.0	8.3	7.0	7.7
16.	Merit	7.0	7.3	8.0	8.3	8.3	7.0	8.0	7.7
17.	Sydsport	8.7	6.3	6.7	8.3	8.0	8.3	7.3	7.7
18.	Victa	6.7	7.3	7.7	8.3	8.3	7.3	8.3	7.7
19.	Fylking	6.3	7.0	7.0	8.0	8.3	8.7	8.0	7.6
20.	239	8.7	6.7	6.3	8.0	7.7	8.0	7.7	7.6
21.	PSU-190	7.3	6.7	6.7	8.3	8.0	8.7	7.7	7.6
22.	Baron	5.7	7.3	8.0	8.3	8.0	8.3	7.7	7.6
23.	SV-01617	6.0	7.0	6.7	9.0	8.3	8.0	8.0	7.6
24.	Aspen	7.7	8.0	7.3	8.0	7.3	7.7	7.3	7.6
25.	MLM-18011	6.3	8.0	7.7	7.7	7.3	8.0	8.3	7.6
26.	Holiday	8.0	8.0	7.7	7.7	6.3	8.7	6.7	7.6
27.	Charlotte	6.0	6.0	6.7	8.7	8.0	9.0	8.7	7.6
28.	Birka	7.3	8.0	6.7	7.3	7.3	8.7	7.3	7.5
29.	WWAg478	6.0	6.3	8.7	8.0	7.7	8.3	7.7	7.5
30.	Columbia	8.3	6.7	6.3	8.0	7.3	8.3	7.7	7.5
31.	Admiral	8.3	6.3	7.0	8.3	7.0	8.3	7.3	7.5
32.	Escort	5.7	7.7	8.0	8.7	8.0	7.7	7.0	7.5
33.	Cheri	7.3	6.7	6.7	8.0	8.3	7.7	7.3	7.4
34.	Rugby	8.3	7.0	6.7	7.7	7.3	7.3	7.3	7.4
35.	A20-6A	7.3	7.0	6.7	8.0	7.0	8.0	7.7	7.4
36.	Mer pp 300	7.3	6.3	7.0	8.7	8.0	7.7	7.0	7.4
37.	Mona	8.3	7.7	6.7	7.3	6.7	7.0	8.0	7.4
38.	BA-61-91	6.3	7.0	7.3	8.0	7.7	7.7	7.7	7.4
39.	Bayside	7.0	6.3	6.7	8.3	7.7	8.0	8.0	7.4
40.	Adelphi	7.7	7.0	7.0	7.3	7.7	7.3	7.0	7.3
41.	Plush	7.0	8.0	8.3	8.3	6.7	7.0	6.0	7.3
42.	Banff	8.0	6.0	7.0	7.0	7.0	7.7	8.3	7.3

Table 1. (Continued)

Cultivar	Disease Ratings	May	June	July	Aug	Sept	Oct	Mean
43. Dormie	6.0	6.7	8.3	8.0	7.3	7.7	7.0	7.3
44. Holiday	5.7	8.3	7.3	8.3	7.0	8.0	6.7	7.3
45. Welcome	6.0	8.0	8.0	8.0	7.7	6.7	6.7	7.3
46. Mosa	6.7	8.0	7.3	7.3	7.3	7.7	7.0	7.3
47. Shasta	8.3	6.3	6.0	7.7	7.0	8.3	7.3	7.3
48. Apart	8.3	6.3	6.3	8.3	7.3	7.7	6.7	7.3
49. Vanessa	6.3	7.3	7.0	8.0	6.3	8.0	7.7	7.2
50. Mystic	8.3	6.0	7.0	8.3	8.0	6.7	6.0	7.2
51. K3-178	7.3	6.3	7.0	7.3	6.7	8.0	7.7	7.2
52. Trenton	7.7	6.7	6.3	8.3	7.3	6.7	6.7	7.1
53. Touchdown	7.3	6.0	6.0	8.0	8.0	7.7	7.0	7.1
54. WWAg480	7.7	6.3	6.3	8.0	7.3	7.3	7.0	7.1
55. A20-6	7.7	7.0	7.7	7.7	6.0	7.0	6.7	7.1
56. Nugget	4.3	6.0	7.3	8.0	7.7	8.0	7.3	7.0
57. Parade	8.3	5.3	6.0	7.3	7.0	7.7	7.0	7.0
58. Harmony	6.7	7.3	7.3	7.7	6.7	7.3	6.0	7.0
59. American	6.3	6.7	6.3	9.0	7.0	7.0	7.0	7.0
60. Argyle	8.0	5.3	5.7	8.0	7.3	7.7	6.7	7.0
61. A-34	8.7	6.3	5.7	8.0	7.0	7.7	5.7	7.0
62. Enoble	5.7	6.3	6.3	8.3	7.0	8.3	6.7	7.0
63. 225	8.3	6.0	6.0	7.7	6.7	7.3	7.0	7.0
64. K3-179	6.0	6.3	6.7	8.0	7.3	7.7	7.0	7.0
65. K1-152	8.3	6.0	6.7	6.7	6.7	7.3	7.3	7.0
66. Geronimo	7.7	6.3	6.0	7.3	7.0	7.0	6.7	6.9
67. WWAg463	8.0	6.7	6.0	7.0	7.0	7.0	6.7	6.9
68. A20	6.3	7.3	7.0	7.3	6.7	7.0	6.3	6.9
69. I-13	8.3	6.3	6.7	7.0	6.7	7.0	6.3	6.9
70. Merion	6.7	6.3	6.3	8.0	7.3	7.7	6.0	6.9
71. Mer pp 43	8.3	5.7	5.7	7.0	6.7	7.7	6.3	6.8
72. SH-2	8.7	6.3	5.7	7.3	6.3	7.0	6.0	6.8
73. S-21	8.3	5.3	5.0	7.7	7.7	6.7	6.3	6.7
74. Cello 41	6.3	7.0	6.7	7.3	6.3	7.0	6.3	6.7
75. Piedmont	9.0	5.0	5.3	6.7	6.7	7.7	6.3	6.7
76. NJ735	6.7	6.0	6.7	7.7	7.0	6.3	6.3	6.7
77. S.D. Common	7.7	5.0	4.7	8.0	6.7	8.0	6.7	6.7
78. Wabash	8.3	5.7	5.0	7.0	7.0	7.0	6.0	6.6
79. Vantage 46	9.0	5.7	5.3	6.7	6.3	7.0	6.0	6.6
80. K3-162 80	8.3	6.0	5.0	6.7	6.3	8.0	6.0	6.6
81. H-7	6.7	6.3	7.3	6.3	6.0	7.0	6.0	6.5
82. Monopoly	7.0	6.7	6.3	6.0	6.3	6.7	6.0	6.4
83. Lovegreen	6.7	5.3	5.3	8.0	6.7	7.0	5.7	6.4
84. Kenblue	4.7	5.0	4.3	7.0	6.3	6.7	6.3	5.8
LSD 0.05	1.5	1.2	1.0	1.3	1.2	1.4	2.0	1.0

* Disease ratings are based on a scale of 9 to 1, 9 = no disease infestation and 1 = severe infestation.

** Quality is rated on a scale of 9-1; 9 = best quality and 1 = dead turf.

Table 2. The 1983 quality ratings for the low maintenance regional Kentucky bluegrass test established in Fall 1980.

Cultivar		May	June	July	Aug	Sept	Oct	Mean
1.	K3-162	6.0	6.0	5.7	6.3	7.7	7.0	6.4
2.	Kenblue	6.0	5.3	5.7	6.7	7.7	6.3	6.3
3.	S-21	6.0	6.3	6.0	5.7	6.3	6.0	6.1
4.	Vantage	6.0	5.7	6.0	6.3	6.7	6.0	6.1
5.	S. D. Common	5.7	6.3	5.3	6.3	6.7	6.3	6.1
6.	Argyle	6.0	5.3	5.7	6.0	6.3	6.3	5.9
7.	Ram-1	4.7	6.0	5.7	5.0	5.7	6.0	5.5
8.	Vanessa	6.0	6.3	6.7	4.7	4.7	4.7	5.5
9.	Mosa	4.7	6.3	5.3	5.3	5.7	5.7	5.5
10.	Monopoly	4.7	6.0	7.0	5.0	5.0	4.3	5.3
11.	PSU-190	6.3	6.7	7.7	4.7	3.3	3.0	5.3
12.	Plush	5.0	6.3	6.7	5.0	5.0	4.0	5.3
13.	Wabash	6.0	6.3	5.3	4.3	4.7	4.7	5.2
14.	PSU-173	5.3	6.7	6.3	5.0	4.7	3.3	5.2
15.	Piedmont	5.7	5.0	5.7	4.7	5.7	4.7	5.2
16.	Victa	7.3	7.0	7.0	4.3	3.0	2.3	5.2
17.	Fylking	4.3	6.0	5.3	4.3	5.0	5.7	5.1
18.	Enmundi	4.3	6.0	6.3	4.7	4.7	4.3	5.1
19.	Parade	5.0	5.7	5.7	4.7	5.3	4.3	5.1
20.	Harmony	4.3	6.0	5.3	4.3	5.3	5.3	5.1
21.	Mystic	4.0	5.3	5.0	6.3	5.7	4.3	5.1
22.	Eclipse	5.3	6.0	6.0	4.7	4.7	3.7	5.1
23.	Barblue	5.0	6.7	6.3	4.3	4.3	4.0	5.1
24.	PSU-150	5.3	6.0	5.3	4.7	4.7	4.0	5.0
25.	MLM-18011	5.3	6.0	6.3	4.0	3.7	4.7	5.0
26.	WWAg478	4.0	5.3	6.0	4.7	4.7	5.3	5.0
27.	BA-61-91	4.7	5.7	5.7	4.3	4.7	5.0	5.0
28.	Baron	6.0	6.3	6.0	4.0	3.3	3.7	4.9
29.	Charlotte	5.3	5.7	6.0	4.7	4.3	3.7	4.9
30.	Apart	4.7	5.3	5.7	4.7	4.7	4.3	4.9
31.	A-34	5.7	6.3	5.3	3.7	4.3	4.3	4.9
32.	Mer pp 43	5.3	6.3	6.0	4.3	3.7	3.7	4.9
33.	K3-179	4.7	5.7	5.3	4.3	5.0	4.7	4.9
34.	Kimono	5.0	6.7	6.3	4.3	3.7	3.0	4.8
35.	Dormie	5.3	5.7	5.3	4.3	4.7	3.3	4.8
36.	Aspen	4.7	5.7	5.3	3.7	4.7	4.7	4.8
37.	CEBVB3965	5.3	5.7	5.7	3.7	3.7	4.7	4.8
38.	American	4.7	5.0	6.7	4.3	4.3	3.7	4.8
39.	Mer pp 300	3.7	6.0	6.0	4.3	4.3	4.3	4.8
40.	Enoble	6.3	6.3	6.3	3.7	3.3	3.0	4.8
41.	Bayside	5.7	6.0	5.3	4.7	4.0	3.3	4.8
42.	Escort	5.0	6.3	6.0	4.0	4.0	3.7	4.8

Table 2. (Continued)

Cultivar		May	June	July	Aug	Sept	Oct	Mean
43.	Adelphi	4.7	6.0	5.0	4.0	4.7	4.0	4.7
44.	Birka	4.3	5.7	5.3	3.7	4.0	5.3	4.7
45.	Trenton	5.0	5.3	6.0	4.0	4.0	4.0	4.7
46.	Touchdown	6.0	6.3	5.7	3.3	3.0	4.0	4.7
47.	Welcome	4.3	5.7	5.0	4.3	4.3	4.7	4.7
48.	Merit	5.3	6.0	5.7	4.0	3.7	3.7	4.7
49.	Shasta	5.3	6.3	5.7	3.7	3.3	3.7	4.7
50.	SH-2	6.0	7.0	5.3	3.7	3.0	3.0	4.7
51.	NJ-735	6.7	6.7	5.7	2.7	3.0	3.3	4.7
52.	Merion	5.0	5.7	5.0	3.7	4.3	4.7	4.7
53.	Admiral	5.0	6.0	5.3	4.3	3.7	4.0	4.7
54.	Cheri	5.0	5.0	5.0	4.7	4.0	3.7	4.6
55.	239	5.0	5.7	5.3	4.3	4.0	3.3	4.6
56.	SV-01617	4.3	6.0	5.3	4.0	4.3	3.7	4.6
57.	Banff	4.3	6.0	5.3	3.7	4.0	4.3	4.6
58.	Geronimo	6.0	6.0	6.0	3.0	3.3	3.3	4.6
59.	WWAg463	5.0	6.3	5.7	3.0	3.3	4.3	4.6
60.	Bono	5.0	6.0	5.7	4.3	3.3	3.3	4.6
61.	Midnight	5.3	6.0	5.3	3.3	4.0	3.3	4.6
62.	Sydsport	6.0	6.3	6.3	3.7	2.7	2.7	4.6
63.	Lovegreen	4.7	6.0	5.7	3.3	3.7	4.3	4.6
64.	K3-178	5.3	6.0	6.0	3.3	3.3	3.3	4.6
65.	K1-152	4.5	6.0	5.0	3.0	4.5	4.5	4.6
66.	Rugby	4.3	6.0	5.3	3.7	3.7	4.0	4.5
67.	Majestic	5.3	6.3	6.3	3.0	3.0	3.0	4.5
68.	Bonnieblue	4.7	6.3	5.0	3.3	4.3	3.3	4.5
69.	Glade	4.7	6.0	5.7	3.0	3.0	4.0	4.4
70.	WWAg480	5.3	6.0	6.0	3.0	3.0	3.0	4.4
71.	Cello	5.3	5.3	5.7	2.7	4.0	3.3	4.4
72.	N535	4.7	5.3	6.0	3.7	3.3	3.3	4.4
73.	Mono	5.3	5.7	5.7	3.3	3.3	3.3	4.4
74.	225	5.0	5.7	5.7	3.7	3.0	3.7	4.4
75.	A20	5.0	5.7	5.0	3.3	3.3	3.3	4.3
76.	H-7	4.7	6.3	5.3	3.0	3.0	3.3	4.3
77.	Columbia	5.0	5.3	5.0	3.3	3.7	3.7	4.3
78.	Bristol	5.7	6.3	5.7	3.0	2.7	2.3	4.3
79.	243	5.3	6.0	5.3	3.0	3.0	2.7	4.2
80.	Nugget	5.0	5.7	5.0	3.0	3.3	3.0	4.2
81.	K3-179	5.0	5.7	5.0	3.3	3.3	2.7	4.2
82.	Holiday	4.3	5.7	5.7	3.0	3.3	2.7	4.1
83.	I-13	5.7	6.0	5.3	2.7	2.3	2.7	4.1
84.	A20-6A	4.3	5.7	5.0	2.7	3.0	2.7	3.9
	LSD 0.05	1.6	1.2	0.5	1.6	1.8	2.0	0.8

Quality is rated at 9=best quality and 1=dead turf. A rating of 6 or higher constitutes acceptable quality.

Kentucky Bluegrass Cultivar Evaluations

Nick Christians

The 49 Kentucky bluegrass cultivars located in section two of the turfgrass research area were seeded in the fall of 1979. These plots were fertilized at a rate of 4 lb. N/1000 ft^2 (urea) in both the 1980 and 1981 seasons and with 4 lb. N/1000 ft^2 (SCU) in 1982 and 1983. No insecticides or fungicides have been used on the area. Irrigation was applied as needed to prevent drought. The results of 1983 evaluations are listed in Table 3.

The values listed under each month 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 1983 season. The cultivars are then listed in descending order of average quality.

Infestations of leaf spot on Kentucky bluegrass were quite severe at the research station in April, 1983. Among the most seriously affected cultivars were Sving, Kimono, Ram-1, Merit, and Midnight (Table 3). No evidence of the early spring disease infestation was present in May when the first quality ratings were performed.

Midnight received the highest overall rating in 1983. It was followed in order by Ram-1, Glade, Enmundi, and Mystic. Midnight and Ram-1 were two of the cultivars which were most seriously affected by leaf spot in April and yet received the highest overall quality rating for the season. It is always very important to evaluate performance over an extended period of time and not judge acceptability on single observations.

Table 3 . The 1983 quality and disease ratings for the Kentucky bluegrass cultivars established in the fall of 1979.

Cultivar		Disease Rating[1]	Quality Rating[2] May	June	July	Aug	Sept	Oct	Mean
1.	Midnight	5.6	9.0	8.7	9.0	8.3	9.0	9.0	8.8
2.	Ram I	5.0	8.0	8.0	8.7	7.7	9.0	8.7	8.3
3.	Glade	7.0	7.7	8.3	9.0	7.7	8.7	7.7	8.2
4.	Enmundi	8.0	8.0	8.0	9.0	7.7	8.7	8.0	8.2
5.	Mystic	6.7	7.7	7.3	9.0	8.3	8.3	7.7	8.1
6.	Nugget	3.6	8.3	8.7	8.3	7.0	8.0	8.3	8.1
7.	America	9.0	8.0	7.3	8.3	7.7	8.7	8.3	8.1
8.	Escort	7.3	8.4	7.3	8.7	8.0	8.7	8.3	8.1
9.	Arista	5.6	7.3	7.3	9.0	7.0	9.0	8.3	8.0
10.	Bristol	7.7	7.3	7.0	9.0	7.7	8.7	8.3	8.0
11.	Adelphi	9.0	7.3	7.7	8.7	7.7	8.7	8.0	8.0
12.	Merit	5.3	7.7	7.7	9.0	7.3	7.7	8.7	8.0
13.	Senic	7.3	6.0	6.7	9.0	7.7	9.0	9.0	7.9
14.	Aspen	9.6	7.2	6.7	9.0	7.7	8.3	8.3	7.9
15.	N535	8.0	7.3	7.3	8.3	8.0	8.3	8.3	7.9
16.	Victa	6.7	7.0	7.7	9.0	8.0	7.7	8.0	7.9
17.	SV01617	6.0	6.8	7.0	9.0	7.7	9.0	8.0	7.9
18.	Barbie	7.3	6.5	7.0	8.7	8.0	8.3	8.3	7.8
19.	Baron	6.0	7.7	7.0	9.0	7.7	7.7	7.7	7.8
20.	Fylking	6.0	7.0	6.7	9.0	7.7	8.3	7.7	7.7
21.	Pennstar	7.3	7.0	7.0	9.0	7.3	8.0	7.7	7.7
22.	Merion	7.0	6.3	6.3	8.7	8.3	8.3	7.7	7.6
23.	K3-160	9.0	5.7	7.0	9.0	7.7	8.3	8.0	7.6
24.	Kimono	4.3	7.3	7.0	8.7	6.3	8.0	8.3	7.6
25.	Cheri	9.0	6.7	6.7	8.7	8.0	7.3	8.0	7.6
26.	Birka	7.3	7.3	7.0	9.0	6.7	8.3	7.3	7.6
27.	Bonnieblue	8.5	6.3	7.0	8.7	7.5	8.0	8.3	7.6
28.	Vantage	8.5	6.0	6.3	9.0	7.5	7.7	8.3	7.5
29.	Aquilla	6.0	6.5	6.0	8.7	7.7	8.7	7.7	7.5
30.	A-20	7.7	7.0	7.3	7.3	8.0	7.3	7.7	7.4
31.	Parade	9.0	6.3	6.0	8.0	7.3	8.3	8.3	7.4
32.	Sving	3.6	7.3	7.7	8.0	6.7	7.0	8.0	7.4
33.	Fanfare	8.5	6.0	6.7	9.0	7.7	8.3	7.0	7.4
34.	Touchdown	7.3	6.7	6.0	9.0	6.0	8.7	7.3	7.3
35.	Sydsport	8.0	6.3	6.3	9.0	7.7	7.0	7.0	7.2
36.	Rugby	9.0	6.8	6.7	8.0	6.3	7.3	8.0	7.2
37.	A-20-6	6.0	7.0	7.3	7.3	7.0	7.3	7.3	7.2
38.	K76-86-4	8.5	5.7	6.3	9.0	7.7	7.3	7.3	7.2
39.	Plush	7.3	7.5	7.0	7.7	6.3	6.7	7.3	7.1
40.	Majestic	8.5	5.8	6.0	8.0	7.3	8.0	7.7	7.1
41.	Common	8.5	5.0	6.0	9.0	8.0	8.0	6.0	7.0
42.	Columbia	8.5	6.2	6.0	7.7	6.7	8.0	7.3	7.0
43.	Trenton	8.5	6.0	6.7	7.3	6.7	7.3	8.0	7.0
44.	Park	8.5	5.0	5.3	8.7	7.7	7.7	7.3	6.9
45.	BFB-35	8.5	6.3	6.3	7.7	7.0	7.3	7.0	6.9
46.	A-34	8.5	6.3	6.7	7.3	7.3	6.7	7.3	6.9
47.	WTN-I-13	9.0	6.3	6.7	7.3	6.7	7.0	6.7	6.8
48.	Wabash	8.5	5.3	6.0	8.3	6.7	6.7	7.0	6.7
49.	WTN-H-7	7.3	6.0	7.0	7.0	6.0	6.7	6.3	6.5
	LSD 0.05	1.5	1.0	0.5	0.8	1.0	0.9	1.2	0.5

1 - Disease ratings are based on a scale of 1 to 9; 9=no visible symptoms and 1=severe damage. 2 - Quality ratings are based on a scale of 1 to 9; 9= best quality, 1=poorest quality, and 6=acceptable quality.

