1989 Iowa Turfgrass Research Report

IOWA STATE UNIVERSITY
EXTENSION

Ames, Iowa 50011

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Introduction

The following research report is the ninth yearly publication of the results of turfgrass research projects performed at Iowa State University. The first was published for the 1981 field day, which was held June 18, of that year. The others were published in conjunction with the 1982, 1983, 1984, 1985, 1986, 1987, and 1988 field days.

The first cultivar and management studies at the field research area were seeded in August 1979, and many of these investigations are now in their tenth season. The research area was expanded between 1979 and 1983 to 4.2 acres of irrigated and approximately 3.0 acres of nonirrigated research area. Funding was obtained in 1983 to add 2.7 acres of irrigated research plots to the existing site. This construction was completed in the spring of 1985. Several new studies were initiated on this area in the 1985, 1986, 1987, and 1988 seasons and a map showing the location of these studies can be found in this report.

The expansion that has taken place since 1979 would not have been possible without the cooperation of the Iowa Agriculture Experiment Station, the Iowa Turfgrass Institute, the Iowa Golf Course Superintendent's Association, the Iowa Professional Lawn Care Association, and the Iowa Turfgrass Producers and Contractors (ITPAC) organization.

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

Special thanks to Betty Hempe for her work on typing and helping to edit this publication and to Barb Erickson for her help in editing.