Regional Perennial Ryegrass Cultivar Evaluation

K. L. Diesburg and N. E. Christians

This trial is part of a national study coordinated by the USDA. It was established during September 1982 in conjunction with several identical trials across the country. The purpose is to identify regional adaptation of the 48 cultivars tested. Cultivars are evaluated each month of the growing season for turf quality and disease infestation. The average yearly performance of a cultivar is most important.

The trial is maintained with 4 lb. N/1000 ft^2 through the growing season and is irrigated as needed. Standard, single applications of preemergence herbicide in May and broad-leaf herbicide in September are used to prevent weeds. The entire area is maintained at a 2-inch mowing height.

A disease epidemic typical of Dreschlera siccans occurred in October 1983. The causal organism was not confirmed. Eleven of the 48 cultivars were severely discolored while all cultivars showed at least a little discoloration. Many of the top performers in 1983 were among the cultivars showing the least disease symptoms.

As indicated by the experiment means at the bottom of Table 4, the cultivars, in general, were sensitive to environmental changes. They performed exceptionally well in September and moderately well in October. During July and August, however, the prolonged heat lowered overall quality dramatically. The top six cultivars in the Mean column were exceptional in that they looked good consistently throughout the season.

Table 4. Turf quality and disease ratings of perennial ryegrass cultivars.

	Cultivar	Quality					Disease
		July	Aug	Sept	Oct	Mean	
1.	Manhattan II	9.0	8.0	8.7	8.7	8.6	7.0
2.	Palmer	9.0	7.7	9.0	7.7	8.3	5.3
3.	GT-II	8.0	7.0	9.0	8.7	8.2	7.3
4.	BT-I (Tara)	7.3	7.0	9.0	8.3	7.9	7.0
5.	Prelude	8.3	6.7	9.0	7.3	7.8	6.3
6.	LP 702	7.7	6.7	8.7	8.0	7.8	6.7
7.	M382	7.7	6.0	9.0	8.0	7.7	6.3
8.	HR-1	9.0	6.3	8.3	7.0	7.7	5.7
9.	2ED	8.0	6.0	8.3	8.0	7.6	6.7
10.	Yorktown II	7.3	6.3	8.7	7.7	7.5	6.3
11.	HE 168	7.0	7.7	8.0	7.0	7.4	6.3
12.	Ranger	7.3	6.0	8.7	7.7	7.4	5.7
13.	Fiesta	7.0	5.7	9.0	8.0	7.4	6.0
14.	SWRC-1	7.3	6.3	8.7	7.3	7.4	5.7
15.	Regal	8.7	6.7	8.3	6.0	7.4	4.7
16.	Acclaim	6.3	7.0	8.3	7.7	7.3	7.3
17.	HE 178	6.3	6.3	8.3	8.0	7.3	7.0
18.	282	6.0	7.0	8.3	7.7	7.3	7.0
19.	Citation	8.3	5.7	9.0	6.3	7.3	4.7
20.	Cigil	7.0	6.0	8.0	7.3	7.1	5.3
21.	Delray	8.0	6.7	7.0	6.7	7.1	5.7
22.	Omega	6.3	6.0	8.3	7.3	7.0	6.0
23.	NK 80389	6.3	6.3	8.3	7.0	7.0	4.7
24.	Derby	7.3	6.3	7.7	6.7	7.0	5.0
25.	Diplomat	6.7	5.7	8.3	7.0	6.9	5.7
26.	Gator	5.7	6.3	9.0	6.7	6.9	5.3
27.	LP 736	6.7	5.3	8.3	6.7	6.8	5.3
28.	LP 792	6.7	6.3	8.0	6.3	6.8	5.3
29.	NK 79309	6.7	6.3	8.7	5.7	6.8	3.3
30.	Pennant	7.0	6.3	6.7	7.3	6.8	6.7
31.	Pennfine	7.0	5.7	7.0	7.7	6.8	6.3
32.	NK 79307	8.0	6.3	8.7	4.0	6.8	2.3
33.	IA 728	6.7	6.3	6.7	7.7	6.8	6.0
34.	Blazer	5.7	6.0	8.0	6.7	6.6	5.3
35.	Dasher	6.3	5.0	8.0	7.0	6.6	5.7
36.	Elka	5.3	5.7	8.3	7.0	6.6	4.7
37.	Birdie	6.0	5.7	7.0	7.7	6.6	6.0
38.	Crown	5.7	5.7	7.7	7.0	6.5	5.0
39.	WWE 19	5.7	6.0	6.7	7.7	6.5	7.3
40.	2EE	5.3	6.0	8.0	6.7	6.5	6.0
41.	Manhattan	4.3	5.3	8.3	8.0	6.5	6.3
42.	Barry	5.0	5.3	9.0	6.3	6.4	4.0
43.	LP 210	4.0	6.0	7.3	7.7	6.3	6.7
44.	Premier	6.3	5.3	7.7	5.7	6.3	3.3
45.	Cockade	4.0	5.3	7.3	6.7	5.8	5.3
46.	Cupido	4.0	4.0	6.0	7.3	5.3	6.7
47.	Pippin	3.7	3.7	5.0	6.3	4.7	5.3

Perennial Ryegrass Cultivar Evaluations

Nick 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/year. The area receives no fungicide or insecticide applications.

Results of winter damage evaluations and yearly quality ratings are listed in Table 5. Winter damage can be a serious problem for perennial ryegrass cultivars. The data listed were taken in spring, 1983. The values in the table represent the percent of the plot area damaged; 100 = total kill and 0 = no damage. NK-100, Delray, and Pennfine were observed to be damaged to the greatest extent. The damage evaluations were performed in early April. By May, most of the cultivars had completely recovered from winter damage.

Regal, Derby, Manhattan, and Belle received the highest overall quality ratings in 1983. However, there was little observable difference among the first 17 cultivars listed. Only NK-100 and Linn were determined to be unacceptable for the entire season. Caravelle, NK-200, K5-94, and Goalie were observed to be unacceptable at certain times during the season but received acceptable ratings for the season as a whole.

Table 5. The 1983 quality ratings for perennial ryegrass cultivars established in 1979.

	Cultivar	Winter Damage	Quality Rating						
			May	June	July	Aug	Sept	Oct	MEAN
1.	Regal	0	7.3	7.7	8.0	8.0	9.0	9.0	8.2
2.	Derby	8	6.7	7.3	7.7	8.0	8.7	8.3	7.8
3.	Manhattan	7	7.3	6.3	7.7	7.7	8.7	8.3	7.7
4.	Belle	8	7.0	6.3	7.7	8.0	8.3	9.0	7.7
5.	Blyes	8	7.3	7.0	7.3	7.0	8.7	8.3	7.6
6.	Citation	8	6.7	6.3	8.0	7.3	8.0	9.0	7.6
7.	Pennfine	10	6.7	6.3	8.0	7.3	8.3	9.0	7.6
8.	Diplomat	0	6.3	6.7	8.0	7.7	7.7	9.0	7.6
9.	Loretta	0	7.3	8.0	7.7	7.3	7.0	7.7	7.5
10.	Fiesta	10	6.7	7.0	7.0	7.7	8.0	8.7	7.5
11.	Med North	0	6.3	7.3	8.7	6.3	7.0	9.0	7.4
12.	Yorktown	0	7.0	7.0	8.3	7.7	6.3	8.3	7.4
13.	Goalie	0	7.0	5.7	7.0	7.3	8.0	8.7	7.3
14.	Elka	7	7.3	8.0	6.7	7.0	6.7	8.0	7.3
15.	Delray	10	6.3	6.7	7.7	7.0	7.0	9.0	7.3
16.	J186 R24	3	7.3	6.3	7.7	6.7	6.7	8.7	7.2
17.	K5-88	8	6.3	6.7	7.7	6.7	7.3	8.7	7.2
18.	K5-94	0	5.7	6.0	7.0	7.0	8.0	8.7	7.1
19.	NK-200	3	7.3	6.3	7.0	5.7	7.0	7.7	6.8
20.	Caravelle	10	5.7	6.7	7.0	5.7	6.0	9.0	6.7
21.	AlK-100	40	5.0	4.7	5.3	4.0	4.3	7.7	5.2
22.	Linn	0	3.7	4.0	4.3	3.0	3.3	6.7	4.2
	LSD 0.05		1.2	1.1	1.4	1.2	1.3	1.1	0.7

Quality is rated on a scale of 9 to 1; 9 = best quality, 6 acceptable, and 1 = poorest quality. Winter damage is based on a percent scale; 100% = total kill and 0 = no damage

Fine Fescue Cultivar Trial

K. L. Diesburg and N. E. Christians

This trial was established during 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 infestation. The average yearly performance of a cultivar is most important.

The trial is maintained with 4 lb. N/1000 ft^2 through the growing season with irrigation as needed. A standard, single application of broad-leaf herbicide in September is used to prevent weeds.

Preemergence herbicides were not used because of potential damage to the sensitive fine fescues during establishment. The entire area is maintained at a 2-inch mowing height.

A combination of poor stand establishment with several cultivars and the lack of preemergence weed control resulted in weed infestation during July and August, the ratings of which are presented in Table 6.

A disease epidemic which existed in the experiment through July and August lowered the quality ratings of some cultivars while others were unaffected (Table 6). All cultivars were recovering in October. Identification of the causal organism was not confirmed, but disease symptoms indicated Pythium sp.

Four of the best cultivars in July (Waldina, NK79189, NK80346, and Wintergreen) were observed to perform poorly in October. In contrast, five cultivars (Aurora, Jamestown, Ensylva, Banner, and Agram) performed well regardless of disease and weather. As indicated by the similarity of experiment means at the bottom of Table 6, average performance of cultivars was generally stable through the growing season.

Table 6. Turf quality,[a] disease,[b] and weed[c] ratings of fine fescue cultivars and blends .

	Cultivar		Turf Quality July	Aug	Sept	Oct	Mean[d]	Disease[e] (July)	Weeds[f] (Aug)
1.	Banner-Checker		6.3	8.3	8.7	7.7	7.8	8.7	7.7
2.	Aurora	H[g]	8.3	7.7	7.0	7.0	7.5	4.7	5.7
3.	Jamestown	C	7.7	8.3	6.7	7.0	7.4	4.0	5.3
4.	Ensylva	CR	7.0	7.3	7.0	7.7	7.3	6.0	5.7
5.	Dawson	CR	8.7	7.0	6.0	7.3	7.3	8.3	6.7
6.	FOF-WC[h]	S	6.0	7.7	7.3	7.7	7.2	7.0	6.0
7.	Banner	C	7.3	7.3	6.7	7.3	7.2	6.3	7.0
8.	Scaldis-Atlanta		6.7	6.7	7.3	7.3	7.0	7.0	6.3
9.	Agram	C	7.0	7.0	6.3	7.3	6.9	6.7	6.0
10.	Koket	C	6.3	8.3	5.3	6.7	6.7	6.0	5.3
11.	Fortress	CR	5.3	7.0	7.0	7.0	6.6	7.3	6.3
12.	Barfalla	C	6.7	6.3	6.0	7.3	6.6	6.7	5.7
13.	Atlanta	C	7.0	6.3	6.0	6.7	6.5	6.0	5.0
14.	Shadow	C	6.3	6.7	5.3	7.3	6.4	6.7	5.0
15.	Checker	C	7.3	6.0	5.7	6.0	6.3	5.7	4.7
16.	Biljart	H	7.7	5.7	5.3	6.0	6.2	5.3	5.3
17.	Dawson-Pennlawn		5.7	6.7	6.0	6.3	6.2	8.0	5.7
18.	Waldina	H	7.0	7.3	4.7	5.3	6.1	3.0	3.7
19.	Ruby	CR	5.0	7.0	5.3	6.3	5.9	6.3	5.0
20.	Highlight	C	6.3	6.0	5.3	5.3	5.8	6.0	4.7
21.	Scaldis	H	6.0	6.3	4.7	5.7	5.7	3.7	4.0
22.	NK79191	CR	4.3	6.7	5.3	6.3	5.7	7.7	5.7
23.	NK79189	CR	7.0	5.7	5.0	5.0	5.7	6.7	5.0
24.	NK80346	CR	7.0	5.3	5.0	5.3	5.7	7.7	5.3
25.	Pennlawn	CR	4.3	6.3	5.3	6.3	5.6	7.0	4.7
26.	NK79190	CR	5.7	6.7	4.3	5.3	5.5	6.3	4.7
27.	NK80345	CR	6.0	6.3	4.3	5.0	5.4	8.3	5.3
28.	Wintergreen	C	7.0	5.0	4.3	4.7	5.3	5.0	3.7
29.	NK80346	CR	5.7	5.3	4.0	4.7	4.9	6.7	4.3
30.	NK80348	CR	5.3	5.0	3.3	4.7	4.6	8.0	5.0
31.	Tournament	H	5.0	4.0	4.0	4.0	4.3	7.0	3.3
32.	Duar	H	1.7	5.3	3.3	3.3	3.3	3.0	3.3
	Exp. Mean		6.3	6.5	5.5	6.2	6.1	6.3	5.2
	LSD		1.8	1.7	2.4	2.2	1.5	2.7	2.5

[a] quality rated on a scale of 1 to 9; 9 = best quality and 1 = poorest quality.
[b] disease rated on a scale of 1 to 9; 9 = no disease and 1 = most disease.
[c] weeds rated on a scale of 1 to 9; 9 = no weeds and 1 = most weeds.
[d] average of monthly quality ratings reflecting, but not including, disease ratings.
[e] disease symptoms typical of Pythium sp., but the causal organism was not confirmed.
[f] amount of weeds is a result of stand density during establishemnt.
[g] hard (H), chewings (C), sheep (S), or creeping red (CR) fescue.
[h] bluish-green color.

Kentucky Bluegrass and Perennial Ryegrass Management Studies

Nick Christians

The Kentucky bluegrass and Perennial Ryegrass management studies were established on August 16, 1979. The studies, which each include 10 cultivars, are divided into irrigated and nonirrigated sections. Each cultivar is maintained at two mowing heights, 1 and 2 inches, and is fertilized with IBDU at two rates, 1 and 3 lb. N/1000 ft^2/year.

The Kentucky bluegrass cultivars were quite uniform in quality under irrigated conditions. Majestic received the highest overall quality rating in the irrigated plots when values were averaged over all mowing heights, fertility levels, replications, and months (Table 7). Under nonirrigated conditions, only Majestic received an acceptable quality rating.

All of the perennial ryegrasses, with the exception of Caravelle and Linn, received acceptable quality ratings under irrigated conditions in 1983 (Table 8). Loretta, Yorktown, and Pennfine received the highest ratings in irrigated plots. Under nonirrigated conditions, there were no cultivars which received acceptable ratings for the entire season (Table 8). Caravelle received the highest rating in this part of the investigation.

Table 7. Quality ratings for ten Kentucky bluegrass cultivars maintained under nonirrigated and irrigated conditions.

Species (Cultivars)	Nonirrigated	Irrigated
1. Merion	4.9	6.6
2. Park	5.2	6.3
3. Aquila	5.4	6.3
4. Glade	5.4	6.5
5. Baron	4.5	6.0
6. Victa	5.4	6.5
7. Sydsport	4.9	6.3
8. Touchdown	6.0	6.4
9. Majestic	4.9	6.9
10. Adelphi	4.9	6.1

Table 8. Quality ratings for ten perennial reygrass cultivars maintained under irrigated and nonirrigated conditions.

Species (Cultivars)	Nonirrigated	Irrigated
1. Manhattan	5.4	6.8
2. Pennfine	5.3	7.0
3. NK 200	4.6	6.1
4. Derby	5.6	6.4
5. Citation	4.8	6.4
6. Diplomat	5.3	6.6
7. Yorktown	5.8	7.1
8. Caravelle	4.8	5.6
9. Linn	4.0	4.4
10. Loretta	5.6	7.2

Fine Fescue Management Study

Nick 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 (FL-1) 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 9 are the means of monthly observations taken from May to October averaged over both mowing heights. Cultivar plots treated with 3 lb. N/1000 ft^2/year were observed to have higher quality ratings than those receiving 1 lb. N/1000 ft^2/year.

Scaldis, Atlanta, Reliant, Jamestown, Pennlawn, and Dawson were the best cultivars at the higher fertility level. Scaldis, Atlanta, Reliant, and Jamestown also performed satisfactorily when maintained with 1 lb. N/1000 ft^2/year. Pennlawn and Dawson, although satisfactory at 3 lb. N, were not acceptable at 1 lb. N.

Of the three species in the study, the hard fescues -- Reliant and Scaldis -- were the best performers overall. These two grasses performed much better than the others included in the test, particularly at the 1 lb. N rate.

Table 9. The effect of N fertilizer rate on the quality of ten fine fescue cultivars.

Species (Cultivar)	N Fertilizer Rate 1	3
1. Pennlawn Red Fescue	5.3*	6.3
2. Scaldis Hard Fescue	7.4	8.4
3. Ruby Red Fescue	4.0	4.8
4. Atlanta Chewings Fescue	6.3	7.1
5. K5-29 Red Fescue	4.0	4.5
6. Dawson Red Fescue	5.6	6.6
7. FL-1 Hard Fescue (Reliant)	7.5	8.5
8. Ensylva Red Fescue	4.6	5.6
9. Highlight Chewings Fescue	4.9	5.1
10. Jamestown Chewings Fescue	7.2	7.6

LSD 0.05 to separate cultivars within a fertilizer rate = 1.0 .

LSD 0.05 to separate differences among fertilizer rates within a cultivar = 0.15.

* values are the means of monthly observations from May through October.

Tall Fescue Management Study

K. L. Diesburg and N. E. Christians

The tall fescue management study includes Kentucky-31 and four new improved cultivars of tall fescue; Falcon, Houndog, Mustang, and Rebel. It was established in September, 1982. Stands were severely damaged by late spring freezing in 1983, and the plots were overseeded. Each cultivar is maintained at 2 and 3-inch mowing heights and is fertilized with urea at 0, 1, and 2 lb./N/1000 ft^2/year. Fertilizer treatments could not be imposed until September, 1983, when 1 lb. N/1000 ft^2 was applied to the 2-lb. N level plots. In October, another 1 pound was applied to both 1 and 2-lb. N level plots.

The data in Table 10 show that the addition of only 1 lb. N in September improved the average performance of all cultivars from an unacceptable (5.2 and 5.5) to acceptable (7.2) level. The difference in quality was due mainly to improved color where N was applied. In October, the plots treated with N showed less disease symptoms.

There was no difference in response to mowing height managements, even though mowing treatments had been imposed since June.

There were no differences in performance among the four improved cultivars averaged over all managements and treatments (Table 11). They all produced better quality turf than that of Kentucky 31, however. The difference was due to finer texture and darker color of the improved cultivars.

Table 10. Means of turf quality ratings at three fertility levels[a] over all cultivars tested.

Applied N	Sept	Oct	Avg
(lb./1000 ft^2)			
1. 0	5.2	3.6	5.1
2. 1	5.5	5.5	5.6
3. 2	7.2	6.3	6.2
LSD 0.05	0.4	0.3	0.1

[a] Equal amounts of N were applied to levels 2 and 3 during October. An additional pound was applied to level 3 in September.

Table 11. Means of turf quality ratings[a] for tall fescue cultivars over all treatments.

Cultivar	July	Aug	Sept	Oct	Avg
Falcon	5.7	6.8	6.2	5.2	6.0
Houndog	6.0	6.3	6.2	5.2	5.9
Kentucky 31	3.8	5.0	4.7	4.6	4.5
Mustang	5.5	6.5	6.4	5.3	5.9
Rebel	5.6	6.3	6.2	5.3	5.9
LSD 0.05	1.0	0.5	0.5	0.4	0.3

[a] ratings based on 9 = best, 1 = dead, and 6 = acceptable turf.

Bentgrass Management Study

Nick Christians

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

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

Each cultivar planting is split into three fertility levels: 0.5, 0.8, and 1.2 lbs. N/1000 sq. ft./growing month. This results in a total N application rate of 3.5, 5.6, and 8.4 lbs. N/1000 sq. ft./year. The area was manged 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.

The summer of 1983 was unusually hot and there was a great deal of stress on the bentgrass study area. Under these conditons, Penncross maintained the best season long quality (Table 12). Emerald also maintained an acceptable season long quality. Penneagle, Kinstown, Prominent, and Seaside received unacceptable ratings for the season as a whole. During the high stress periods of July and August, only Penncross performed satisfactorily. Penncross was clearly the best cultivar for the high stress conditions in central Iowa in 1983.

Quality ratings increased with increasing rates of N for each of the cultivars (Table 13). For Kingstown, Penneagle, and Prominent there was no advantage to increasing N from 0.8 to 1.2 lb. N/month. For Emerald, Penncross, and Seaside, the highest quality was observed at 1.2 lb. N/month. This is a very high level of N and it is surprising that these cultivars did not deteriorate in quality at this rate during high stress periods.

Table 12. The 1983 quality ratings 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	7.6	6.8	7.1	7.0	6.4	6.8
2. Emerald	6.2	5.9	5.9	5.7	5.8	6.4	6.0
3. Penneagle	6.0	6.0	6.3	5.0	4.3	6.7	5.7
4. Kingstown	5.8	4.9	5.5	5.3	5.8	6.0	5.5
5. Prominent	5.9	5.3	5.3	5.4	4.9	6.3	5.5
6. Seaside	5.6	5.3	5.6	5.7	4.6	5.6	5.4
LSD 0.05	0.9	0.9	1.0	1.4	1.4	0.7	0.7

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

Table 13. The effects of fertility level on the quality of six bentgrass cultivars.

Cultivar	lb. N/growing month		
	0.5	0.8	1.2
1. Emerald	5.5	5.9	6.5
2. Kingstown	5.1	5.8	5.7
3. Penncross	6.1	6.9	7.5
4. Penneagle	5.5	5.7	5.9
5. Prominent	4.9	5.9	5.9
6. Seaside	4.8	5.3	6.1

LSD 0.05 for comparison of fertility levels within cultivar = 0.5.

Evaluation of Different N Sources, Rates, and Timings for Fertilization of Kentucky Bluegrass Turf

Norman Hummel

In this study five nitrogen sources are being evaluated at different rates and timing for maintenance fertilization of Kentucky bluegrass turf. The turf is Enmundi Kentucky bluegrass which was established in August 1981 and is maintained at a cutting height of 2 inches. All clippings are removed. A randomized complete block design with three replications is being used. Plot size is 4 x 6 feet.

The treatments include four slow release N sources applied at 2, 3, and 4 lb N/1000 sq ft/year. The treatments are applied in one, or split into two applications. Urea was applied at 2, 3, and 4 lb N/1000 sq ft/year split into four equal applications.

The dates of fertilizer applications in 1983 were May 20 and September 24 for all treatments. The urea treatments were also applied on July 7 and November 15.

To assess turf quality, visual ratings of color were made approximately every two weeks. Ratings were made on a scale of 0 to 5, using half units, with 5 indicating dark green. Ratings less than 3.0 were considered unacceptable quality. A value of 0 would indicate a yellow or straw-colored appearance.

Results

The color ratings are shown in Table 14. Means followed by the same letter are not significantly different.

The highest color ratings prior to spring fertilization were produced by the Andersons SCU 1 + 3 (1 lb N/1000 ft^2 in spring, 3 lb N in fall), followed by the IBDU treatments in which 2 or 3 lb N was applied per 1000 ft^2 in the previous fall. Good color was also produced by the Lakeshore SCU 1 + 3 and 2 + 2. The poorest color was found on all ureaform plots, and on all plots receiving less than 1.5 lb N/1000 ft^2 the previous fall.

The quickest response to fertilization, as reflected in color ratings, was produced by the Andersons SCU at the 2 and 3 lb rates, followed closely by the Lakeshore SCU at the same rates. Acceptable color was also produced by all the IBDU treatments four and six weeks after fertilization. Poor color ratings were obtained on all ureaform plots for most of the season. Even the 3 lb rate in spring failed to produce acceptable color during the summer.

Only the 1 lb rate of urea produced acceptable color after spring fertilization. The other two urea rates (0.5 and 0.75 N/1000 sq ft) simply did not provide sufficient available nitrogen to maintain quality turf. This may be of special interest to lawn care companies using urea as the primary N source in their program. Where clippings are removed from the turf area, 1 lb N/1000 sq ft appears to be the minimum needed in the spring to produce the desired quality. Later in the summer and fall, the lower rates of N from urea did produce acceptable color.

The most uniform response to fertilization was produced by the Lakeshore SCU 2 + 2 and the Andersons SCU 2 + 2. Excellent performance was also observed for the Lakeshore SCU 1 + 3. The heavy fall fertilization provided excellent residual N the following spring, and through the following summer. The Lakeshore SCU 3 + 1 provided sufficient N to maintain good color through the summer, but did not have enough residual N to hasten spring green-up.

A quicker release rate was evident with the Andersons SCU. Both the 3 + 1 and 1 + 3 treatments produced excellent color following fertilization, but there was not sufficient residual N to maintain acceptable color through the season.

It appears that where clippings are removed, a minimum annual rate of 3 to 4 lb N/1000 sq ft is necessary to maintain high quality bluegrass turf in Iowa. Of course, N requirements will vary with cultivar, management, and the individual's perception of quality.

Table 14. Effect of nitrogen source, rate and timing of application on quality of Enmundi Kentucky bluegrass turf.[a]

TRT.[c] No.	Rate	4/20	5/4	Date 5/20	6/9[b]	6/27	7/15	7/29	8/19	Date 9/9	9/24	10/14[b]	11/5
				Color Rating						Color Rating			
1	0 + 2	1.8 h-j	2.3 f-i	2.8 c-f	2.3 j-l	2.3 i-l	2.2 kl	2.5 i-l	2.3 f-i	2.3 b-e	2.3 c-e	3.0 c-g	3.0 c-f
2	1 + 1	1.3 j-l	2.0 h-j	2.0 g-j	3.0 f-h	3.5 b-e	3.2 f-h	2.7 f-i	2.3 f-i	2.0 d-f	2.8 a-d	2.5 f-j	2.0 i-l
3	2 + 0	1.7 i-k	2.3 f-i	2.3 e-i	3.5 c-e	3.5 b-e	3.3 e-g	3.3 d-g	3.0 c-e	3.0 ab	3.0 a-c	2.0 i-k	1.5 l-n
4	1.5 + 1.5	2.0 f-i	2.3 f-i	2.8 c-f	3.3 d-f	3.3 c-f	3.3 e-g	3.5 d-f	3.0 c-e	2.5 a-e	2.8 a-d	2.8 d-h	2.5 f-i
5	1 + 2	2.5 d-g	3.0 b-e	3.2 b-e	2.8 g-i	3.3 c-f	3.2 f-h	3.5 d-f	2.8 c-f	2.7 a-d	3.0 a-c	2.8 d-h	3.3 b-d
6	2 + 1	2.0 f-i	2.5 e-h	2.8 c-f	3.7 b-d	3.7 a-d	3.7 c-e	3.7 c-e	3.0 c-e	2.7 a-d	2.7 a-d	2.5 f-j	2.7 e-h
7	2 + 2	2.7 c-f	3.0 b-e	3.7 ab	4.0 ab	4.0 ab	4.3 ab	4.5 a	3.7 ab	3.0 ab	3.3 a	3.7 a-c	3.3 b-d
8	1 + 3	3.0 b-d	3.3 bc	3.5 a-c	3.7 b-d	3.8 a-c	4.0 bc	3.8 b-d	3.3 a-c	2.8 a-c	3.2 ab	3.3 a-e	3.7 ab
9	3 + 1	2.3 e-h	2.8 c-f	3.2 b-d	4.0 ab	4.0 ab	4.5 a	4.5 a	3.8 a	3.2 a	3.3 a	2.7 e-i	2.7 e-h
10	0 + 2	2.7 c-f	3.3 bc	3.0 b-e	2.2 kl	2.0 k-m	2.2 kl	2.2 k-m	1.8 i-k	2.2 c-f	2.2 de	3.7 a-c	3.5 a-c
11	1 + 1	2.3 e-h	2.3 f-i	2.7 d-g	3.0 f-h	2.8 f-j	2.8 h-j	2.7 h-k	2.3 f-i	2.2 c-f	2.7 a-d	2.8 d-h	2.5 f-i
12	2 + 0	1.0 l	1.3 k	1.5 j	3.8 a-c	3.5 b-e	3.7 c-e	3.8 b-d	3.0 c-e	2.3 b-e	2.2 de	1.8 jk	1.3 mn
13	1.5 + 1.5	2.7 c-f	3.0 b-e	3.0 b-e	3.3 d-f	3.3 c-f	3.3 e-g	2.8 g-j	2.3 f-i	1.8 ef	2.3 c-e	3.2 b-f	3.2 b-e
14	1 + 2	3.2 a-c	3.5 ab	3.5 a-c	2.8 g-i	2.8 f-i	3.0 g-i	3.0 f-i	2.5 e-h	1.8 ef	2.3 c-e	3.3 a-e	3.2 b-e
15	2 + 1	2.7 c-f	2.8 c-f	3.2 b-d	3.8 a-c	3.5 b-e	3.5 d-f	3.5 d-f	3.0 c-e	2.3 b-e	2.5 b-e	3.0 c-g	2.5 f-i
16	2 + 2	3.2 a-c	3.5 ab	3.7 ab	3.8 a-c	3.2 d-g	3.7 c-e	4.2 a-c	3.2 b-d	2.3 b-e	3.2 ab	3.7 a-c	3.7 ab
17	1 + 3	3.7 a	4.0 a	4.0 a	2.8 g-i	2.8 f-i	2.8 h-j	3.2 e-h	2.7 d-g	2.3 b-e	2.3 c-e	4.0 a	4.0 a
18	3 + 1	2.8 b-e	3.3 bc	3.5 a-c	4.2 a	4.0 ab	4.3 ab	4.3 ab	3.3 a-c	2.8 a-c	3.0 a-c	3.5 a-d	3.2 b-e
19	0 + 2	1.0 l	1.5 j-k	1.7 ij	2.0 l	1.8 lm	2.0 lm	2.2 k-m	2.0 h-k	2.0 d-f	2.8 a-d	3.5 a-d	2.0 i-l
20	1 + 1	1.3 j-l	1.5 jk	1.8 h-j	2.2 kl	2.0 k-m	2.0 lm	2.0 l-n	2.2 g-j	2.2 c-f	2.8 a-d	2.5 f-j	1.7 k-m
21	2 + 0	1.3 j-l	1.8 i-k	1.8 h-j	2.2 kl	2.5 h-k	2.5 jk	2.3 j-l	2.2 g-j	2.2 c-f	2.8 a-d	2.0 i-k	1.8 j-m
22	1.5 + 1.5	1.2 kl	2.0 h-j	2.3 e-i	2.7 h-j	2.8 f-i	2.5 jk	2.2 k-m	2.2 g-j	2.2 c-f	2.3 c-e	2.7 e-i	2.0 i-l
23	1 + 2	1.8 h-j	2.0 h-j	2.2 f-j	2.2 kl	2.3 i-l	2.2 kl	2.2 k-m	2.3 f-i	2.7 a-d	3.0 a-c	3.7 a-c	3.0 c-f
24	2 + 1	1.3 j-l	1.8 i-k	2.0 g-j	2.5 i-k	2.5 h-k	2.7 ij	2.7 h-k	2.3 f-i	2.5 a-e	2.5 b-e	2.7 e-i	1.8 j-m
25	2 + 2	1.7 i-k	2.0 h-j	2.2 f-j	2.7 h-j	3.0 e-h	3.2 f-h	3.0 f-i	2.5 e-h	2.0 d-f	3.0 a-c	2.8 d-h	2.8 d-g
26	1 + 3	1.3 j-l	2.0 h-j	2.0 g-j	2.2 kl	2.5 h-k	2.7 ij	2.8 g-j	2.7 d-g	2.3 b-e	3.0 a-c	3.3 a-e	3.2 b-e
27	3 + 1	1.7 i-k	1.8 i-k	2.2 f-j	2.8 g-i	2.5 h-k	2.8 h-j	3.3 d-g	3.0 c-e	2.2 c-f	2.7 a-d	2.8 d-h	2.0 i-l
28	0 + 2	2.2 f-i	2.5 e-h	2.5 d-h	2.0 l	2.0 k-m	1.8 lm	1.7 mn	1.5 k	1.5 f	2.2 de	2.0 i-k	2.8 d-g
29	1 + 1	2.5 d-g	2.3 f-i	2.2 f-j	2.0 l	2.3 i-l	2.0 lm	2.2 k-m	2.5 e-h	2.3 b-e	2.3 c-e	2.3 g-j	1.8 j-m
30	2 + 0	1.3 j-l	1.8 i-k	2.0 g-j	2.7 h-j	2.8 f-i	3.0 g-i	3.0 f-i	2.7 d-g	2.2 c-f	2.2 de	1.8 jk	1.7 k-m
31	1.5 + 1.5	2.8 b-e	3.0 b-e	2.8 c-f	2.2 kl	3.0 e-h	3.0 g-i	3.0 f-i	2.7 d-g	2.3 b-e	2.2 de	2.0 j-k	2.5 f-i
32	1 + 2	3.2 a-c	3.3 bc	3.2 b-d	2.5 i-k	3.0 e-h	3.0 g-i	2.8 g-j	2.5 e-h	2.2 c-f	2.2 de	1.5 k	2.7 e-h
33	2 + 1	2.2 f-i	2.3 f-i	2.5 d-h	2.3 j-l	3.2 d-g	3.2 f-h	3.0 f-i	2.7 d-g	2.3 b-e	2.5 b-e	2.2 h-k	1.8 j-m
34	2 + 2	3.2 a-c	3.3 bc	3.5 a-c	2.7 h-j	3.5 b-e	3.3 e-g	3.3 d-g	2.8 c-f	2.3 b-e	2.7 a-d	2.0 i-k	2.2 h-k
35	1 + 3	3.3 ab	3.5 ab	3.7 ab	2.2 kl	3.0 e-h	3.2 f-h	3.3 d-g	2.7 d-g	2.0 d-f	2.3 c-e	2.2 h-k	3.2 b-e
36	3 + 1	3.0 b-d	3.2 b-d	3.5 a-c	2.7 h-j	4.2 a	3.8 cd	3.8 b-d	3.3 a-c	2.8 a-c	2.8 a-d	2.5 f-j	1.8 j-m
37	4 x 0.5	2.0 f-i	2.2 g-i	1.8 h-j	2.2 kl	2.0 k-m	2.5 jk	2.8 g-j	2.3 f-i	1.8 ef	2.2 de	3.3 a-e	2.3 g-j
38	4 x 0.75	2.7 c-f	2.7 d-g	2.7 d-g	3.0 f-h	2.2 k-m	2.8 h-j	3.5 d-f	3.0 c-e	2.2 c-f	2.2 de	3.8 ab	3.2 b-e
39	4 x 1	2.8 b-e	3.2 b-d	3.0 b-e	3.2 e-g	2.7 g-j	3.5 d-f	4.3 ab	3.2 b-d	2.3 b-e	2.3 c-e	3.7 a-c	3.0 c-f
40	0	1.2 kl	1.3 k	1.8 h-j	2.0 l	1.5 m	1.7 m	1.5 n	1.7 jk	1.8 ef	1.8 e	2.0 i-k	1.0 n

[a]Means followed by the same letter are not significantly different.

[b]First rating after fertilization.

[c]Treatments 1-9, Lakeshore SCU, 37-0-0; treatments 10-18, Andersons SCU, 32-0-0; treatments 19-27, Ureaform, 38-0-0; treatments 28-36, IBDU, 31-0-0; treatments 37-39, urea, 46-0-0; treatment 40, check.

Plastic-Coated Urea as a Slow-Release Fertilizer for Kentucky Bluegrass

Norman Hummel

The objective of this study was to evaluate five plastic-coated urea (PCU) treatments for maintenance fertilization of Kentucky bluegrass turf. The turf is Enmundi Kentucky bluegrass which was established in August 1981, and is maintained at 2 inches in height. A randomized complete block design was used with three replications. Plot size was 4 x 6 feet.

The treatments include four PCU materials with different release rates: 70, 100, 150, and 270 days. A fifth treatment was a mixture of equal proportions (25%) of the four PCU materials. Lakeshore (LS) SCU and Canadian Industries Ltd. (CIL) SCU were included for comparison. All materials were applied at a rate of 4 lb N/1000 sq ft/year in either single spring or split applications. The spring treatments were applied May 20, 1983 and the fall treatments were applied September 24, 1983.

Fresh weight yields were taken twice monthly except (September and October) to evaluate response to the different treatments. To determine fresh weight yields, clippings were collected from 1.6 square meters, which represents one pass over the length of the plot with a 21-inch rotary mower.

To assess turf quality, visual color ratings were made twice monthly. Ratings were made on a scale of 0 to 5, using half units, with 5 indicating dark green. Ratings of less than 3.0 were considered unacceptable color.

Results

Fresh-weight yields and color ratings are shown in Tables 15 and 16, respectively. Means were compared using the Waller-Duncan LSD test, allowing comparisons within each column. Means followed by the same letter are not significantly different.

The highest yields and dark color were produced by the PC-70 4 + 0 and the CIL SCU 4 + 0 following spring fertilization. High yields were also produced by the single spring application of LS SCU and PC-mixed.

The most uniform response to fertilization was produced by the PC-270 4 + 0. Dark color and moderate yields were produced throughout the season. Acceptable color was maintained until November. Uniform response was also obtained from the single spring application of LS SCU and PC-mixed; however, the LS SCU produced very high yields after fertilization which would require more frequent mowing (Table 15).

While the performance of the PC-270 was impressive at the high spring rate, there was insufficient available N at the 2 lb rate to maintain acceptable color for very long. The PC-70 and PC-100 performed very well when the total N was split into two applications. The performance of the treatments could have improved even more had the fall treatments been applied 3 weeks sooner.

Table 15 Effect of various fertilizer treatments on fresh-weight yields of Kentucky bluegrass turf.