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

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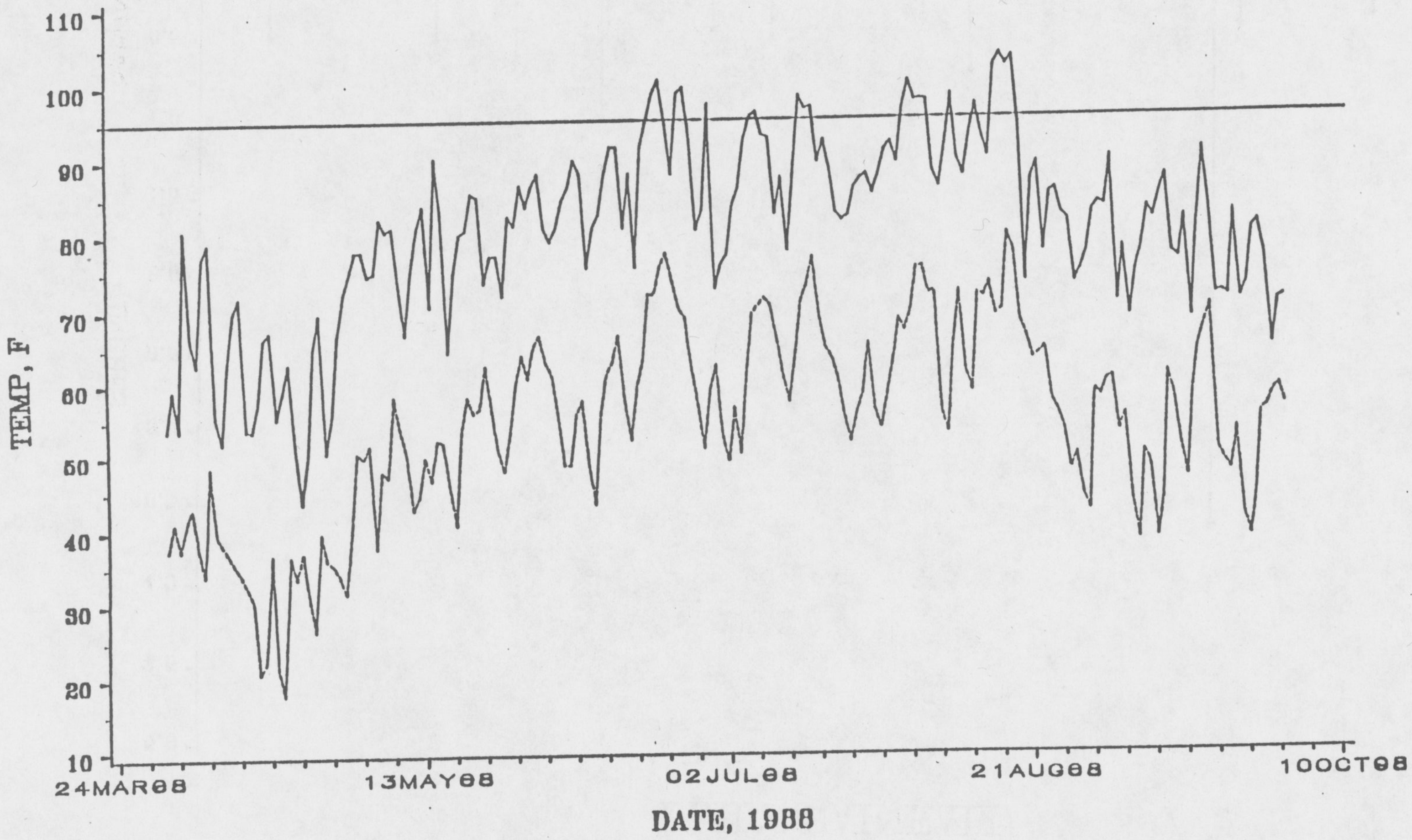
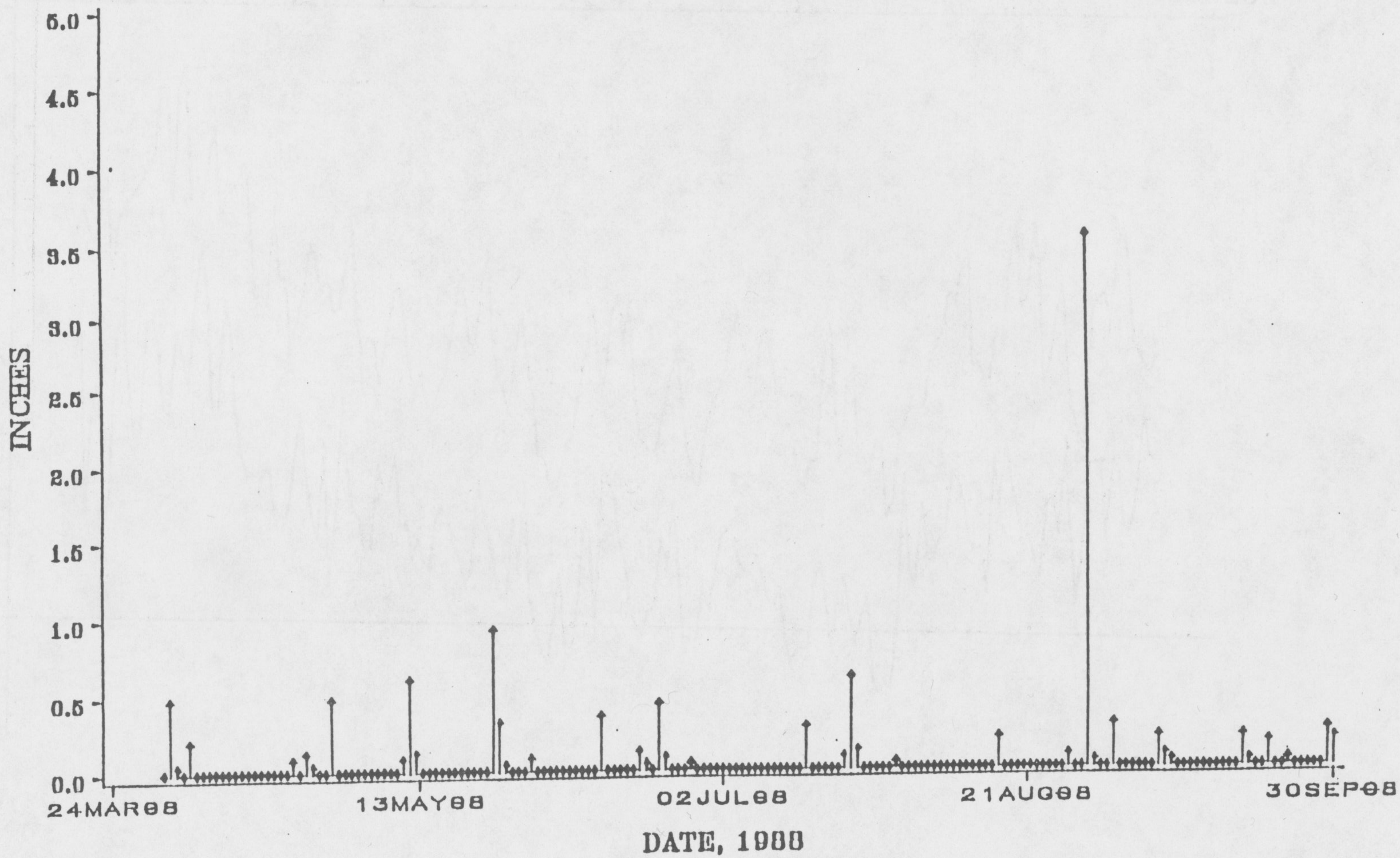