TRT. Number	Treatment	6/9	6/27	7/15	DATE 7/31 Weight (g)	8/19	9/16	10/14
1	PC-Mixed 4 + 0	106a	126de	120ab	85c	76c	82a	55e
2	PC-Mixed 2 + 2	127a	98f	90de	81cd	55gh	43d	77c
3	PC-270 4 + 0	113a	104f	108c	90c	101a	76b	66d
4	PC-270 2 + 2	136a	62h	72f	84c	73cd	55c	71cd
5	PC-150 4 + 0	123a	135cd	95d	82cd	63ef	39de	36fg
6	PC-150 2 + 2	113a	84g	70fg	74de	60fg	34f	76cd
7	PC-100 4 + 0	116a	122e	85e	82cd	56f-h	41de	31gh
8	PC-100 2 + 2	111a	104f	52h	45g	33ij	25g	105b
9	PC-70 4 + 0	132a	175a	127a	106b	62ef	39de	38fg
10	PC-70 2 + 2	133a	141c	63g	48g	35i	40de	137a
11	LS SCU 4 + 0	150a	132d	106c	105b	90b	51c	43f
12	LS SCU 2 + 2	151a	97f	85e	63f	52h	36ef	104b
13	CIL SCU 4 + 0	106a	165b	116b	125a	92b	39de	24h
14	CIL SCU 2 + 2	125a	118e	84e	69ef	68de	45d	114b
15	Check	91a	64h	52h	40g	26j	20g	24h

Table 16 Effect of various fertilizer treatments on color ratings of Kentucky bluegrass turf.

TRT. Number	Treatment		6/9	6/27	7/15	7/31	8/19	8/26	9/16	9/14	10/14	11/15
			DATE Color Rating									
1	PC-Mixed	4 + 0	3.5a-d	3.7a-d	4.5a-c	3.5 A.S.	3.7ab	3.7ab	3.7ab	3.5ab	3.0b-d	1.8e-g
2	PC-Mixed	2 + 2	3.0b-d	3.0de	3.5de	2.7	2.5b	2.7bc	2.5b-d	2.7b-d	2.3de	3.3a-c
3	PC-270	4 + 0	3.7a-c	3.5b-d	4.0cd	4.3	4.2a	4.2a	4.2a	4.0a	3.7ab	2.7c-e
4	PC-270	2 + 2	3.2b-d	2.7ef	2.8f	2.8	3.0ab	2.7bc	2.7b-d	2.7b-d	2.5de	2.3d-f
5	PC-150	4 + 0	2.7cd	3.3b-e	4.3bc	3.0	3.3ab	3.0bc	3.3b-c	2.7b-d	2.7cd	1.8e-g
6	PC-150	2 + 2	3.0b-d	3.7a-d	4.0cd	3.7	3.2ab	2.7bc	2.5b-d	2.2cd	2.7cd	3.0b-d
7	PC-100	4 + 0	3.3a-d	3.7a-d	5.0a	3.8	3.7ab	3.2a-c	2.8b-d	2.8a-d	2.7cd	1.8e-g
8	PC-100	2 + 2	3.5a-d	3.8a-c	4.3bc	3.3	3.0ab	2.7bc	2.5b-d	2.8a-d	3.2b-d	3.5a-c
9	PC-70	4 + 0	3.8a-c	4.0ab	4.3bc	4.0	3.5ab	3.0bc	2.7b-d	2.8a-d	2.7cd	1.7fg
10	PC-70	2 + 2	3.3a-d	3.7a-d	3.3ef	3.7	3.2ab	2.7bc	2.3cd	2.3b-d	3.5a-c	4.0a
11	LS SCU	4 + 0	4.5a	4.0ab	4.7ab	3.3	3.3ab	3.0bc	2.8b-d	3.3a-c	2.8b-d	1.5fg
12	LS SCU	2 + 2	3.7a-c	3.2c-e	2.8f	3.0	2.5b	2.3c	2.0d	1.8d	3.5a-d	3.3a-c
13	CIL SCU	4 + 0	4.2ab	4.3a	4.3bc	3.8	3.7ab	3.0bc	2.8b-d	3.3a-c	2.3de	1.5fg
14	CIL SCU	2 + 2	4.2ab	3.3b-c	3.5de	3.0	2.7ab	2.5c	2.7b-d	2.7b-d	4.3a	3.8ab
15	Check		2.3d	2.0f	2.0g	3.3	3.0ab	2.3c	2.0d	2.0d	1.7e	1.2g

Eagle-Iron Studies

Nick Christians

Eagle-Iron is an organic compound which contains 10% Iron (Fe) by weight. It's manufactured by the Agriculture Chemical Division of Eagle-Picher Industries of Joplin, Missouri and is being marketed in the turfgrass industry as a liquid applied Fe source.

In 1983, Eagle-Iron (E.I.) was compared to iron sulfate (I.S.) on an experimental golf course green and on a Park Kentucky bluegrass turf located at the Iowa State University Horticultural Research Station. The green was established with emerald creeping bentgrass in the fall of 1979. The soil on this area is a 1-1-1 (sand-soil-peat) mixture with a pH of 7.5, available P levels of 20 lb/A and K levels of 180 lb/A.

The study was arranged so that Eagle-Iron and iron sulfate were applied at rates of 0.05, 0.10, and 0.15 lb Fe/1000 ft^2 in combination with 0.5 and 1.0 lb N/1000 ft^2. The N source was urea. All materials were individually tank mixed and applied as liquids to 5' x 5' plots in the equivalent of 3 gallons water/1000 ft^2. Control areas treated with 0.5 and 1.0 lb N/1000 ft^2 were included as 5' x 25' strips located along the edge of each study. Applications were made on the bentgrass area on June 9, June 27, and September 2; and on the bluegrass area on June 9 and September 2. Data collected on the areas included ratings of discoloration 24 hours after application and ratings of turfgrass color in the 2 week period following treatment.

Both Eagle-Iron (E.I.) and iron sulfate (I.S.) discolored the creeping bentgrass in the first 24 hours after application on each of the treatment dates (Table 17). Ratings of 5 and below were very dark green, almost black, and were considered to be unacceptable. In each case, the green was irrigated 2 hours after the last treatment was applied. The greatest discoloration occurred after the June 27 date. There was no difference between E.I. and I.S. at the 0.05 and 0.15 lb Fe/1000 ft^2 rate at this date, however, at the 0.10 lb rate (the recommended rate for Eagle-Iron) the plots treated with E.I. were rated at an acceptable 6 and the I.S. plots were rated as unacceptable. In every case, the discoloration disappeared after the second mowing.

Discoloration of the emerald bentgrass varied with N rate (Table 18). Particularly following the June 9 application date, there was much more discoloration by Fe treatments applied with 1.0 lb N/1000 ft^2 than on areas treated with Fe + 0.5 lb N/1000 ft^2. A similar difference was observed following the September 1 application, although the differences were not as great.

Color enhancement of the bentgrass was apparent on all areas treated with Fe for approximately 2 weeks following treatment. There was little difference between Eagle-Iron and iron sulfate following any of the application dates (Table 17). Likewise there was little difference among the 3 rates of each product. The color enhancement generally lasted from 14 to 16 days after which time areas treated with Fe could not be distinguished from controls.

Eagle-Iron is believed to provide a longer term iron response than that expected from Iron Sulfate on many species. That may be true on high pH soils, where the iron from iron sulfate is rapidly removed from the soil solution; however, at the more moderate pH of the soil used in this study the response was very similar for the two materials. An interesting project for the future would be to compare Eagle-Iron, iron sulfate and an iron chelate material on turf grown in soils with pH's ranging from 7.0 to 8.3.

Iron and nitrogen treatments were applied to Kentucky bluegrass on June 9 and September 1. There was very little visible response to the iron treatments following the June 9 treatment and no visible response following the September 1 application. There was a discoloration of the bluegrass turf 24 hours after application and, in the first week, there were some visible color differences between the control and the plots treated with Fe (Table 19). However, by June 15 there were no significant differences among treatments.

Table 17. Discoloration and green color ratings for Emerald creeping bentgrass following each of three Iron and Nitrogen Treatments.

Treatment		Treatments Applied June 9			Treatments Applied June 27			Treatments Applied September 1			
		Discoloration* 6/10	Color** 6/15	Color 6/24	Discoloration 6/28	Color 7/9	Color 7/13	Discoloration 9/2	Color 9/7	Color 9/10	Color 9/16
	– lb Fe/1000 ft^2 –										
1. Control	--	9.0†	6.5	7.0	9.0	7.0	7.0	9.0	7.5	6.5	7.5
2. E.I.	0.05	7.5	8.0	7.0	6.5	7.5	7.0	8.0	8.0	8.0	8.5
3. E.I.	0.10	7.5	8.0	7.5	6.0	7.5	7.0	7.0	7.5	8.0	8.0
4. E.I.	0.15	6.5	8.0	7.5	5.0	7.5	8.0	7.0	8.5	8.0	8.5
5. I.S.	0.05	7.5	7.5	7.0	6.5	7.0	7.0	8.5	7.5	8.0	8.0
6. I.S.	0.10	7.0	8.0	7.5	5.0	7.5	7.0	7.5	7.5	8.0	8.5
7. I.S.	0.15	6.5	8.0	7.5	5.0	7.0	7.0	7.5	8.0	8.0	8.5
LSD	0.05	0.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	0.5	0.5

* Discoloration ratings are based on a scale of 9-1 where 9 = no discoloration and 1 = dark black discoloration of tissue.

** Color ratings are based on a scale of 9-1 where 9 - dark green color and 1 - yellow, chlorotic turf.

† All data are averaged over the 2 N rates.

Table 18. Discoloration ratings for increasing rates of Eagle Iron and Iron Sulfate applied on creeping bentgrass at 0.5 and 1.0 lb $N/1000\ ft^2$.

Treatment		Discoloration June 10		Discoloration September 2	
		0.5 lb $N/1000\ ft^2$	1.0 lb $N/1000\ ft^2$	0.5 lb $N/1000\ ft^2$	1.0 lb $N/1000\ ft^2$
1. Color	--	9.0*	9.0	9.0	9.0
2. E.I.	0.05	8.0	7.0	8.5	7.5
3. E.I.	0.10	7.5	7.0	7.5	6.5
4. E.I.	0.15	7.0	5.5	6.5	7.5
5. I.S.	0.05	8.5	7.0	8.5	8.0
6. I.S.	0.10	8.0	6.5	8.0	6.5
7. I.S.	0.15	7.0	6.0	8.0	7.0
LSD	0.05**	1.0	1.0	2.0	2.0

* LSD for the separation of treatment means in rows (N rate) = 0.5 for June 10 and 1.0 for September 2.

** LSD for the separation of iron treatment means within N rate.

Table 19. Discoloration and green color ratings for Park Kentucky bluegrass following the June 9 application of iron and nitrogen.

Treatment	lb Fe/ $1000\ ft^2$	Treatments Applied June 9: Discoloration* June 10	Treatments Applied June 9: Color ** June 15
1. Control	--	9.0	7.0
2. E.I.	0.05	7.5	7.5
3. E.I.	0.10	7.5	7.5
4. E.I.	0.15	6.5	7.5
5. I.S.	0.05	7.0	7.5
6. I.S.	0.10	7.0	7.5
7. I.S.	0.15	6.0	7.5
LSD 0.05		1.0	NS

* Discoloration ratings are based on a scale of 9-1, where 9 = no discoloration and 1 = dark discoloration of tissue.

** Color ratings are based on a scale of 9-1, where 9 = dark green color and 1 = yellow, chlorotic turf.

Nitrogen × Potassium Study

K. L. Diesburg, N. E. Christians, and D. Larocque

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 two inch mowing, pre- and postemergent weed control, and irrigation as needed. No insecticides or fungicides have been applied to the area.

The study is arranged as a complete factorial with four levels of N (0, 2, 3, and 4 lb./1000 ft^2/year) and four levels of K (0, 2, 3, and 4 lb./1000 ft^2/year). 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 began in April 1981, and have continued with applications split over late April, May, late August, and September.

Monthly ratings of turf quality and fresh weights of clippings are presented in Table 20. 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. Higher levels of applied K maintained better quality during the heat stress of July and August.

Clipping weights were increased by increments of K for every mowing except that of late August.

The need for a proper balance of N and K can be seen in Table 20. Although there was no interaction between Nitrogen and Potassium, optimum stimulation of grass growth from increments of applied N seemed to occur at 2 lbs. K/1000 ft^2, while least stimulation occurred at 0 lbs. K. Optimum improvement of quality from increments in applied N was also seen at 2 lbs. K, but least improvement seemed to be at 3 lbs. K. Likewise, increments of applied K appeared to cause optimal effects at either 2 or 3 lbs. N/1000 ft^2 compared to 0 and 4 lbs. N.

Table 20. Mean effects of Nitrogen (N) and Potassium (K) on turf quality and vegetative growth of Kentucky bluegrass.

N	K	Fresh Clipping Weights July 27	Aug 8	Aug 19	Sept 2	Sept 23	Avg
lb./1000 ft^2		grams					
4	4	98.6	32.7	69.7	125.1	73.9	80.0
4	3	116.8	36.8	78.9	126.4	68.1	85.4
4	2	85.6	37.6	63.3	138.3	96.8	84.3
4	0	66.6	29.6	60.5	118.1	81.5	71.3
3	4	89.7	38.0	90.8	154.0	74.9	89.5
3	3	76.2	31.5	78.7	137.8	77.7	80.4
3	2	80.3	32.4	84.1	133.8	74.9	81.1
3	0	35.7	21.6	45.0	90.2	57.3	50.0
2	4	62.8	28.5	27.2	52.6	39.8	42.2
2	3	60.4	22.2	29.4	51.6	36.4	40.0
2	2	47.2	25.8	30.1	48.8	28.7	36.1
2	0	28.8	17.3	18.0	33.8	21.6	23.9
0	4	19.6	14.8	16.4	31.6	20.3	20.5
0	3	14.1	11.2	10.9	26.0	19.5	16.4
0	2	7.5	7.9	6.0	18.2	10.2	10.1
0	0	10.5	9.6	10.2	17.3	12.1	12.0
Mean		56.3	24.8	45.0	81.5	49.6	51.4
LSD	0.05	18.5	6.0	14.3	18.2	7.3	11.3

N	K	Quality Ratings[a] July	Aug	Sept	Oct	Avg
4	4	9.0	8.7	8.7	8.7	8.8
4	3	8.3	8.0	9.0	8.3	8.4
4	2	9.0	9.0	8.7	9.0	8.9
4	0	8.0	8.3	8.7	8.3	8.3
3	4	8.7	9.0	7.7	8.3	8.4
3	3	8.7	8.7	8.0	8.0	8.3
3	2	8.3	8.3	8.3	7.7	8.2
3	0	7.3	7.7	7.0	8.0	7.5
2	4	8.0	5.7	6.0	6.7	6.6
2	3	8.0	6.3	6.7	7.7	7.2
2	2	8.0	5.3	6.3	6.7	6.6
2	0	6.7	4.3	5.3	6.3	5.7
0	4	4.7	3.7	4.3	3.3	4.0
0	3	5.3	3.7	4.7	3.0	4.2
0	2	3.3	2.7	3.3	3.0	3.1
0	0	3.7	2.7	4.3	3.3	3.5
Mean		7.2	6.4	6.7	6.6	6.7
LSD	0.05	0.9	0.8	0.8	0.5	0.6

[a] ratings based on 9 = best, 1 = dead, and 6 = acceptable.

Phosphorous Fertilization Study

K. L. Diesburg, D. Laroque, and N. E. Christians

The phosphorus (P) fertilization study was initiated in April 1981 to test the response of Kentucky bluegrass to increasing levels of P on a typical Iowa soil.

The study is located on Section V, Block I of the ISU turf plots at the ISU Horticulture Research Station. The area was seeded with 'Baron' Kentucky bluegrass in September, 1979. At the time of establishment, 1.0 lb. P_2O_5 (as triple super phosphate) and 0.5 lb./N 1000 ft^2 (as ammonium nitrate) were applied. The area used for the phosphorus fertilization has been maintained in lawn condition including two inch mowing, pre- and postemergent weed control, and standard fertilization with urea. No insecticides or fungicides have been applied to the area. Initial soil test levels of P on this area were 27 lb/A.

The study was designed in a randomized complete block with six treatments and three replications. Treatments include 0, 1, 2, 4, 8, and 12 lb. P_2O_5/1000 ft^2. Phosphorus is applied as triple super phosphate once per season in approximately the middle of May.

Results of data taken on turf quality and vegetative growth are summarized in Table 21. Phosphorus levels of 2 and 12 lb./1000 ft^2 resulted in either highest or second highest quality ratings and clipping weights at all sampling dates, though differences among treatments were not significant in most cases. The only set of data in which there were significant differences was the August turf quality ratings in which phosphorus levels of 2, 4, and 12 lb. resulted in higher quality than 0, 1, or 8 lb. August is generally the month in which turfgrass is under most stress. The 1983 season was the first one since the study was begun in 1980 in which differences in response to phosphorus were detected. However, it can be seen from the data that the trends were not consistent in 1983. This is a long-term study and should yield more conclusive data in the years to come.

Table 21. Effects of increasing levels of Phosphorus on turf quality and vegatative growth.

	Turf Quality Rating[a]					Clipping Weight				
Treatment	July	Aug	Sept	Oct	Mean	July 27	Aug 8	Aug 17	Sept 2	Mean
lbs P_2O_5/1000 ft^2						grams				
1. 0	9.0	8.0	8.7	7.3	8.3	54.3	60.8	56.2	62.9	58.5
2. 1	8.3	8.3	8.3	7.7	8.2	54.4	67.7	55.3	69.9	61.8
3. 2	8.7	9.0	8.3	7.7	8.4	78.0	72.0	70.7	80.8	75.4
4. 4	8.3	9.0	8.3	8.0	8.4	64.7	66.0	60.2	79.6	67.6
5. 8	8.3	8.3	8.0	7.3	8.0	67.1	69.5	60.7	78.4	68.9
6. 12	8.7	9.0	8.7	7.7	8.5	74.8	83.3	71.2	85.3	78.7
Exp. Mean	8.6	8.6	8.4	7.6	8.3	65.6	69.9	62.4	76.2	68.5
LSD 0.05	1.0	0.6	1.3	1.5	0.8	23.1	18.7	18.4	28.0	19.6

[a] ratings based on 9 = best, 1 = dead, and 6 = acceptable turf.

The Reduction of Ammonia Volatilization from Turfgrass Areas Treated with Surface-Applied Urea

Young Joo and Nick Christians

PPD Screening Test: Summer 1983

Urease inhibitors are chemicals that have the potential to decrease ammonia volatilization losses from surface-applied urea. The objectives of this test were to observe the effects of the urease inhibitor Phenylphosphoro-diamidate (PPD) on foliar burn and growth of Kentucky bluegrass. The treatments included liquid urea solutions applied at 1, 2, and 3 lbs. N/1000 ft^2, with and without PPD (1% by weight of urea). The treatments were applied on August 26, 1983. Although there appeared to be little difference in foliar burn (Table 22), a definite effect on growth was observed among treatments. The average fresh weight of clippings over a seven week period in plots treated with PPD was observed to increase 30% at 1 lb N/1000 ft^2, 11.8% at 2 lb N/1000 ft^2, and 33.5% at 3 lb N/1000 ft^2 (Table 23). Similar trends were observed in height of regrowth after mowing (Table 24).

The results indicate that PPD can have a definite effect on the N use efficiency of urea surface-applied to Kentucky bluegrass. However, more detailed work will be required to prove this conclusively.

Comparison of PPD and Mg: Summer 1983

The objectives of this test were to observe the effects of PPD and Mg on foliar burn and growth of Kentucky bluegrass. The treatments included urea solution at 1 lb N/1000 ft^2, with PPD at 0.1%, 0.5%, and 1.0% of the weight of urea. Also included were solutions with 3% K, 3% K and Mg, and 3% K, Mg and S. These treatments were applied on September 8, in a cool temperature period.