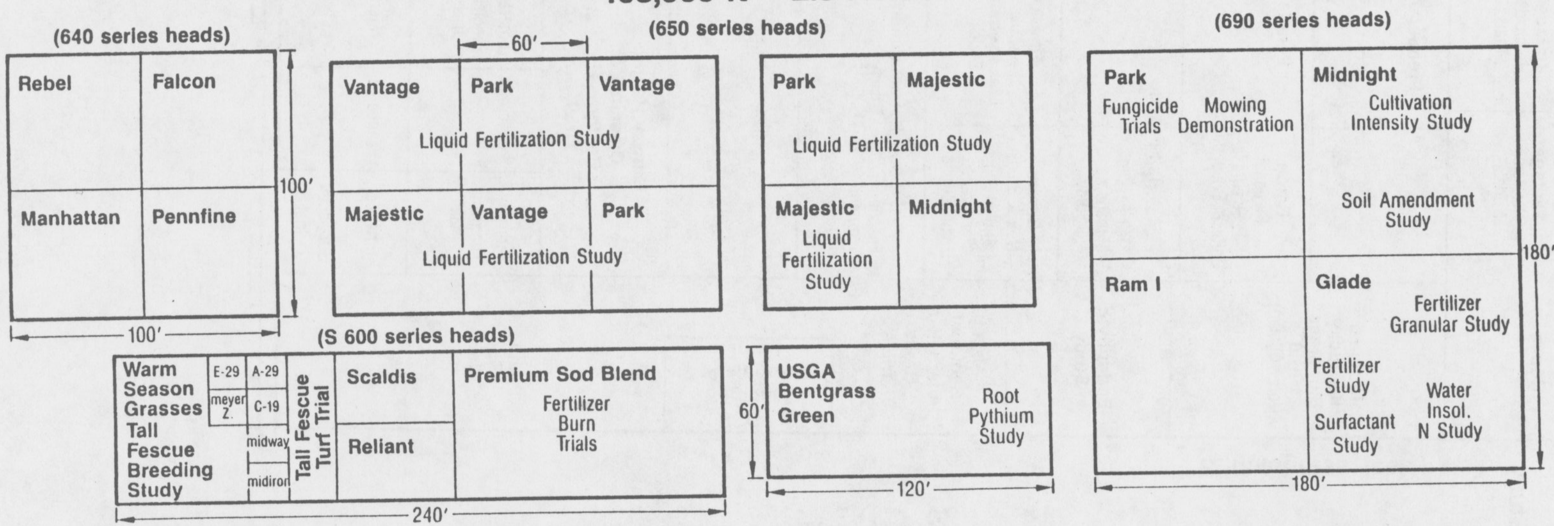
SOLID LINE = MAX DASHED LINE = MIN

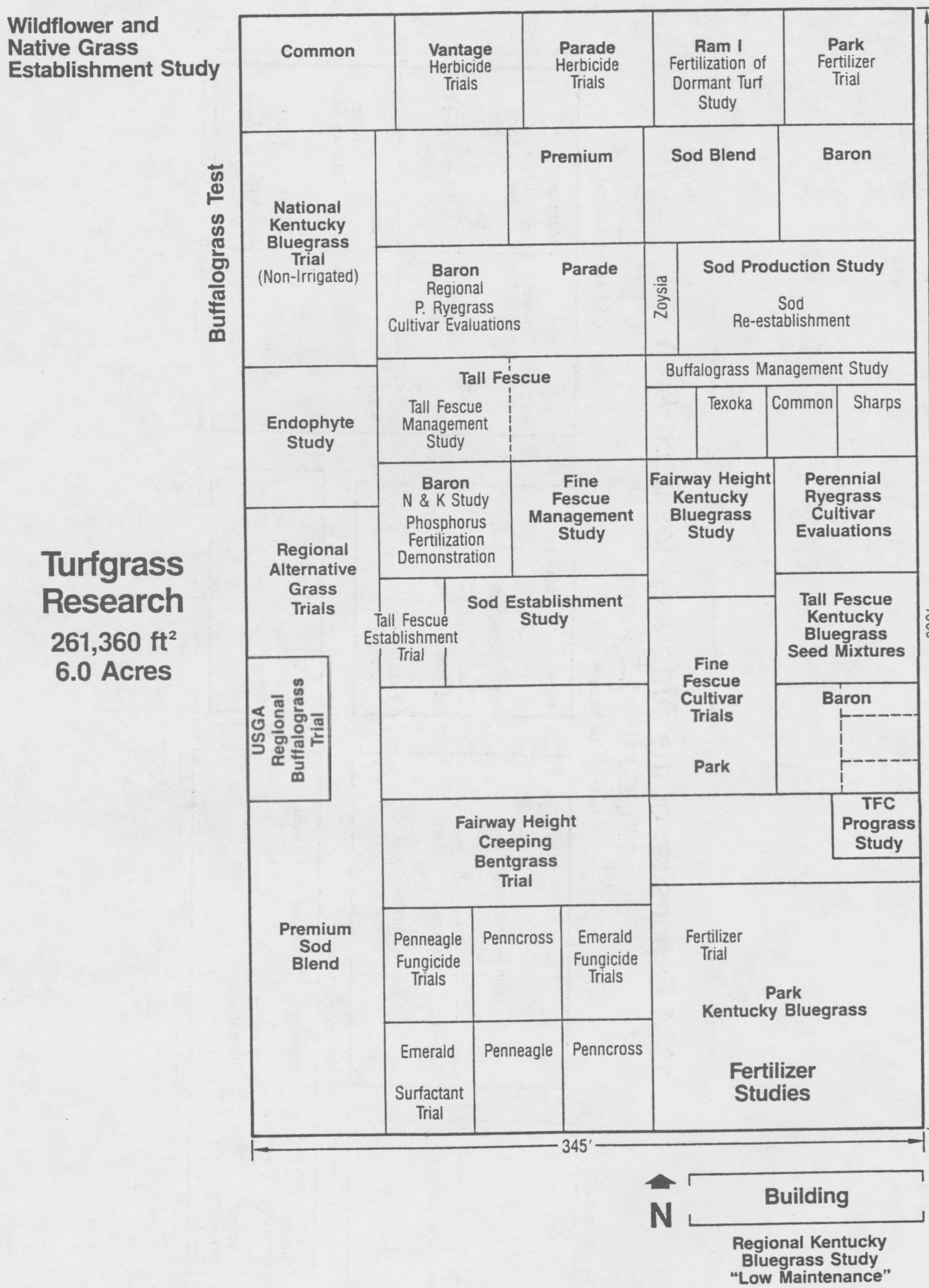
DAILY RAINFALL



1984 Expansion of the Turfgrass Research Area

108,900 ft² - 2.5 Acres

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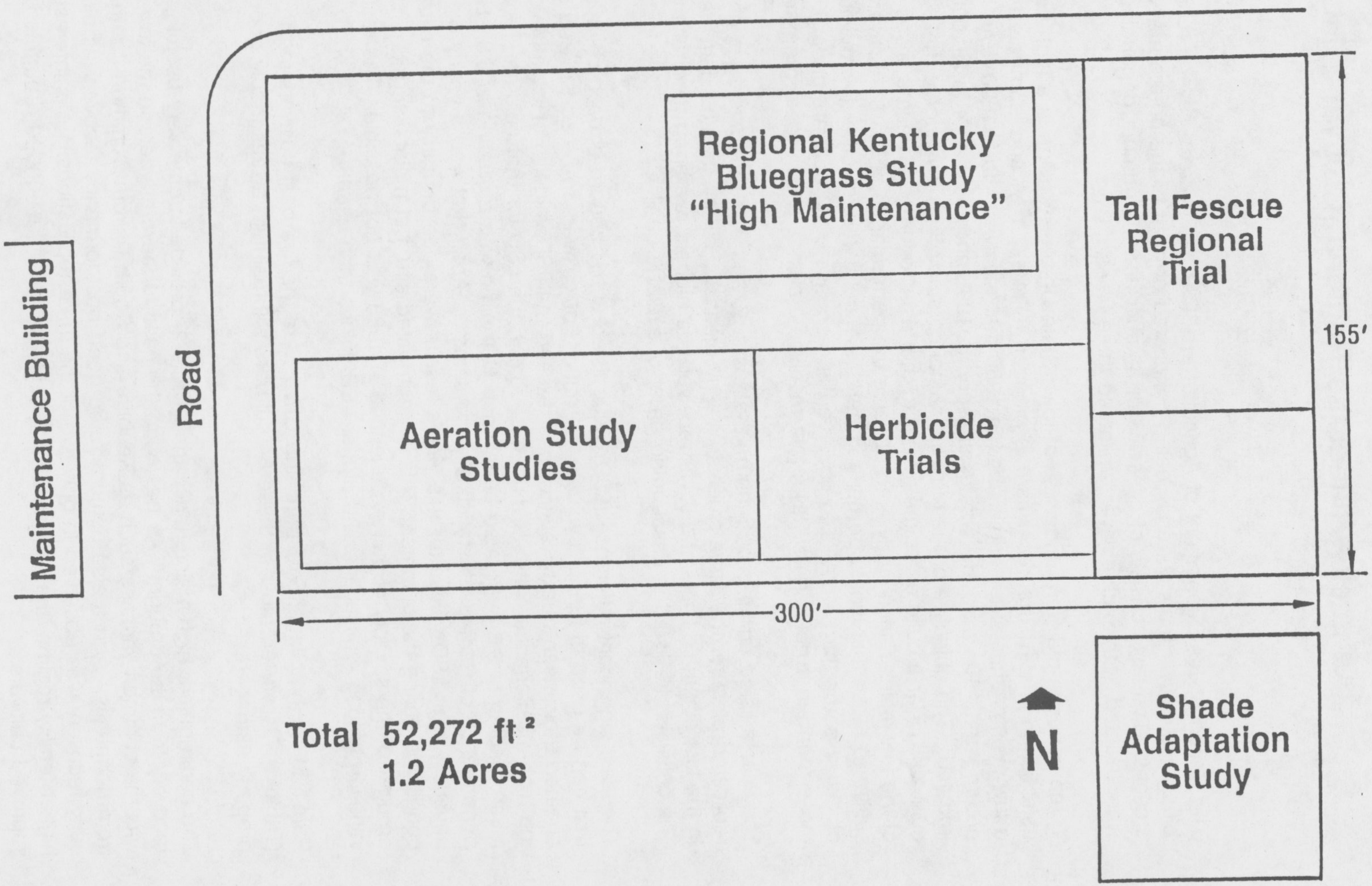
600′
345′
N
Building
Regional Kentucky Bluegrass Study "Low Maintenance"

East Research Area



Results of High- and Low-Maintenance

Kentucky Bluegrass Regional Cultivar Trials - 1988

N.E. Christians

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

Three separate trials are underway at Iowa State University. One is a high-maintenance study established in 1981 that receives 4 lb nitrogen (N)/1000 ft^2/yr and is irrigated as needed; another is a low-maintenance study established in 1980 that receives 1 lb N/1000 ft^2/yr in September and is not irrigated. The third trial was established in 1985 and receives 4 lb N/1000 ft^2/yr but is not irrigated. The objective of the high-maintenance study is to investigate the performance of the 84 cultivars under a cultural regime similar to that used on irrigated home lawns in Iowa. The objective of the low-maintenance study is to observe the performance of the 84 cultivars under conditions similar to those that would be used in parks, school yards, or other low-maintenance areas. The objective of the third study is to observe the response of 80 cultivars under conditions similar to those found in a nonirrigated lawn that receives a standard lawn care program.

The values listed under each month in tables 1, 2, and 3 are the averages of ratings made on three replicated plots for the three studies. Yearly means of all the months data were taken and are listed in the last column. The first cultivar received the highest average rating for the entire 1988 season. The cultivars are listed in descending order of average quality.

The least significant difference (LSD) value listed at the bottom of each column is a statistical value that can be used to further evaluate the data. For cultivars to be considered different from one another, their mean quality ratings must exceed the LSD value. For example, the yearly means for the high-maintenance cultivars must exceed 1.4, the LSD for that column (Table 1). Ram-I with a mean reading of 8.3 performed better than Geronimo with a reading of 6.8. However, the performance of Ram-I was statistically the same as Apart that had a yearly mean of 7.8. The unusually high LSD values for this year's results were due primarily to the extreme drought conditions during the summer. This is an irrigated site, but maintaining its uniformity during a drought of the severity of that experienced in 1988 was not possible. The result was greater variation among replications and higher LSD values than usual.

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

The nonirrigated, high-maintenance trial (Table 2) provided some very useful information following recovery from the drought. As has been the case for several years in the low-maintenance trial, it was the common varieties such as Kenblue and South Dakota Common ~~that~~ recovered most quickly from dormancy. Aquila also demonstrated good postdormancy recovery as did Mystic. (Mystic's early recovery was observed in only two of the three replications.) It is interesting that even under a higher fertility regime, the common types seem to tolerate extended droughts better than most improved cultivars.