The fresh weight of clippings and the height of regrowth were unaffected by PPD and Mg treatments (Table 25, 26). This was probably due to low volatilization during this cooler period of late summer. However, the addition of Mg (12-0-3-3) in the solution was observed to reduce foliar burn (Table 27). More detailed work under various temperature regimes will be required to further investigate the effects of PPD and Mg on the reduction of ammonia volatilization and foliar burn on turfgrass areas treated with surface-applied urea.

Table 22. The measured quality of Kentucky bluegrass over a seven week period, following treatment with Urea and Urease Inhibiter (UI).

	TREATMENT*	WEEK ONE	WEEK TWO	WEEK THREE	WEEK FOUR	WEEK FIVE	WEEK SIX	WEEK SEVEN	MEAN
1.	Control	8.0 †	7.0	7.0	7.0	6.0	6.0	6.0	6.7
2.	UREA 1	8.0	8.0	8.0	8.0	8.0	7.5	7.5	7.9
3.	UREA 2	8.0	8.0	8.0	8.0	8.0	7.5	7.5	7.9
4.	UREA 3	8.0	8.0	8.0	9.0	9.0	9.0	9.0	8.6
5.	UREA + UI 1 ‡	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
6.	UREA + UI 2	8.0	8.0	8.0	8.0	8.0	7.5	7.5	7.9
7.	UREA + UI 3	8.0	8.0	8.0	9.0	9.0	9.0	9.0	8.6
	L S D 0.05	NS	NS	NS	NS	NS	1.2	1.2	0.3

* Nitrogen rates were lb N/1000 ft^2, applied in a liquid form on August 26, 1983.

† Quality was evaluated on a scale of 1-9, where 9 = best quality and 1 = lowest quality.

‡ UI was applied at a rate equal to 1% of the weight of Urea.

Table 23. The measured fresh weight of Kentucky bluegrass over a seven week period, following treatment with Urea and Urea + Urease Inhibitor (UI).

	TREATMENT*	WEEK ONE	WEEK TWO	WEEK THREE	WEEK FOUR	WEEK FIVE	WEEK SIX	WEEK SEVEN	MEAN
					(Grams)				
1.	Control	17.3 †	10.2	11.6	3.5	2.1	1.6	1.2	6.8
2.	UREA 1	31.9	24.7	20.6	8.6	3.8	2.0	1.8	13.3
3.	UREA 2	46.3	52.4	45.0	15.2	11.5	5.9	2.0	25.5
4.	UREA 3	49.0	64.2	59.9	25.6	17.4	6.2	2.7	32.1
5.	UREA + UI 1‡	40.4	40.5	29.1	12.1	6.6	2.5	1.4	18.9
6.	UREA + UI 2	55.0	57.2	53.3	18.8	11.4	4.3	2.2	28.9
7.	UREA + UI 3	76.0	99.3	80.3	38.4	27.0	12.0	5.6	48.4
	L S D 0.05	17.3	20.9	24.9	5.0	6.2	3.0	1.8	7.1

* Nitrogen rates were lb N/1000 ft^2, applied in a liquid form on August 26, 1983.

† UI was applied at a rate equal to 1% of the weight of Urea.

‡ The fresh weights were measured in a 5' x 20" strip, each plot was 5' x 5' size.

Table 24. The measured height of regrowth of Kentucky bluegrass over a seven week period, following treatment with Urea and Urea + Urease Inhibitor (UI).

	TREATMENT	WEEK ONE	WEEK TWO	WEEK THREE	WEEK FOUR	WEEK FIVE	WEEK SIX	WEEK SEVEN	MEAN
					(mm)				
1.	Control	22.3	15.9	14.7	15.6	5.0	2.7	0.7	11.0
2.	UREA 1	32.8	29.0	23.7	14.2	9.3	4.7	2.0	16.5
3.	UREA 2	34.4	41.0	31.2	20.3	17.3	9.3	5.1	22.6
4.	UREA 3	37.5	44.0	44.6	25.8	21.5	13.5	8.0	27.8
5.	UREA + UI 1	31.2	33.8	27.0	14.4	13.0	9.1	3.7	18.9
6.	UREA + UI 2	36.5	39.3	35.8	23.9	16.7	11.1	6.7	24.2
7.	UREA + UI 3	38.3	48.6	48.5	27.9	27.5	16.4	9.9	31.0
	L S D 0.05	10.2	11.3	10.1	8.0	8.1	8.0	5.5	5.0

Table 25. The measured fresh weight of Kentucky bluegrass clippings over a four week period, following treatment with Urea and Urease Inhibitors (UI), Mg, and S.

	TREATMENT*	WEEK 2	WEEK 3	WEEK 4	MEAN
			(Grams)		
1.	12-0-0	30.8‡	15.6	9.7	18.7
2.	12-0-3	24.5	14.8	6.8	15.4
3.	12-0-3-3 (Mg)	28.3	15.5	7.5	17.1
4.	12-0-3-3-3 (Mg+S)	31.6	16.8	9.8	19.4
5.	12-0-0 + 0.1% UI†	25.3	13.2	8.5	15.7
6.	12-0-0 + 0.5% UI	22.2	13.9	6.1	14.1
7.	12-0-0 + 1.0% UI	21.2	16.9	6.1	14.7
8.	Oxamide	15.5	9.3	5.7	10.2
	L S D 0.05	8.1	5.3	3.4	4.6

* Nitrogen rates were 1 lb N/1000 ft^2, applied in a liquid form on September 8, 1983.

† UI was applied at a rate equal to 0.1, 0.5, and 1.0% of the weight of Urea.

‡ The fresh weights were measured in a 5' x 20" strip, each plot was 5' x 5' size.

Table 26. The measured height of regrowth of Kentucky bluegrass over a four week period.

	TREATMENT	WEEK 2	WEEK 3	WEEK 4	MEAN
			(mm)		
1.	12-0-0	18.9	16.9	11.3	15.7
2.	12-0-3	19.7	15.9	10.3	15.3
3.	12-0-3-3 (Mg)	21.7	16.1	12.0	16.6
4.	12-0-3-3-3 (Mg+S)	17.8	17.6	10.5	15.3
5.	12-0-0 + 0.1% UI	15.6	16.0	10.6	14.1
6.	12-0-0 + 0.5% UI	20.7	16.1	11.0	15.9
7.	12-0-0 + 1.0% UI	18.6	14.0	10.2	14.3
8.	Oxamide	15.2	11.9	7.8	11.6
	L S D 0.05	6.4	4.5	5.5	3.8

Table 27. The measured quality of Kentucky bluegrass over a four week period.

	TREATMENT	OCT. 9*	OCT. 12	OCT. 16	OCT. 23	MEAN
1.	12-0-0	6.7†	7.0	7.3	9.0	7.5
2.	12-0-3	6.7	6.7	7.0	9.0	7.3
3.	12-0-3-3 (Mg)	6.7	8.0	8.0	9.0	7.9
4.	12-0-3-3-3 (Mg+S)	5.3	6.3	7.0	9.0	6.9
5.	12-0-0 + 0.1% UI	7.3	6.6	7.0	9.0	7.5
6.	12-0-0 + 0.5% UI	6.6	6.6	6.6	9.0	7.3
7.	12-0-0 + 1.0% UI	6.3	6.0	6.3	9.0	6.9
8.	Oxamide	9.0	9.0	9.0	9.0	9.0
	L S D 0.05	1.1	0.7	0.6	NS	0.5

* Treatment applied on September 8, 1983

† Qualities were evaluated on a scale of 1-9, where 9 = best quality and 1 = lowest quality.

1983 Preemergence Crabgrass Control Study

Nick Christians

The treatments for the 1983 preemergence crabgrass control study were applied on April 27, 1983, with follow up applications applied on June 15. Treatments were applied on 5' x 5' plots on a lawn area which has been heavily infested by crabgrass for several years. The treatments included Dacthal W-75 and Dacthal 6F from Diamond Shamrock, Ando-A and Ando-B sprayable experimentals from the Andersons Company of Maumee, Ohio, Benefin-Peltech 20 from the Andersons, Ronstar G from Rhone-Poulenc and Bensulide 4E (Betamec 4).

All treatments reduced crabgrass infestation, although no treatments were totally effective in eliminating this species. The spring of 1983 was very wet (see Appendix I) and the stand of Kentucky bluegrass in this area is quite thin due to a lack of fertilization. Complete weed control would not be expected.

Repeat applications of 10.5 + 7.5 lb ai/A Dacthal reduced numbers of crabgrass more than single 10.5 lb ai/A applications, although the reduction was statistically lower for the 6F material only (Table 28).

Both the Ando-A and Ando-B products were relatively effective at rates of 2 and 3 lb ai/A. The 1 and 1.5 lb ai/A rate of Ando-A reduced crabgrass numbers, but were not as effective as the higher rates. Benefin-PelTech 20 reduced crabgrass at the single 2 lb ai/A rate, but provide acceptable control only when followed by a 1.5 lb application.

The bensulide 4E was quite effective at both the 7.5 and 10.0 lb ai rate, as was the Ronstar G at the 3 lb rate.

No phytotoxic effects were observed on the Kentucky bluegrass in the first 2 weeks following application, or at any time during the season.

Spurge counts were quite variable with few spurge plants being found in the untreated control. It is apparent that the bensulide 4E was not effective in controlling spurge in this test. Beyond that observation it is difficult to draw any conclusions concerning the control of spurge.

Table 28. Results of the 1983 preemergence crabgrass control study.

Treatment	lb ai/A	Crabgrass	Spurge**
1. Control		254*	5
2. Dacthal W-75	10.5	58	4
3. Dacthal W-75	10.5 + 7.5	22	2
4. Dacthal 6F	10.5	72	6
5. Dacthal 6F	10.5 + 7.5	16	1
6. ANDO-A	1.0	98	2
7. ANDO-A	1.5	77	4
8. ANDO-A	2.0	40	0
9. ANDO-A	3.0	36	1
10. ANDO-B	2.0	20	1
11. ANDO-B	3.0	10	2
12. Benefin-PelTech 20	2.0	158	4
13. Benefin-PelTech 20	2.0 + 1.5	35	5
14. Bensulide 4E	7.5	25	11
15. Bensulide 4E	10.0	17	9
16. Ronstar G	3.0	13	0
L S D 0.05		51	5

* Numbers of weeds on a 5' x 5' plot.

** Prostrate spurge Euphorbia supina .

1983 Postemergence Annual Grass and Broadleaf Weed Control Study

Nick Christians

The 1983 postemergence annual grass and broadleaf weed control study was conducted at the North Dakota Avenue Cemetery in West Ames. The Kentucky bluegrass on this area was established more than forty years ago and no herbicides have been used on the site. There is a uniform stand of bluegrass which is heavily infested with crabgrass and dandelions.

The treatments included Daconate 6 (MSMA) in single and repeat applications, a combination of Daconate 6 with an MCPP + 2,4-D-Amine broadleaf weed control herbicide, and two experimental products from PBI Gordon; Gordons EH 697 and Gordons EH 707. The Gordons products are combinations of MSMA + Trimec with somewhat higher levels of MSMA in the EH 697 material. All treatments were applied in 3 gal water/1000 ft^2. The plots measured 5' x 5' and each treatment was replicated four times. The first treatments were applied on 6/21/83 and follow up treatments of Daconate 6 were made 10 days later. The crabgrass was in the 2 to 3 leaf stage and the broadleaf weeds were actively growing.

The first evaluations of phytotoxicity were made on 6/24/83 and a second evaluation was made 74 days later on 9/7/83 (Table 29). There was a greater reduction of quality on plants treated with Daconate 6 + the MCPP + 2,4-D than on plots treated with Daconate 6 alone on the first date. There was also some noticeable reduction in quality on plots treated with Gordons EH 697 and EH 707. By the 9/7 rating, the only plots showing visible damage were those treated with the follow up application of Daconate 6. The summer of 1983 was unusually hot and dry and the damage from the repeat applications of Daconate 6 may have been due to the extremes in temperature.

The Daconate 6 (MSMA) treatments were the most effective in controlling crabgrass (Table 29). There were no significant differences between the single and repeat applications of this material. The EH 697 and EH 707 reduced crabgrass populations, but were less effective than the MSMA alone.

The Daconate 6 with MCPP + 2,4-D treatments were very effective in controlling broadleaf weeds, as was Trimec. The Gordons EH 697 and EH 707 were effective controls for broadleaf weeds, although there were more dandelions observed in plots treated with these two materials. Of the two, there were fewer dandelions remaining in plots treated with EH 697 than in plots treated with EH 707; however, these readings were not statistically different.

The results of the 1983 study would indicate that there is little value in repeating Daconate 6 applications 10 days after initial treatments from a weed control standpoint, and that these treatments may result in damage to Kentucky bluegrass.

Table 29. Results of the 1983 postemergence crabgrass and broadleaf weed control study.

Treatments	Rate	Phyto Rating 6/24	Phyto Rating 9/7	Crab-grass	Dande-lion	Spurge	Black Medic	White Clover
1. Control		9*	9	61**	78	6	10	52
2. Daconate 6* + MCPP + 2,4-D Amine Daconate 6 (10 days later)	2 lb ai/A 2 lb ai/A 2 lb ai/A	4	7	0	7	1	0	0
3. Daconate 6 + MCPP + 2,4-D Amine Daconate 6 (10 days later)	2 lb ai/A 3 lb ai/A 2 lb ai/A	3	6	0	4	0	0	0
4. Daconate 6	2 lb ai/A	7	9	6	82	3	17	22
5. Daconate 6 Daconate 6 (10 days later)	2 lb ai/A 2 lb ai/A	7	7	0	26	0	2	0
6. MSMA	2 lb ai/A	7	9	6	38	6	7	6
7. Gordons EH 697	1.63 gal/A	4	9	22	9	0	0	0
8. Gordons EH 707	1.74 gal/A	5	9	14	26	0	0	0
9. Trimec	0.50 gal/A	6	9	58	4	0	0	0
L S D 0.05		2	1	33	21	N.S.	7	30

* Phytotoxicity is rated on a scale of 9-1, where 9 = no damage, and 1 = complete kill of the Kentucky bluegrass.

** Weed numbers are the number of weeds in the 5' x 5' plots averaged over the four replications.

1983 Broadleaf Weed Control Studies

Nick Christians

The 1983 broadleaf weed control study was conducted at the North Dakota Avenue cemetery in west Ames. The Kentucky bluegrass on this area was established more than 40 years ago and no herbicides have been used on the area. It is heavily infested with dandelion, white clover and black medic. The treatments included MCPP-D4 and MCPP + 2,4,-D(2+2), which are both experimentals from Diamond Shamrock; Formula 40 and Garlon 4, products of Dow Chemical, and Trimec (2,4,-D/MCPP/Dicamba) from PBI Gordon.

The treatments were applied on 5' x 10' plots in 2 gallons of water per 1000 ft^2 on June 24, 1983. The temperature was 84°F, the weather was clear and the wind speed was less than 5 mph. There was no rain for 48 hours following application. Counts of dandelion and black medic plants and estimates of percent cover of white clover were made on June 24. On July 5, evaluation of visible damage to weed species was made. A rating scale of 9 = complete kill and 1 = no damage was used. Counts of dandelion and black medic, and estimates of white clover were again performed on August 22. Data were expressed as percent control of each species in each plot.

All treatments had a visible effect on the weeds 11 days after application on July 5, 1983, (Table 30). The plots treated with Trimec had the lowest rating and the MCPP-D4 had the highest numeric rating. The visible effects of postemergence herbicides can be very important from a consumer satisfaction standpoint for the lawn care companies.

The MCPP + 2,4,-D(2+2) (2.78 lb ai/A), Formula 40 (3.00 lb ai/A), Garlon 4 (1.00 lb ai/A), and Trimec provided satisfactory control of dandelions, whereas the MCPP-D4, and Garlon 4 (0.50 lb ai/A) did not.

All of the material provided satisfactory control of white clover and black medic. Although the plots treated with Garlon 4 (0.50 lb ai/A) showed a numerically lower control than the other treatments.

Of some interest, is the low percent control of dandelions and the relatively high control of white clover by Garlon 4 (0.50 lb ai/A). The control of dandelions is usually high with low rates of 2,4-D and control of white clover is usually low. Perhaps satisfactory control of both species can be obtained by combinations of the two materials at low rates.

Table 30. Results of the 1983 broadleaf weed control study.

Treatment	lb ai/A	Visible effects on Weeds	Dand. Control	White Clover Control	Black Medic Control
				&	
1. Control	----	1.0*	0	0	0
2. MCPP-D4	2.00	5.0	33	100	87
3. MCPP + 2,4-D(2+2)	2.78	3.0	91	98	90
4. Formula 40	3.00	3.5	87	92	87
5. Garlon 4	0.50	4.5	24	75	72
6. Garlon 4	1.00	4.5	97	80	100
7. 2,4-D/MCPP/ Dicamba (Trimec)	1.50/0.80/0.156	2.5	92	96	95
L S D		2.0	29	32	31

* Ratings were performed on July 5, 1983; 1 = no damage to weeds and 9 = complete kill.

Selective Control of Tall Fescue in Kentucky Bluegrass with Chlorsulfuron

Brian Maloy and Nick Christians

Abstract

Kentucky bluegrass (Poa pratensis L.) and tall fescue (Festuca arundinacea Schreb.) field plots were treated with single applications of (Chlorsulfuron), 2-Chloro-N- [(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl] benzenesulfonamide at rates of .25, .50, 1, 2, 3, and 4 oz/A and with split applications of .25 + .25, .50 + .50, 1 + 1, 2 + 2, and 3 + 3 oz/A applied at a two-week interval. Data taken weekly during the study included fresh clipping weights and quality ratings. The chlorsulfuron severely damaged the tall fescue at single application rates of 2 oz/A and split application rates of 2 + 2 oz/A and greater. Quality and clipping weight decreased with increasing rates of the chemical. The Kentucky bluegrass showed a much higher tolerance to the chlorsulfuron with no decrease in quality at the higher 4 oz/A single application rate or the 3 + 3 oz/A split application rate. However, with an increase in the chlorsulfuron rate a slight decrease in clipping weight was observed.

Introduction

Most of the work with chlorsulfuron has been carried out during the past decade. Research has been directed towards mode of action, species selectivity, and analysis of residues. The herbicide is labeled for use in cereal crops and does not have a label for use in turf at this time.

Materials and Methods

The field study was started on June 28, 1983, at the Iowa State University turf research plots north of Ames, Iowa. In section IV two studies were established; one in tall fescue (Kentucky 31) and the other in a premium sod blend of Kentucky bluegrass. The studies consist of twelve 5' x 5' plots replicated three times. In both studies each 5' x 5' plot is 1/2 bluegrass and 1/2 fescue. The plots were established by interchanging strips of sod (2 1/2' x 5') between the two areas. The study is arranged as a split-plot with chlorsulfuron treatments as main plots and species as sub plots.

Treatments included single rates of .25, .50, 1, 2, 3, and 4 oz/A and split rates of .25 + .25, .50 + .50, 1 + 1, 2 + 2, and 3 + 3 oz/A. Each treatment was applied in 326 ml. of water at 20 psi with a hand held boom operated in four differing directions to ensure uniform coverage. The 326 ml. of water per plot is equivalent to 150 gallons of water per acre. The single application rates were applied July 11, 1983, and the second application of the split rates were applied July 25, 1983.

Kentucky bluegrass was maintained at a height of 2" while tall fescue was cut at 3". At quarterly intervals throughout the growing season, 1 lb. N (SCU)/1000 ft^2 was applied to the studies. Water was applied by the sprinkler irrigation system as needed to prevent moisture stress.

Data taken weekly during the study included fresh clipping weights and quality ratings. The quality ratings were determined on a scale from 9 to 1, 9 = best quality and 1 = dead turf.

The same treatments were applied to the second study later in the Fall (October 1 and 15) . Data will be taken in Spring 1984.

Results and Discussion

The responses varied with species and treatment rates. The Kentucky bluegrass showed a much higher tolerance to the chemical with no decrease in quality at the highest single and split application rates. However, as the chlorsulfuron rate increased the clipping weight decreased (Table 31). This observation suggests that chlorsulfuron has some growth retarding effects on Kentucky bluegrass.

Chlorsulfuron is systemic and is active through the foliage and root system. Death of tall fescue plants is slow and is accompanied by chlorosis, necrosis, terminal bud death, vein discoloration and complete growth inhibition. The tall fescue showed a very low tolerance to the chemical and was severely effected at single rates of 2 oz/A and split rates of 2 + 2 oz/A and greater. Injury occurred at the lower rates, however, the tall fescue recovered from damage at 1 oz/A single rate and the 1 + 1 oz/A split rate. The data from this study indicates that chlorsulfuron has the potential for being a selective control for tall fescue in Kentucky bluegrass.

Table 31. Quality and clipping weight data for single and split applications of chlorsulfuron.

SINGLE APPLICATIONS

TREATMENT - OZ/A	QUALITY		CLIPPING WEIGHT - GRAMS	
	K.B.	T.F.	K.B.	T.F.
Control	8	9	14.7	52.7
.25	8	9	17.0	43.1
.50	8	8.3	14.0	44.0
1	8	8.7	8.3	32.3
2	8	4.7	10.3	5.3
3	8	4	5.3	5.3
4	8	2.3	7.7	0.0

SPLIT APPLICATIONS

TREATMENT - OZ/A	QUALITY		CLIPPING WEIGHT - GRAMS	
	K.B.	T.F.	K.B.	T.F.
.25 + .25	8	9	10.3	38.3
.5 + .5	8	8.3	8.7	39.0
1 + 1	8	8	12.0	21.3
2 + 2	8.3	3.7	7.3	2.3
3 + 3	8	1.7	7.7	0.0

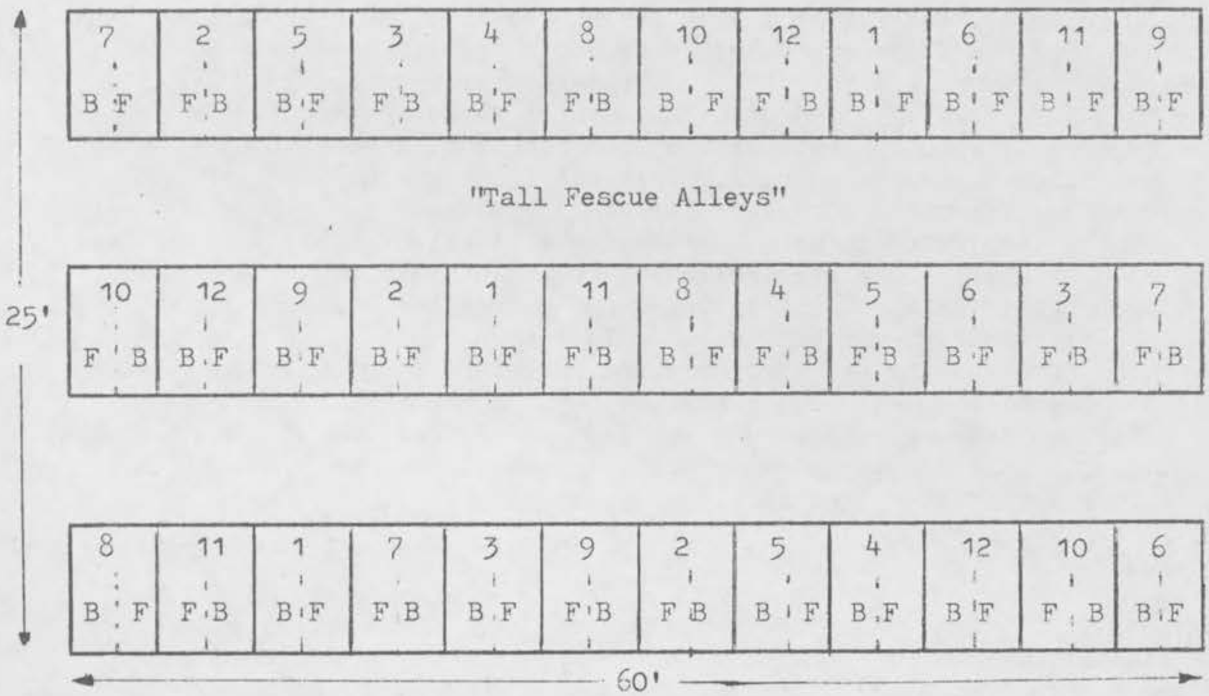
* K.B. = Kentucky Bluegrass, T.F. = Tall Fescue

TALL FESCUE CONTROL STUDY - 1983

CHLORSULFURON TREATMENTS - OZ/A

1. Control
2. .25
3. .50
4. 1.0
5. 2.0
6. 3.0
7. 4.0
8. .25 + .25
9. .50 + .50
10. 1.0 + 1.0
11. 2.0 + 2.0
12. 3.0 + 3.0

(split rates at 2 week interval)



* B = Bluegrass, F = Fescue

1983 Growth Retardant Study

Nick Christians

The objectives of this investigation were to evaluate the effectiveness of Monsanto 4621 flowable and Monsanto 4623 2G as growth retardants of Kentucky bluegrass, to compare the effects of the recommended rate of these materials (2.5 lb ai/A) to double applications (2.5 + 2.5 lb ai/A), and to compare the Monsanto materials to other growth retarding compounds.

Monsanto 4621 4 flowable (2.5 and 2.5 + 2.5 lb ai/A), Monsanto 4623 2G (2.5 and 2.5 + 2.5 lb ai/A), Mefluidide (0.38, 0.38 + 0.38, and 0.25 lb ai/A), EL-500 (0.75 and 1.00 lb ai/A), and Ethephon (3.5 and 5.0 lb ai/A) were applied to 5' x 5' plots on a 2 year old stand of Enmundi Kentucky bluegrass on April 29, 1983. All liquid materials were applied with a CO_2 backpack sprayer designed for 5' plots. The Mon 4623 2G was applied with a hand held shaker. Each of the double application treatments were applied first at the recommended rate, then immediately reapplied at that same rate. This was done to simulate overlaps during application. The materials were allowed to remain on the tissue for 24 hours and were then irrigated in with approximately ½" water. This was followed by 2.32" of rain by May 3. One week following treatment, all plots were mowed at a 2" mowing height. Data collection began one week after that mowing and continued for six weeks. Weekly data were collected on quality, both before and after mowing, on fresh weight of clippings, and on height of growth above the 2" mowing height. One half of each plot remained unmowed throughout the study. The height of growth measurements were taken from the top of the 2" mowing height to the top of the unmowed area. Seed head counts were made on this unmowed area four weeks after treatment.

Results

The Mon 4621 (2.5 and 2.5 + 2.5 lb ai/A), Mon 4623 (2.5 and 2.5 + 2.5 lb ai/A), and the mefluidide (0.38 + 0.38 lb ai/A) were the most effective growth retarding treatments (Table 32). The mefluidide (0.38 lb ai/A) treatment reduced growth--averaged over six weeks--in comparison with the control, but was not as effective as the single applications of the Mon 4621 and 4623 materials. The double applications of Mon 4621 and Mon 4623 reduced growth over the six week period as compared to single applications; however, these reductions were not statistically lower. EL-500 (0.75 and 1.00 lb ai/A) reduced growth as compared to the control, but was not as effective as the Mon 4621, Mon 4623, or the double application of mefluidide. The ethephon was not effective in reducing growth. This was surprising, because of the effectiveness of this material in previous studies. The lack of effectiveness in this test may have been due to the unusually high rainfall which occurred during the investigation.

The clipping yield data followed similar trends to the height of growth data (Table 33). Again, the Mon 4621, Mon 4623, and mefluidide were effective in reducing growth. The EL-500 (1.00 lb ai/A) was also quite effective. The Mon 4621 and Mon 4623 reduced clipping yield effectively for the first six weeks. In the 7th and 8th weeks, there was a rapid increase in growth at all rates of these two materials. This increase was nearly double the control in week 8. The mefluidide also showed a large increase in clipping yield in weeks 7 and 8. The EL-500 (0.75 and 1.00 lb ai/A) was still effective in growth reduction in the 6th week of data collection (eight weeks after treatment).

Quality ratings prior to mowing were generally lower than those made just after mowing (Tables 34 and 35). This is likely due to the fact that non-uniformity enters into evaluations performed prior to mowing. Evaluations made after mowing are based primarily on color and density. The mefluidide treatments were generally unacceptable in quality prior to mowing for the first four weeks of data collection (Table 34). The mefluidide (0.38 + 0.38) was in some cases higher than single application rates due to the improved seed head inhibition at the double rate (Table 36). The Mon 4621 and 4623 were acceptable in pre-mowing quality throughout the study. All treatments were judged to be acceptable in quality after mowing at all dates (Table 35). The ethephon maintained an exceptionally good color and density at each testing week. Only the Mon 4623 (2.5 + 2.5 lb ai/A) had a lower quality than the control when means of the six weeks of data collection were compared.

No treatments were totally effective in reducing seed head development (Table 36). The plots with the fewest seed heads were those treated with Mon 4621 (2.5 + 2.5 lb ai/A). The Mon 4621 (2.5 and 2.5 + 2.5 lb ai/A), Mon 4623 (2.5 and 2.5 + 2.5 lb ai/A), and mefluidide (0.38 and 0.38 + 0.38 lb ai/A) treatments were effective in reducing seed head numbers as compared to the control. The El-500, ethephon, and mefluidide (0.25 lb ai/A) were not effective.

Considering all measured variables, the Mon 4621 and Mon 4623 were the most effective growth retardants in this study. There appeared to be no serious detrimental effects from applying double applications of these materials to the same plot. It should be noted that this study was conducted during an unusually wet spring. During a more normal period, better results would have been expected from the mefluidide and ethephon. The fact that the Mon 4621 and 4623 maintained effectiveness under these wet conditions may indicate that they would be preferable to other materials in more humid regions.

Table 32. Growth above the 2" mowing height over a six week period following application.

	Treatment	lb ai/A	Week 3**	Week 4	Week 5	Week 6	Week 7	Week 8	Mean
		Inches							
1.	Control	----	1.8*	2.8	3.4	4.2	6.3	9.8	4.7
2.	Mon 4621 4 flo	2.50	0.9	1.1	1.2	1.8	3.8	4.5	2.2
3.	Mon 4621 4 flo	2.5 + 2.5	0.9	0.7	0.9	1.4	2.8	4.1	1.8
4.	Mon 4623 2 G	2.50	0.8	1.1	1.7	1.7	3.2	4.1	2.1
5.	Mon 4623 2 G	2.5 + 2.5	0.7	0.7	0.8	1.2	2.5	4.5	1.7
6.	Mefluidide	0.38	1.3	1.7	1.7	3.0	5.5	7.5	3.5
7.	Mefluidide	0.38 + 0.38	0.9	1.2	1.2	1.8	2.8	4.9	2.1
8.	Mefluidide	0.25	1.7	2.0	2.1	3.1	5.8	9.8	4.1
9.	EL-500	0.75	1.7	2.5	2.8	2.9	3.7	7.1	3.4
10.	EL-500	1.00	1.6	2.2	2.5	2.8	3.8	5.8	3.1
11.	Ethephon	3.50	2.0	2.6	3.0	4.2	5.8	9.1	4.4
12.	Ethephon	5.00	2.0	2.8	3.0	3.7	6.6	9.2	4.5
	LSD 0.05	----	2.1	0.7	1.1	1.0	1.6	2.2	0.8

* data are the difference between the two inch mowing height and the unmowed section of the plot.

** data collection began at the beginning of the third week after treatment.

Table 33. Clipping weights in pounds per 1000 sq ft produced over a six week period following application.

	Treatment	lb ai/A	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Mean
			----------------------------lbs-------------------------------						
1.	Control	----	20.5*	32.1	14.5	5.9	13.5	11.8	16.4
2.	Mon 4621 4 flo	2.50	2.0	6.0	2.5	1.9	12.7	20.3	7.6
3.	Mon 4621 4 flo	2.5 + 2.5	1.2	5.3	1.8	1.8	10.7	21.5	7.0
4.	Mon 4623 2 G	2.50	4.3	6.0	2.5	2.3	12.3	24.5	8.6
5.	Mon 4623 2 G	2.5 + 2.5	1.5	8.2	9.7	4.3	10.5	22.0	9.4
6.	Mefluidide	0.38	6.7	12.8	6.8	5.7	9.6	22.5	10.7
7.	Mefluidide	0.38 + 0.38	2.4	5.7	4.1	3.5	13.1	26.5	9.2
8.	Mefluidide	0.25	10.3	14.9	10.5	6.7	14.5	22.1	13.2
9.	EL-500	0.75	18.8	25.5	7.4	3.6	15.3	6.4	12.8
10.	EL-500	1.00	14.3	19.5	6.2	2.2	4.4	4.4	8.5
11.	Ethephon	3.50	23.2	30.8	12.7	5.0	9.2	9.4	15.0
12.	Ethephon	5.00	25.2	31.8	10.6	4.6	12.0	10.7	15.8
	LSD 0.05	----	5.9	7.3	7.1	2.8	N.S.	4.5	3.3

* plots were mowed at a 2" mowing height.

Table 34. Weekly quality ratings taken just prior to mowing.

	Treatment	lb ai/A	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Mean
1.	Control	----	8.0*	8.5	9.0	9.0	8.5	7.5	8.5
2.	Mon 4621 4 flo	2.50	6.5	7.5	6.5	7.5	7.5	8.0	7.0
3.	Mon 4621 4 flo	2.5 + 2.5	6.5	7.0	6.5	7.0	8.0	7.5	7.0
4.	Mon 4623 2 G	2.50	7.0	6.5	5.5	6.5	7.5	8.0	7.0
5.	Mon 4623 2 G	2.5 + 2.5	6.5	7.5	6.5	6.5	8.0	8.0	7.0
6.	Mefluidide	0.38	5.5	5.0	5.0	5.5	8.0	7.5	6.0
7.	Mefluidide	0.38 + 0.38	6.5	6.5	5.5	7.0	8.5	8.0	7.0
8.	Mefluidide	0.25	5.0	5.5	5.5	6.5	8.0	8.0	6.5
9.	EL-500	0.75	8.0	8.5	9.0	7.5	7.5	6.5	8.0
10.	EL-500	1.00	8.0	8.5	8.5	7.5	7.0	6.5	8.0
11.	Ethephon	3.50	8.0	8.5	8.5	8.5	7.5	7.5	8.0
12.	Ethephon	5.00	8.0	8.0	8.5	8.0	8.0	7.5	8.0
	LSD 0.05	----	0.8	0.8	1.1	1.0	N.S.	N.S.	0.5

* quality rating on a scale of 9 to 1; 9 = best quality, 6 = acceptable, and 1 = lowest quality.

Table 35. Weekly quality ratings taken after weekly mowing.

	Treatment	lb ai/A	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Mean
1.	Control	----	8.5*	9.0	8.5	8.0	7.5	7.5	8.0
2.	Mon 4621 4 flo	2.50	7.5	8.0	7.0	7.5	8.5	7.5	7.5
3.	Mon 4621 4 flo	2.5 + 2.5	7.0	8.0	7.0	7.5	7.5	7.5	7.5
4.	Mon 4623 2 G	2.50	7.0	7.5	6.5	7.5	8.0	8.0	7.5
5.	Mon 4623 2 G	2.5 + 2.5	6.5	8.0	6.5	7.5	7.0	8.0	7.0
6.	Mefluidide	0.38	6.5	7.5	6.5	7.5	8.5	7.5	7.5
7.	Mefluidide	0.38 + 0.38	7.0	7.5	6.5	7.5	8.0	8.0	7.5
8.	Mefluidide	0.25	7.0	7.5	7.0	7.5	7.5	8.0	7.5
9.	EL-500	0.75	8.5	9.0	9.0	8.0	6.5	6.5	8.0
10.	EL-500	1.00	8.5	8.5	8.5	8.0	6.0	6.5	7.5
11.	Ethephon	3.50	8.5	9.0	8.5	8.5	8.0	8.0	8.5
12.	Ethephon	5.00	8.5	8.5	8.5	8.0	8.0	7.5	8.5
	LSD 0.05	----	0.6	0.7	0.8	N.S.	0.7	N.S.	0.5

* quality rating on a scale of 9 to 1; 9 = best quality, 6 = acceptable, and 1 = lowest quality.

Table 36. The number of seed heads per square foot of plot area.

Treatment	lb ai/A	Seed heads/sq ft
1. Control	----	202
2. Mon 4621 4 flo	2.50	64
3. Mon 4621 4 flo	2.5 + 2.5	19
4. Mon 4623 2G	2.50	74
5. Mon 4623 2G	2.5 + 2.5	36
6. Mefluidide	0.38	88
7. Mefluidide	0.38 + 0.38	29
8. Mefluidide	0.25	171
9. EL-500	0.75	167
10. EL-500	1.00	193
11. Ethephon	3.50	193
12. Ethephon	5.00	181
LSD 0.05		60

The Effects of Monsanto 4623 2G on Six Cultivars of Tall Fescue

Nick Christians

The objective of this investigation was to evaluate the effects of Mon 4623 2G on six cultivars of tall fescue.

On May 2, 1983, Mon 4623 2G (2.5 lb ai/A) was applied to Kenhy, Falcon, Rebel, Kentucky-31, Belt TF-11, and T.F. 14801 tall fescue (Festuca arundinacea Schreb.). The cultivars chosen for this study were established in 1979 in three replications in plots measuring 4' x 6'. The Mon 4623 was randomly applied to one half of each cultivar plot in each replication with a hand held shaker. The plots were mowed once per week in such a way that one half of the treated and one half of the untreated area were mowed at 3" and one half of each area remained unmowed.

Data collected included measurements of growth between the unmowed control and the unmowed treated area, measurements of growth between the unmowed treated area and the 3" mowing height, quality ratings on the unmowed treated area, quality rating on the treated area just after mowing, and percent seed head inhibition.

Results

The effects of the treatments were very slow to develop. It was not until the 3rd week after treatment that data collection began. The efficacy of the material was also quite short, with no apparent differences between treated and untreated areas by the 6th week after treatment.

The growth of Kenhy was inhibited to a lesser extent than any of the other cultivars (Table 37). The T.F. 14801 (an experimental from North American Plant Breeders) was inhibited more than Kenhy but less than Falcon, Rebel, and Kentucky-31.

There were no differences in quality rating for any of the cultivars. Many of the cultivars were unacceptable in quality on unmowed areas and were generally acceptable after mowing (Table 38).

Percent seed head inhibition varied numerically, but there were no significant differences (Table 39).

The response of Falcon, Rebel, and Kentucky-31 to Mon 4623 were fairly uniform, although there was a small difference in growth between Falcon and Rebel (Table 37).

There are cultivars of tall fescue, such as Kenhy, which may respond differently to Mon 4623 than do the more commonly used cultivars. It should be noted that these are the results of only one limited field study. If these potential differences in response pose a serious problem in marketing of the product, more detailed greenhouse studies should be conducted.

Table 37. The effect of Mon 4623 (2.5 lb ai/A) on six cultivars of tall fescue.

	Cultivar	Control-unmowed treated*				Unmowed treated-mowed treated**			
		Week 3	Week 4	Week 5	Mean	Week 3	Week 4	Week 5	Mean
		inches							
1.	Kenhy	0.8	1.2	0.6	0.9	1.2	3.7	9.8	4.9
2.	Falcon	1.1	2.6	4.2	2.6	0.7	2.5	5.6	2.9
3.	Rebel	1.3	2.8	5.1	3.1	0.5	2.1	4.3	2.3
4.	Kentucky-31	1.6	5.3	5.5	4.1	0.6	1.8	6.1	2.8
5.	Belt TF-11	1.1	3.9	4.2	3.1	0.8	2.1	7.0	3.3
6.	T.F. 14801	1.2	2.6	2.5	2.1	0.5	3.3	7.2	3.7
	LSD 0.05	N.S.	2.4	N.S.	1.5	N.S.	N.S.	3.0	0.5

* Measurement of the difference between unmowed control and unmowed treated area.