The nonirrigated study was so devastated by the drought that data were collected in May, June, and August only. No differences were observed among the cultivars during the other months due to complete dormancy of all varieties. This study was terminated in late August and will not be rated in future years.

Table 1. The 1988 quality ratings for the high-maintenance regional Kentucky bluegrass test established in the fall 1981.

Cultivar	May	June	July	Aug	Sept	Oct	Mean
1. Ram-I	8.7	8.0	8.0	7.3	8.7	8.3	8.2
2. Midnight	8.0	8.0	8.0	7.7	9.0	8.7	8.2
3. Glade	7.7	8.0	7.3	7.3	9.0	7.7	7.8
4. Sydsport	7.3	8.0	7.7	7.7	8.3	8.0	7.8
5. Cheri	7.0	7.0	7.3	8.0	8.7	7.7	7.6
6. Enmundi	7.3	7.7	7.3	7.7	8.3	7.3	7.6
7. CEB VB 3965	6.7	7.0	7.0	7.3	9.0	8.3	7.6
8. Majestic	6.3	7.3	7.3	7.7	8.7	8.0	7.6
9. N535	6.3	7.7	7.3	7.3	8.7	8.3	7.6
10. BA-61-91	7.3	7.3	7.0	7.7	8.3	7.7	7.6
11. Eclipse	7.3	7.7	7.3	6.7	8.7	7.7	7.6
12. PSU - 150	8.0	7.7	6.7	8.0	8.3	6.3	7.5
13. Parade	6.7	7.0	7.0	8.0	8.7	7.7	7.5
14. Charlotte	6.0	7.0	7.3	7.7	9.0	8.0	7.5
15. A20-6	7.7	7.0	6.3	7.0	9.0	8.0	7.5
16. NJ 735	7.3	6.7	7.0	7.7	8.3	8.0	7.5
17. Fylking	7.0	7.0	7.0	7.7	8.7	7.3	7.4
18. PSU-190	7.0	7.0	7.0	7.3	8.3	8.0	7.4
19. Kimono	6.7	7.0	7.3	7.7	8.3	7.7	7.4
20. Holiday	7.3	7.3	6.7	7.3	8.7	7.3	7.4
21. Merit	6.7	6.7	7.0	8.0	8.7	7.3	7.4
22. I-13	8.0	7.3	6.7	7.0	8.0	7.7	7.4
23. Bristol	6.7	8.0	6.7	6.7	8.3	8.0	7.4
24. P141 (Mystic)	8.0	7.3	6.7	7.0	8.3	7.3	7.4
25. Escort	6.3	7.0	7.7	7.7	8.7	7.0	7.4
26. Birka	7.3	7.0	6.3	7.3	8.3	7.7	7.3
27. Plush	7.7	7.3	6.7	6.7	8.3	7.3	7.3
28. MLM-18011	7.3	6.7	6.3	7.0	8.0	8.3	7.3
29. Touchdown	8.0	6.7	7.0	7.0	8.3	7.0	7.3
30. Welcome	7.3	7.0	7.0	7.0	8.0	7.7	7.3
31. Shasta	6.0	6.3	6.7	7.7	8.7	8.3	7.3
32. Mer pp 300	6.7	7.0	7.0	7.3	8.3	7.7	7.3
33. Mer pp 43	6.7	6.7	7.3	7.0	8.3	8.0	7.3
34. Admiral	7.3	7.0	6.3	7.0	8.3	7.7	7.3
35. Barblue	7.3	7.7	6.7	5.7	8.0	8.7	7.3
36. Monopoly	7.0	7.7	6.3	7.0	7.7	7.3	7.2
37. Nugget	6.0	7.0	7.3	7.0	8.0	8.0	7.2
38. SV-01617	6.3	6.3	6.3	7.3	8.7	8.3	7.2
39. Vanessa	7.7	6.7	6.7	7.0	7.7	7.3	7.2
40. Mosa	7.3	7.3	7.0	7.0	7.7	7.0	7.2
41. WW Ag 478	6.0	7.3	7.3	7.3	8.0	7.3	7.2
42. A-34 (Bensun)	7.0	7.3	6.0	7.7	8.0	7.3	7.2
43. Mona	6.7	6.7	5.7	7.3	9.0	7.7	7.2
44. Victa	6.7	7.3	6.0	7.3	8.3	7.7	7.2
45. Enoble	8.0	7.0	6.0	7.0	8.0	7.3	7.2
46. Merion	6.7	6.7	6.7	7.7	8.3	7.3	7.2
47. 225	6.7	7.0	6.7	7.3	8.0	7.3	7.2

Table 1. The 1988 quality ratings for the high-maintenance regional Kentucky bluegrass test established in the fall 1981. (continued)

Cultivar	May	June	July	Aug	Sept	Oct	Mean
48. Adelphi	6.0	6.7	6.0	8.3	8.3	7.3	7.1
49. 239	6.7	6.7	5.7	7.3	8.0	8.0	7.1
50. Baron	6.0	6.3	6.7	8.0	7.7	7.7	7.1
51. Banff	7.3	7.0	5.7	6.0	8.7	7.7	7.1
52. WW Ag 463	6.7	6.3	5.7	7.3	9.0	7.3	7.1
53. Argyle	6.7	7.0	6.0	7.0	8.0	7.7	7.1
54. PSU-173	7.7	7.3	7.3	8.0	5.3	6.3	7.0
55. Apart	6.7	6.3	6.3	7.3	8.0	7.3	7.0
56. 243	6.3	6.3	6.3	7.0	8.3	7.3	6.9
57. Trenton	6.3	6.0	6.0	6.7	8.7	8.0	6.9
58. Dormie	7.0	6.3	6.3	7.3	7.7	7.0	6.9
59. WW AG 480	6.7	6.3	6.3	7.3	8.0	6.7	6.9
60. Bono	6.0	7.3	6.3	7.3	7.7	7.0	6.9
61. H-7	7.0	6.0	6.0	7.0	8.0	7.7	6.9
62. A20-6A	7.3	7.3	6.7	6.3	6.0	7.7	6.9
63. Columbia	6.3	5.7	7.0	6.3	8.7	7.7	6.9
64. Geronimo	5.3	6.7	6.0	7.0	8.0	7.7	6.8
65. Harmony	7.0	6.7	6.0	7.0	7.3	7.0	6.8
66. Bonnieblue	6.7	6.7	6.3	7.7	5.7	7.7	6.8
67. Vantage	6.0	6.0	6.3	7.0	8.0	7.3	6.8
68. A20	7.7	7.3	6.3	6.0	6.0	7.3	6.8
69. SH-2	7.0	6.7	7.3	7.0	5.3	7.3	6.8
70. S.D. Common	6.3	6.0	6.7	6.7	8.3	6.7	6.8
71. Rugby	7.0	7.0	5.7	6.7	6.0	7.7	6.7
72. Aspen	6.7	6.7	5.7	6.0	7.7	7.3	6.7
73. Cello	7.7	7.0	5.7	6.7	7.0	6.3	6.7
74. Bayside	6.7	6.7	6.7	7.7	5.7	7.0	6.7
75. American America?	5.3	6.0	5.7	7.0	8.0	7.3	6.6
76. Piedmont	6.0	6.3	5.3	7.0	7.7	7.0	6.6
77. Lovegreen	6.0	7.0	6.0	6.7	7.7	6.0	6.6
78. K3-178	6.0	5.7	5.3	7.0	8.0	7.0	6.5
79. K1-152	7.0	6.7	6.0	6.3	5.3	7.0	6.4
80. Wabash	7.0	6.3	6.3	6.7	5.0	6.7	6.3
81. S-21	5.3	6.0	5.7	7.3	7.3	6.3	6.3
82. Kenblue	5.7	5.7	5.7	6.3	7.7	6.3	6.2
83. K3-179	5.7	5.7	5.7	7.0	5.7	7.0	6.1
84. K3-162	5.3	5.3	5.0	6.3	7.3	6.0	5.9
LSD 0.05	1.2	1.2	1.4	N.S.	N.S.	1.4	1.0

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

Table 2. The 1988 quality ratings for the nonirrigated, high-maintenance Kentucky bluegrass trial established in the fall of 1985.