** Measurement of the difference between the unmowed treated and the 3" mowing height of the treated area.

Table 38. Quality ratings taken just after mowing and quality ratings taken on unmowed areas.

	Cultivar	Quality Rating After Mowing			Quality Rating of Unmowed Area		
		Week 3	Week 4	Week 5	Week 3	Week 4	Week 5
1.	Kenhy	6.0	6.5	8.0	5.0	5.0	8.0
2.	Falcon	6.5	6.5	8.0	5.5	5.5	7.5
3.	Rebel	6.0	6.5	8.0	5.5	5.5	7.5
4.	Kentucky-31	5.5	5.5	8.0	5.0	4.5	7.0
5.	Belt TF-11	6.5	7.0	8.0	5.5	5.5	6.5
6.	T.F. 14801	6.0	6.5	8.0	5.5	5.5	8.0
		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

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

Table 39. Seed head inhibition of 6 tall fescue cultivars by Mon 4623 (2.5 lb ai/A).

Cultivars	% Seed head control*
1. Kenhy	15
2. Falcon	45
3. Rebel	30
4. Kentucky-31	30
5. Belt TF-11	45
6. TF 14801	33
	N.S

* 100% control = no seed heads and 0 = no difference between treated and control.

Effects of Six Growth Retardants on the Vegetative Growth of Kentucky Bluegrass 1983

Kenneth L. Diesburg and Nick Christians

INTRODUCTION

A field experiment was conducted to compare the effects of Ethrel, EL500, Embark, PP-333, Monsanto 4621, and Monsanto 4623 on leaf and stem growth of Baron Kentucky bluegrass at three different seasonal stages of growth.

MATERIALS AND METHODS

Application dates May 5, June 23, and September 24, represented spring reproductive, summer, and fall vegetative stages, respectively. Chemicals were applied at recommended rates to 5' x 5' plots. Liquid solutions were dispersed through a hand-held boom with three spaced nozzles passing three feet above the ground with pressurized CO_2 in a tank strapped to the operator's back. Granular Mon 4623 was broadcast by hand. A split-plot design was used, with application dates as whole-plots and chemicals as sub-plots in three replications.

The grass was mowed immediately prior to application and once more one week afterward. Canopy height was measured from the soil surface three times per plot on a given date, then averaged. Leaf length, leaf number, and internode number were measured and counted from nine representative shoots per plot on the same date and then averaged. Subjective ratings of toxicity were based on turf color with 9 = green and 1 = brown. Ratings of heading were also subjective with 1 = most heading and 9 = no heads.

RESULTS

Canopy Height. All of the chemically treated plots showed lower canopy heights than that of the control. Ethrel and Embark were, generally, more effective than EL500, PP-333, Mon 4621, and Mon 4623 (Tables 40 and 41). The effectiveness of EL500 was not different from that of PP-333, Mon 4621, or Mon 4623. Embark's advantage was negated by its phytotoxicity (Table 42). Response to Ethrel was not evident until more than two weeks after application (Tables 40 and 41). In fall, EL500 was more effective than Ethrel within the first two weeks, less effective from two to four weeks, and equally effective beyond four weeks. In summer, however, Ethrel was consistently better than EL500 in restricting increase in canopy height.

Toxicity. Ethrel, EL500, and PP-333 caused little or no browning of turfgrass leaves. Mon 4621 and Mon 4623 produced more evidence of toxicity and Embark severely damaged the leaves (Table 42).

Heading. Embark, Mon 4621, and Mon 4623 were very effective in preventing heading while Ethrel, EL500, and PP-333 were ineffective (Table 40). Although the differences in heading among EL500, PP-333, and the control were within the limits of variability, the heading in response to EL500 and PP-333 seemed to be greater than that of the control.

Leaf Length and Number. The data in Tables 43, 44, and 45 were taken after the summer treatments had been applied on June 23. Initial plant response to the chemicals was generally slow with the exception of Ethrel and Embark (Table 43). The effect of Embark was obvious in that plant growth was immediately arrested and existing leaves were damaged. The initial effect of Ethrel was more subtle. Leaves continued to elongate as with the other four chemicals and control, but the frequency in which a leaf was missing at the third, fourth, and fifth leaf positions was markedly reduced. It appeared that the senescence of older leaves was being greatly delayed. Leaf senescence in response to the other four chemicals was similar to that of the control.

Optimal effects of all chemicals could be seen within 28 days after application (Table 44). The inhibition of new leaf growth relative to the control can be seen in the low values in average leaf length at leaf one. Differences in average leaf length at leaves four and five are due mainly to differences in leaf senescence since those leaves were present before applying the chemicals. (Bear in mind that mean leaf length at leaves three, four, and five is affected by the number of leaves absent at those positions among the nine shoots sampled. Each leaf absent caused a zero to be entered into the corresponding Length mean.)

With Ethrel, EL500, PP-333, Mon 4621, and Mon 4623 the accumulated Length over all five leaves was not drastically reduced, rather leaves one and two were significantly shorter than those of the control while leaves three, four, and five were similar to or longer than those of the control. This redistribution of leaf area caused a lower canopy, thereby postponing the need for mowing. Ethrel caused a much more dense canopy than that of any other chemical or the control. It changed plant morphology from that of two to four leaves per shoot with leaf two being much longer than the others, to that of three to six leaves per shoot with quite uniform leaf length. Leaf density and color were not objectional for any chemical except Embark. Plots sprayed with Embark had a brown thin canopy as a result of shoot death, leaf senescence, and strong inhibition of growth.

Inhibition of leaf elongation at leaves one or two was still evident with Ethrel, Embark, and EL500 more than a month after application (Table 45). Plants treated with PP-333, Mon 4621, and Mon 4623 had completely recovered.

Shoot Elongation. Ethrel stimulated an elongation of internodes in shoot stems that was not observed with any other chemical or the control (Table 46).

Interactions. In affecting canopy height, the interaction of chemicals with times of application was significant at all time periods of sampling after the application dates. This indicates that some chemicals performed better in one season versus another. For instance, EL500 exerted stronger restriction of growth relative to the other chemicals after fall application versus summer application. The performance of Ethrel, on the other hand, was the reverse.

DISCUSSION

The results among chemicals after each seasonal application were much different. Air temperatures during and after the spring application were quite cool (40-50°F), and plants were not growing vigorously. During and after summer applications, however, air temperatures ranged from 65-90°F. Soil temperatures were probably equally divergent. Although air temperatures were moderate during and after the fall application (50-70°F), the plants had previously shifted growth phases from that of upright, rapid leaf growth to prostrate, slow leaf growth in the beginnings of preparation for winter. The significant chemical-by-application time interactions indicate the sensitivity of all the chemicals to a combination of environment and growth phase of the turfgrass.

An effect peculiar to Ethrel was the elongation of internodes in shoots. This phenomenon is normally seen only in reproductive shoots. The effect on turf quality could be either negative or positive. Canopy height is raised, but shoot density might be improved if extended nodes root into the soil.

SUMMARY

Embark quickly stopped all plant growth, but severely damaged the turf. Ethrel was the most effective inhibitor of leaf elongation and subsequent increase in canopy height without damaging turf color. EL500, PP-333, Mon 4621, and Mon 4623 inhibited growth to lesser extents. The EL500 and PP-333 caused no decrease in turf color ratings while Mon 4621 and Mon 4623 caused slight damage. Embark, Mon 4621, and Mon 4623 effectively inhibited heading while Ethrel, EL500, and PP-333 were ineffective. Ethrel was the only chemical to alter growth habit.

Table 40. Mean canopy heights of Kentucky bluegrass in response to growth retardants.

Growth Regulator	Rate (lb AI/A)	Spring Applied: May 5	Heading[a]	Summer Applied: June 23				Fall Applied: Sept. 24			Grand MEAN
		34 Days After		15 Days After	28 Days After	50 Days After	Avg.	7 Days After	28 Days After	Avg.	
		— cm —		cm							
Ethrel	4.0	15.3	1.3	6.7	7.3	10.7	8.2	6.7	5.0	5.8	9.8
EL500	1.0	11.0	1.0	7.7	9.3	15.7	10.9	5.3	7.0	6.2	9.4
Embark	0.4	14.7	8.3	5.3	5.7	13.0	8.0	5.3	5.0	5.2	9.3
PP-333	0.4	14.3	1.7	7.0	8.3	12.7	9.3	6.7	6.7	6.7	10.1
Mon 4621	2.5	13.0	8.0	7.0	8.7	15.7	10.4	6.0	6.3	6.2	9.9
Mon 4623	2.5	13.7	6.7	7.3	9.0	15.3	10.6	5.7	6.0	5.8	10.0
Control	---	18.3	3.3	8.7	10.7	16.7	12.0	5.7	6.7	6.2	12.2
LSD	0.05	4.3	2.8	1.1	1.6	3.6	1.5	1.2 (NS)	1.0	1.0 (NS)	1.4

[a] ratings with 9 = no heads and 1 = full heading .

Table 41. Mean canopy heights of Kentucky bluegrass at three time periods after application of growth retardants averaged over all application dates.

Growth Regulator	Rate (lb AI/A)	One-Two Weeks	Two-Four Weeks	Six-Eight Weeks	Grand MEAN
		cm			
Ethrel	4.0	6.7	6.2	13.0	9.8
EL500	1.0	6.5	8.2	13.3	9.4
Embark	0.4	5.3	5.3	13.8	9.3
PP-333	0.4	6.8	7.5	13.5	10.1
Mon 4621	2.5	6.5	7.5	14.3	9.9
Mon 4623	2.5	6.5	7.5	14.5	10.0
Control	---	7.2	8.7	17.5	12.2
LSD	0.05	0.8	0.9	2.7	1.4

Table 42. Mean toxicity ratings[a] of growth retardants in Kentucky bluegrass.

Growth Regulator	Rate (lb AI/A)	June 23 Application			September 24 Application			Grand Mean
		15 Days After	28 Days After	Mean	8 Days After	29 Days After	Mean	
Ethrel	4.0	9.0	8.0	8.5	8.7	5.0	6.8	7.7
EL500	1.0	9.0	9.0	9.0	7.0	7.7	7.3	8.2
Embark	0.4	4.0	2.0	3.0	6.0	2.0	4.0	3.5
PP-333	0.4	8.3	8.3	8.3	7.7	7.3	7.5	7.9
Mon 4621	2.5	8.0	7.3	7.7	7.7	6.7	7.2	7.4
Mon 4623	2.5	7.3	5.7	6.5	7.3	5.7	6.5	6.5
Control	---	9.0	8.3	8.7	7.7	7.7	7.7	8.2
LSD	0.05	1.3	1.0	0.9	0.9	1.2	0.8	0.6

[a] based on color; 9 = green, 1 = brown, and 6 = acceptable.

Table 43. Mean leaf lengths and leaves absent in Kentucky bluegrass shoots 15 days after summer growth retardant treatments.

Growth Regulator	Rate (lb AI/A)	Leaf: Youngest (1) to Oldest (5)											
		Length[a] (cm)						Number of Leaves Absent per Nine Shoots					
		1	2	3	4	5	Total	1	2	3	4	5	Total
Ethrel	4.0	2.0	4.0	5.0	3.3	1.0	15.3	0.0	0.0	0.0	1.3	6.3	7.6
EL500	1.0	5.3	7.3	3.7	1.0	0.0	17.3	0.0	0.0	0.7	6.3	8.7	15.7
Embark	0.4	1.0	3.7	2.3	0.3	0.0	7.3	6.3	1.7	2.0	7.0	9.0	26.0
PP-333	0.4	4.0	6.3	3.3	1.3	0.0	14.9	0.3	0.0	0.0	6.0	9.0	15.3
Mon 4621	2.5	3.0	6.0	3.7	0.3	0.0	13.0	1.7	0.3	1.0	7.7	9.0	19.7
Mon 4623	2.5	3.7	5.0	3.7	0.3	0.0	12.7	1.0	0.3	2.3	7.7	8.3	19.6
Control	---	4.7	7.0	3.0	0.7	0.0	15.4	0.3	0.3	1.0	6.3	8.7	16.6
LSD	0.05	1.8	1.8	1.7	0.8	N.S.		1.8	1.1	1.5	1.9	0.8	

[a]each leaf absent caused a zero to be entered into the corresponding Length mean.

Table 44. Mean leaf lengths and leaves absent in Kentucky bluegrass shoots 28 days after summer growth retardant treatments.

		Leaf: Youngest (1) to Oldest (5)											
		Length[a] (cm)						Number of Leaves Absent per Nine Shoots					
Growth Regulator	Rate (lb AI/A)	1	2	3	4	5	Total	1	2	3	4	5	Total
Ethrel	4.0	2.3	4.3	3.0	3.3	3.3	16.2	0.0	0.0	0.0	0.0	1.7	1.7
EL500	1.0	5.0	6.7	6.3	3.0	0.7	21.7	1.3	0.0	0.3	4.0	7.7	13.3
Embark	0.4	0.0	2.0	3.0	1.3	0.0	6.3	9.0	3.7	0.7	3.0	9.0	25.4
PP-333	0.4	3.7	5.7	6.7	2.7	0.0	18.8	0.0	0.0	0.0	3.7	8.0	11.7
Mon 4621	2.5	4.3	6.7	5.7	1.3	0.0	18.0	0.3	0.0	0.3	5.0	9.0	14.6
Mon 4623	2.5	0.0	6.3	7.3	5.0	1.0	19.6	8.0	0.0	0.0	1.3	6.3	15.6
Control	---	7.7	10.0	6.3	0.7	0.3	25.0	0.0	0.0	1.0	6.3	8.3	15.6
LSD	0.05	3.4	1.9	2.2	1.7	1.1		2.1	1.0	1.1	3.8	2.5	

[a]each leaf absent caused a zero to be entered into the corresponding Length mean.

Table 45. Mean leaf lengths and leaves absent in Kentucky bluegrass shoots 50 days after summer growth retardant treatments.

Growth Regulator	Rate (lb AI/A)	Leaf: Youngest (1) to Oldest (5) Length[a] (cm) 1	2	3	4	5	Total	Number of Leaves Absent per Nine Shoots 1	2	3	4	5	Total
Ethrel	4.0	4.3	6.7	5.3	3.3	1.3	20.9	0.0	0.0	0.3	2.0	5.3	7.6
EL500	1.0	6.0	15.0	9.7	2.0	0.0	32.7	0.3	0.3	1.3	6.0	9.0	16.9
Embark	0.4	7.0	8.0	4.0	0.0	0.0	19.0	1.0	1.3	3.3	8.3	9.0	22.9
PP-333	0.4	8.7	11.7	4.7	0.7	0.3	26.1	0.0	0.3	2.7	7.0	8.7	18.7
Mon 4621	2.5	8.3	13.3	7.3	1.0	0.0	29.9	0.0	0.0	2.3	7.0	8.7	18.0
Mon 4623	2.5	7.0	9.7	6.0	1.3	0.0	24.0	1.7	1.0	3.3	6.3	8.3	20.6
Control	---	11.0	13.3	6.0	0.3	0.0	30.6	0.0	0.3	2.7	8.0	9.0	20.0
LSD	0.05	4.9	4.4	3.9	1.6	1.0		2.3	1.7	3.0	2.2	2.6	

[a]each leaf absent caused a zero to be entered into the corresponding Length mean.

Table 46. Number of elongated internodes in Kentucky bluegrass shoots after growth retardant treatments: June 23.

Growth Regulator	Rate (lb AI/A)	July 8 15 Days After	July 21 28 Days After	August 12 50 Days After
Ethrel	4.0	0.0	3.0	4.7
EL500	1.0	0.0	0.0	0.7
Embark	0.4	0.0	0.0	1.0
PP-333	0.4	0.0	0.0	0.7
Mon 4621	2.5	0.0	0.0	1.0
Mon 4623	2.5	0.0	0.0	0.7
Control	---	0.0	0.0	0.0
LSD	0.05	N.S.	N.S.	1.3

The Use of Mefluidide and PP-333

Brian Maloy and Nick Christians

Two growth retardants, Mefluidide from the 3-M Corporation and PP-333 from ICI Americas Inc., were tested on a Kentucky bluegrass turf at the Iowa State University Horticultural Research Station in 1983. Treatments included Mefluidide (0.25 and 0.375 lb. a.i./acre) and PP-333 (0.375 and 0.50 lb. a.i./acre) applied in individual applications; a factorial combination of Mefluidide (0.125 and 0.187 lb. a.i./acre) and PP-333 (0.25, 0.375, and 0.50 lb. a.i./acre); Mefluidide (0.125 and 0.25 lb. a.i./acre) with 0.5% X-77 surfactant; and Mefluidide (0.15 and 0.25 lb. a.i./acre) in factorial combination with an experimental surfactant, H3AM (0.5 and 1.0%).

The materials were applied May 2, 1983. No moisture was recorded for 48 hours. The study was then irrigated with 0.25 inches of water. The area was mowed uniformly seven days after application at a two inch mowing height and then remained unmowed for the rest of the season. Data collection began one week following the mowing and continued for the next nine weeks. Data taken included canopy height and quality ratings, (based on a scale of 1-9; 1 being dead turf, 9 being best quality and a rating of six or higher constituting acceptable quality).

Mefluidide suppressed growth at the 0.25 and 0.375 lb. a.i./acre rates (Table 47), with the two rates maintaining an acceptable height until four to five weeks into the study. The two surfactants (X-77 and H3AM) showed little decrease in growth over the applications of Mefluidide alone. The only exceptions were in weeks 2, 4, and 5 where plots treated with Mefluidide (0.25 lb. a.i./acre) + 0.5% X-77 and Mefluidide (0.25 lb. a.i./acre) + 0.5% H3AM showed a greater reduction of growth than plots treated with Mefluidide (0.25 lb.) alone. Increasing the concentration of H3AM from 0.5% to 1.0% provided no increase in growth inhibition when used with Mefluidide (Table 47), although the use of a surfactant with Mefluidide greatly decreased the number of seedheads produced (Table 49). The PP-333 had no effect on seedhead suppression. However, when it was combined with Mefluidide, seedheads were suppressed. Increasing the Mefluidide rate increased seedhead suppression, with greatest suppression occurring in plots treated with Mefluidide (0.187 lb. a.i./acre) and PP-333 (0.50 lb. a.i./acre). The PP-333 (0.375 lb.. a.i./acre) maintained an acceptable height for two to three weeks. Increasing the rate to 0.50 lb. a.i./acre had no effect on the inhibition of growth (Table 47). Quality ratings for plots treated with PP-333 were low after the sixth week (Table 48). This unacceptable rating was due to the nonuniform control of growth by PP-333 at week six.

The use of Mefluidide with PP-333 provided the best growth inhibition, with acceptable height being maintained for five to six weeks (Table 47, Fig. 1). Best control was observed when PP-333 was used at rates above 0.25 lb. a.i./acre in combination with either Mefluidide rate (Fig. 1).

In conclusion, all of the treatments inhibited growth substantially as compared to the controls. Quality decreased during the last few weeks of the study due to the nonuniform control of growth. The use of Mefluidide and a surfactant greatly reduced seedhead production. Mefluidide + PP-333 at all rates retarded growth for the longest period of time (five to six weeks), followed by Mefluidide + surfactant (four to five weeks) and PP-333 used alone (two to three weeks). Future studies should be conducted to evaluate the effects of Mefluidide + PP-333 + surfactant on growth retardation and seedhead suppression.

Table 47. The growth height of Kentucky bluegrass over 9 weeks following treatment with growth retarding chemicals.

TREATMENT	lb a.i./A	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Means
1. Control	----	7.0	12.2	14.8	20.0	31.3	41.7	45.7	46.0	46.0	29.4
2. Mefluidide	0.25	5.0	7.3	7.3	9.7	14.3	18.7	25.7	30.7	35.7	17.2
3. Mefluidide	0.375	6.0	6.5	6.5	7.7	12.0	15.0	24.0	28.7	33.7	15.6
4. Mefluidide	0.125 + 0.5% x-77	5.7	7.5	7.5	10.3	13.7	19.0	30.0	34.7	36.3	18.3
5. Mefluidide	0.25 + 0.5% x-77	6.0	6.3	6.2	6.8	11.7	14.0	23.0	26.7	29.7	14.5
6. Mefluidide	0.15 + 0.5% H3AM	5.7	6.2	5.8	7.7	12.0	15.0	24.6	28.0	31.7	15.2
7. Mefluidide	0.25 + 0.5% H3AM	5.2	6.0	6.2	7.2	11.3	16.7	26.3	28.0	36.7	15.9
8. Mefluidide	0.15 + 1.0% H3AM	5.3	6.3	6.0	7.3	12.0	14.7	23.7	27.7	30.7	14.9
9. Mefluidide	0.25 + 1.0% H3AM	5.2	6.5	6.5	6.7	11.0	15.3	21.7	28.0	34.3	15.0
10. PP-333	0.375	7.3	9.5	10.5	14.0	18.7	23.0	28.0	26.3	25.0	18.0
11. PP-333	0.50	6.7	9.7	10.3	12.0	15.3	24.3	30.7	26.0	25.0	17.8
12. Mef + PP-333	0.125/0.25	5.2	6.7	6.5	7.2	10.3	12.3	19.0	21.0	23.7	12.4
13. Mef + PP-333	0.125/0.375	6.0	6.3	6.0	6.3	7.3	9.0	12.3	13.3	16.3	9.2
14. Mef + PP-333	0.125/0.50	5.3	6.2	5.7	5.8	7.0	8.2	11.3	12.7	15.3	8.6
15. Mef + PP-333	0.187/0.25	5.2	6.2	6.2	6.8	8.3	12.0	15.3	19.3	24.7	11.6
16. Mef + PP-333	0.187/0.375	5.0	6.2	5.7	6.3	7.7	9.0	13.3	14.7	18.0	9.5
17. Mef + PP-333	0.187/0.50	5.5	6.0	5.8	6.2	7.0	8.7	11.7	12.7	16.0	8.8
18. Control	----	6.7	12.3	14.7	20.7	33.0	43.3	45.3	46.0	44.0	29.6
LSD	0.05	1.3	0.9	1.2	1.9	1.9	3.1	4.8	3.4	6.5	1.9

Table 48. Kentucky bluegrass quality ratings over 9 weeks following treatment with growth retarding chemicals.

TREATMENT	lb a.i./A	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Means
1. Control	----	7.0	9.0	8.3	8.0	7.0	5.0	4.0	3.0	2.7	6.0
2. Mefluidide	0.25	6.0	6.0	5.3	5.7	6.3	6.0	5.0	4.3	3.7	5.4
3. Mefluidide	0.375	6.3	6.3	6.5	6.3	6.3	6.7	5.3	4.3	4.3	5.8
4. Mefluidide	0.125 + 0.5% x-77	5.7	6.0	6.0	6.3	6.7	6.7	5.0	4.3	3.7	5.6
5. Mefluidide	0.25 + 0.5% x-77	6.3	6.3	7.7	7.3	8.0	8.3	5.3	4.7	4.0	6.4
6. Mefluidide	0.15 + 0.5% H3AM	6.0	6.5	6.7	6.0	7.7	7.3	5.3	4.7	4.7	6.1
7. Mefluidide	0.25 + 0.5% H3AM	6.0	6.3	6.0	7.0	7.3	7.3	5.7	4.3	4.3	6.0
8. Mefluidide	0.15 + 1.0% H3AM	6.7	7.0	7.7	7.7	8.0	8.3	5.8	4.3	4.3	6.6
9. Mefluidide	0.25 + 1.0% H3AM	6.7	7.0	7.7	6.3	8.0	8.3	5.7	4.7	4.3	6.5
10. PP-333	0.375	5.7	7.7	8.0	6.8	5.7	4.0	3.0	2.0	2.0	5.0
11. PP-333	0.50	6.7	8.0	8.7	8.3	6.0	4.0	3.0	2.0	2.7	5.5
12. Mef + PP-333	0.125/0.25	6.3	6.2	6.0	6.3	5.7	5.3	5.0	4.7	5.0	5.6
13. Mef + PP-333	0.125/0.375	5.8	6.3	6.7	6.7	6.3	6.7	5.7	5.3	5.8	6.1
14. Mef + PP-333	0.125/0.50	6.0	6.7	7.3	6.3	7.0	6.3	6.0	6.0	6.0	6.4
15. Mef + PP-333	0.187/0.25	6.3	6.3	6.7	6.0	5.7	6.0	6.0	5.0	5.3	5.9
16. Mef + PP-333	0.187/0.375	6.0	6.3	7.3	6.7	6.3	6.0	5.7	5.7	5.5	6.2
17. Mef + PP-333	0.187/0.50	6.3	6.3	6.7	7.0	6.0	6.0	5.7	5.7	5.3	6.1
18. Control	----	6.7	7.2	8.3	8.0	7.0	5.0	4.0	3.0	3.0	5.8
LSD	0.05	1.3	1.1	1.5	1.2	1.0	1.2	1.0	1.0	1.2	0.7

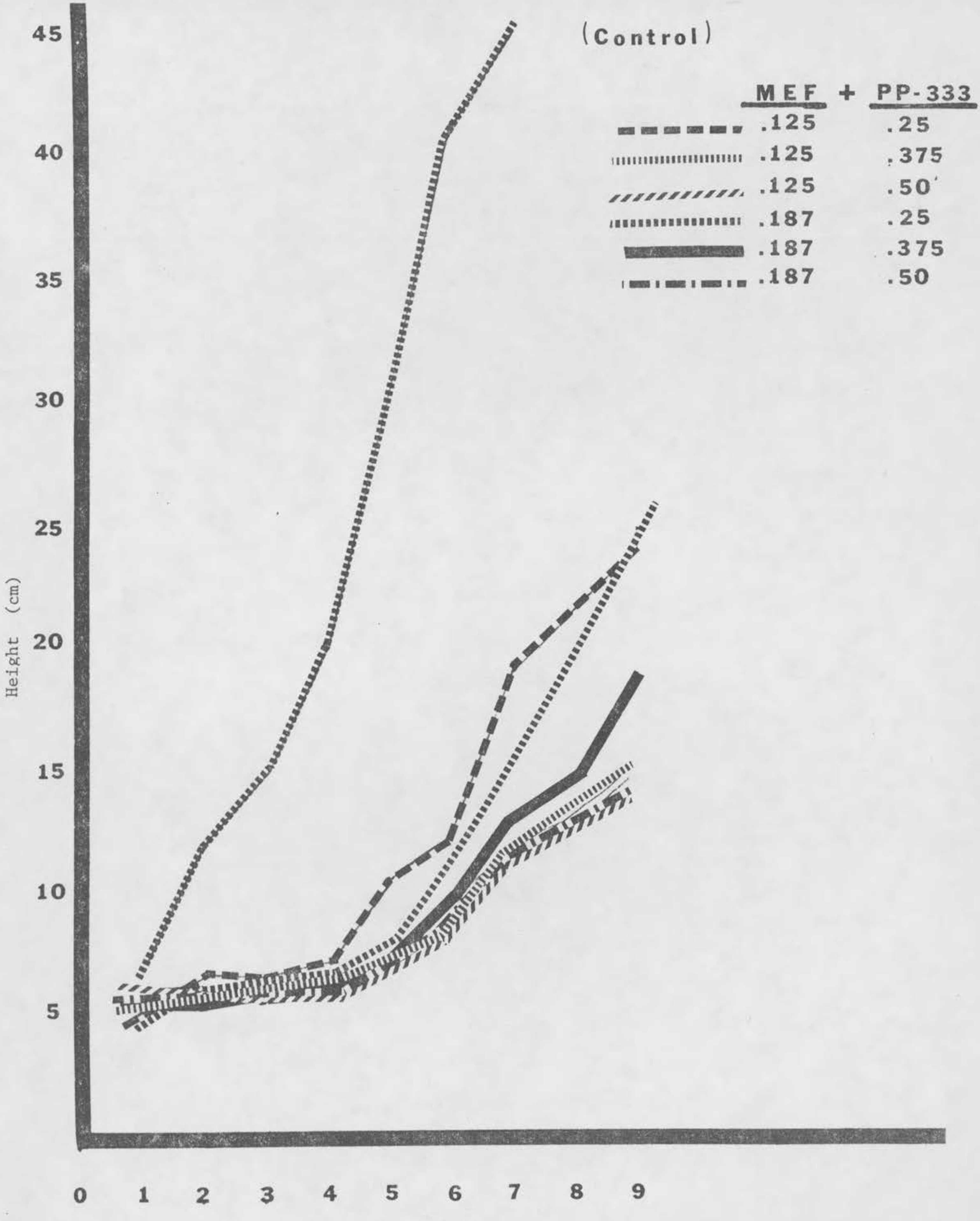


Fig. 1. The effect of Mefluidide plus PP-333 on Kentucky bluegrass height.

Table 49. Ratings of seedhead production on Kentucky bluegrass treated with Mefluidide and PP-333.

Treatment	lb. a.i./A	Seedhead Production
1. Control	-----	100*
2. Mefluidide	0.25	47
3. Mefluidide	0.375	8
4. Mefluidide	0.125 + 0.5% x-77	12
5. Mefluidide	0.25 + 0.5% x-77	1
6. Mefluidide	0.15 + 0.5% H3AM	5
7. Mefluidide	0.25 + 0.5% H3AM	1
8. Mefluidide	0.15 + 1.0% H3AM	1
9. Mefluidide	0.25 + 1.0% H3AM	1
10. PP-333	0.375	100
11. PP-333	0.50	100
12. Mef + PP-333	0.125/0.25	47
13. Mef + PP-333	0.125/0.375	40
14. Mef + PP-333	0.125/0.50	22
15. Mef + PP-333	0.187/0.25	23
16. Mef + PP-333	0.187/0.375	30
17. Mef + PP-333	0.187/0.50	23
LSD 0.05		18

* A rating of 100 = no seedhead suppression and 1 = complete suppression.

Ethylene Production by *Bipolaris Sorokiniana*

L. W. Coleman and C. F. Hodges

Production of ethylene by some fungi is well documented. The amount of ethylene produced varies considerably between species and appears to depend on the physiological state of the fungus, as well as the composition of the nutrient media.

Recently, a mutant of Penicillium digitatum which did not cause sustained ethylene production but induced wound ethylene like the wild-type was isolated. It was pathogenic, and in the resulting disease, ethylene did not appear to be a primary causal agent. In contrast, ethylene has been implicated in leaf spot of Poa pratensis caused by Bipolaris sorokiniana. Although ethylene may not be the primary cause of damage, it appears to be involved with general chlorosis late in infection.

The biosynthetic formation of ethylene in P. digitatum is different from the 1-aminocyclopropane-1-carboxylic acid (ACC) pathway in higher plants. Rhizobitoxine, an inhibitor of ethylene production in apples, does not inhibit ethylene production in P. digitatum. Although the enzymatic conversions were not demonstrated, glutamic acid, 2-ketoglutaric acid or methionine stimulated ethylene production by this fungus. Induction of ethylene production by P. digitatum varied with the method of fungal culture (shake or static) and the concentration of phosphate in the media. Exogenous glutamic acid (7mM) stimulated ethylene production in shake cultures of the fungus cultured with 1 mM phosphate; growth was unaffected. Conversely, glutamic acid inhibited ethylene production when present in a media with high phosphate concentrations (0.1 M). Methionine (7mM), the precursor of ethylene in higher plants, only slightly stimulated ethylene production of P. digitatum grown with low phosphate but induced extensive ethylene production in high phosphate media. The possibility of nonenzymatic production of ethylene in the presence of exogenous methionine could not be ruled out in this case. In contrast to its stimulation of ethylene production with high phosphate, methionine treatment caused a 50% decrease in mycelial weight. Methionine and other amino acids added to the culture media have been shown to inhibit growth in some plants. Methionine decreased fresh weight, dry weight, and ethylene evolution while increasing phenol production in stem callus of Atropa belladonna. In the absence of exogenous glutamate or methionine, phosphate controlled ethylene production in P. digitatum. Low phosphate (0.01 mM PO_4) stimulated ethylene production, but decreased fresh weight, protein content, respiration and ATP content. High phosphate (0.1M) increased growth, and the ATP content but decreased ethylene production.

In Drechslera graminea, methionine has been shown to stimulate ethylene production where 2-ketoglutaric acid did not. 2-ketoglutaric acid inhibited ethylene production in shake cultures of P. digitatum with low phosphate. Methionine dependent ethylene production in the pathogenic fungus Cylindorcladium floridanum was observed. Ethylene was produced by active mycelium and nonenzymatically from the culture media. In this fungus, methionine, light, a flavinlike compound, and fungal metabolites may contribute to ethylene production. A different pathway(s) for ethylene production may occur in various plant pathogenic fungi, and may relate to their separate pathogenic mechanisms.

The studies being conducted describe differential ACC and methionine-stimulated ethylene production and, ACC synthase activity of the turfgrass pathogen Bipolaris sorokiniana. The results suggest that at least two separate pathways for ethylene formation may exist in this pathogen.

Results

1. Methionine stimulated ethylene production of Bipolaris sorokiniana cultured on complex (grass infusion, barley seed infusion) or synthetic (0.1 strength Czapek) media.

2. Methionine (1mM) stimulated protein production of B. sorokiniana cultured on grass infusion but not on Czapek media.

3. Methionine inhibited fresh weight gain of B. sorokiniana cultured on either grass infusion or Czapek media.

4. Methionine inhibited sporulation of B. sorokiniana cultured on grass infusion. No obvious sporulation occurred when B. sorokiniana was grown on barley seed infusion with or without 1 mM methionine.

5. Sporulation of B. sorokiniana cultured on Czapek media with or without methionine was low.

6. Cultures grown in small vials with grass infusion supplemented with 1 mM methionine exhibited peak ethylene production earlier and produced much less ethylene than cultures grown in larger volumes of media.

7. Methionine stimulated ethylene production earlier and to a greater extent than ACC.

8. ACC synthase activity does not correlate with ethylene production in B. sorokiniana.

Conclusions

1. B. sorokiniana cultured in small vials of either complex or synthetic media supplemented with 1 mM methionine rapidly deplete the nutrient supply which limits ethylene production.

2. Methionine may be converted to ethylene using a pathway independent of ACC synthase and is probably also metabolized to CO_2.

3. Sporulation is inhibited by methionine when the nutrient supply is low (grass infusion). When the nutrient supply is high (barley seed infusion), methionine does not effect sporulation.

4. At least two pathways for ethylene production exist in B. sorokiniana: a) a methionine stimulated pathway that may produce most of the ethylene observed, and b) an ACC stimulated pathway.

5. Methionine concentrations up to 1 mM stimulate a linear production of ethylene.

6. Nonenzymatic formation of ethylene from fungal metabolites is probable.

7. Growth of B. sorokiniana may be inversely correlated with the production of ethylene. ACC-stimulated ethylene production requires ATP and the ATP content of P. digitatum is decreased when high levels of ethylene are produced.

8. It is speculated that conditions that result in high production of ethylene by the fungus may weaken the pathogen by decreasing the ATP content and this might contribute to decreased pathogenicity.

9. Alternately, high levels of ethylene produced either directly by the pathogen or, by the host in response to the pathogen, may cause damage to the host.

10. Additional work is required to determine the relationship between ethylene production, fungal growth and disease.

Result of 1983 Turfgrass Disease Control Trials

L. E. Sweets

Selected fungicides were tested in field trials for efficacy of control of Rhizoctonia brown patch (Rhizoctonia solani) and Pythium blight (Pythium aphanidermatum). Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station, Ames, Iowa.

In both trials, fungicides were applied to Penneagle bentgrass maintained at 1/4" cutting height. Fungicides were applied with a modified bicycle sprayer at 30 lbs p.s.i. and a dilution rate of 5 gallons per 1000 square feet. The experimental design was a randomized block plan with four replicates. The brown patch plots were 4 x 5 feet and the Pythium blight plots were 5 x 7 feet. Fungicides were applied on a 7, 14, or 21 day schedule as indicated in either Table 50 or 51. Applications began on June 8, 1983, and continued through September 28, 1983. Plots were evaluated for percent diseased turf on July 20 and August 11, 1983.

Rhizoctonia Brown Patch on Penneagle Bentgrass

The purpose of this study was to evaluate the relative efficacy of standard and experimental fungicides in the control of Rhizoctonia brown patch. Fungicides included in the trial along with rates of application and spray schedules are given in Table 50. The trial was conducted in an area with a history of leaf spot problems. However, environmental conditions (i.e. cool and wet during May and June and then unusually hot and dry during July and August) favored Rhizoctonia brown patch. Disease ratings were made on July 20 and August 11. Ratings were made on the basis of the percent of diseased turf per plot; rating results are given in Table 50.

Table 50. Rates, spray schedules and efficacy of fungicides tested in Rhizoctonia brown patch trial.

Treatment	Rate of Formulated Product (oz/1000 sq. ft.)	Time Interval Between Spray (Days)	Disease Rating[1] July 20	August 11
Chipco 26019	1.5	14	2.50 bc	28.75 abc
Chipco 26019	2.0	14	3.75 abc	12.50 c
Daconil 2787	3.0	7-14	13.75 abc	37.50 ab
Daconil 2787	6.0	7-14	5.00 abc	16.25 bc
Bayleton 25DF	1.0	30	17.50 abc	17.50 bc
Bayleton 25DF	0.5	14	12.50 abc	32.50 abc
Bayleton 0.5%G	50.0	30	8.75 abc	32.50 abc
Bayleton 0.5%G	25.0	14	2.50 bc	26.25 abc
Dyrene 4F	8.0	14	6.25 abc	28.75 abc
CGA 64250	1.0	28	21.25 ab	22.50 bc
CGA 64250	1.0	as needed	8.75 abc	15.00 bc
Tersan 1991	1.0	14	0.00 c	10.00 c
Duosan	3.0	14	5.00 abc	11.25 c
Vorlan	2.0	14	6.25 abc	18.75 bc
Cadminate	0.5	30	10.00 abc	22.50 bc
Fungo 50	1.0	14	8.75 abc	17.50 bc
Fore	8.0	14	15.00 abc	28.75 abc
Acti-Dione RZ	1.2	14	2.50 bc	31.25 abc
Check			15.00 abc	46.25 a
Check			22.50 a	23.75 abc

Pythium Blight on Penneagle Bentgrass

The purpose of this trial was to compare the relative efficacy of standard and experimental fungicides in the control of Pythium blight. Fungicides included in the trial along with rates of application and spray schedules are given in Table 51. Although the trial was located in an area with a history of Pythium blight, no Pythium blight symptoms were visible when the trial was initiated. Some Pythium blight did develop in the trial area. However, damage from scalping made it difficult to rate the plot. None of the plots showed symptoms of phytotoxicity from fungicides applied.

Table 51. Rates and spray schedule of fungicides tested in Pythium blight trial.

Treatment	Rate of Formulated Product (oz/1000 sq. ft.)	Time Interval Between Sprays (Days)
Aliette	3.12	14
Aliette	6.25	14
Aliette	12.50	14
Subdue 2E	1.0	14
Subdue 2E	2.0	14
Subdue 2E	2.0	21
Koban	4.0	5-10
Banol	2.0	14
Banol	4.0	14
Banol	4.0	21
Termec SP	4.0	as needed
Check		

Companies and Organzations that 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 that it can be added in future reports.

Nick Christians

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Made Donations to the Research Program

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