Cultivar	May	June	Sept	Oct	Mean
1. Kenblue	4.0	5.0	6.0	6.7	5.4
2. F-1872 (Freedom)	7.0	4.7	4.3	5.3	5.3
3. Aquila	5.0	4.7	5.7	6.0	5.3
4. Able I	5.3	3.3	6.3	5.3	5.1
5. South Dakota	3.7	4.3	6.3	6.0	5.1
6. Monopoly	6.3	4.0	4.7	5.0	5.0
7. Wabash	5.0	4.3	5.3	5.3	5.0
8. Rugby	6.7	4.0	4.3	5.0	5.0
9. Huntsville	5.0	4.7	5.3	4.7	4.9
10. WW Ag 496	6.0	4.0	5.0	4.7	4.9
11. Tendos	5.0	4.3	4.3	5.3	4.8
12. Somerset	5.7	3.7	4.7	5.0	4.8
13. Mystic	4.0	4.0	6.0	5.0	4.8
14. Loft's 1757	5.7	4.0	4.7	4.7	4.8
15. Aspen	4.0	3.7	6.0	5.7	4.8
16. WW Ag 495	6.0	4.3	4.7	4.3	4.8
17. NE 80-14	4.7	3.7	5.7	5.0	4.8
18. Joy	3.3	4.3	5.7	5.3	4.7
19. Victa	4.3	3.3	5.7	5.3	4.7
20. BA-70-242	4.7	3.3	5.3	5.0	4.6
21. K3-178	6.0	3.7	4.7	4.0	4.6
22. NE 80-47	5.0	4.0	4.7	4.7	4.6
23. Parade	7.0	4.7	2.7	3.7	4.5
24. Welcome	4.7	4.3	4.3	4.7	4.5
25. NE 80-110	5.0	4.0	5.0	4.0	4.5
26. Georgetown	6.3	4.3	3.7	3.3	4.4
27. BAR VB 534	5.0	4.7	3.7	4.3	4.4
28. Harmony	4.7	4.0	4.3	4.7	4.4
29. WW Ag 491	4.7	4.0	4.0	5.0	4.4
30. Haga	6.0	4.0	3.3	3.7	4.3
31. Baron	5.0	4.0	4.0	4.3	4.3
32. Cynthia	4.3	3.3	5.0	4.7	4.3
33. Destiny	4.0	3.7	5.0	4.7	4.3
34. Dawn	4.0	4.3	4.3	4.3	4.3
35. 239	6.0	4.0	3.3	3.7	4.3
36. Julia	5.7	4.3	3.7	3.7	4.3
37. Challenger	4.7	3.3	5.0	4.3	4.3
38. Classic	6.3	4.0	3.0	3.3	4.2
39. BA-73-626	4.7	3.7	4.3	4.0	4.2
40. BA-72-441	5.0	3.3	3.7	4.3	4.1
41. BA-73-540	5.7	4.0	3.3	3.3	4.1
42. Liberty	5.3	3.3	3.7	4.0	4.1
43. Glade	4.0	4.0	4.0	4.3	4.1
44. K1-152	6.0	4.0	3.0	3.3	4.1
45. Trenton	6.0	4.0	2.7	3.7	4.1
46. WW Ag 468	4.3	4.0	4.0	4.0	4.1
47. Barzan Barezan?	5.0	4.3	3.0	3.7	4.0

Table 2. The 1988 quality ratings for the nonirrigated, high-maintenance Kentucky bluegrass trial established in the fall of 1985. (continued).

Cultivar	May	June	Sept	Oct	Mean
48. Sydsport	5.0	3.7	4.0	3.3	4.0
49. Merit	5.3	3.7	3.3	3.7	4.0
50. Bristol	6.0	3.7	3.0	3.3	4.0
51. BA-69-82	6.0	4.0	3.0	3.0	4.0
52. HV 97	5.0	4.7	3.0	3.3	4.0
53. Eclipse	4.3	3.3	3.7	4.7	4.0
54. Nassau	6.0	3.7	3.3	3.0	4.0
55. Ikone	5.7	4.3	2.7	3.3	4.0
56. PST-CB1	5.0	3.7	3.3	4.0	4.0
57. Park	4.0	4.3	4.0	3.7	4.0
58. Gnome	4.3	4.0	3.7	3.7	3.9
59. A-34 (Bensun)	6.3	4.0	2.7	2.7	3.9
60. Annika	5.0	3.7	3.7	3.3	3.9
61. BA-72-492	6.3	4.0	2.7	2.7	3.9
62. NE 80-88	4.3	4.3	3.3	3.7	3.9
63. America	6.0	3.3	3.0	3.3	3.9
64. Blacksburg	5.0	3.3	3.7	3.7	3.9
65. NE 80-50	6.3	4.0	2.7	2.7	3.9
66. Ram-I	4.7	3.3	3.7	3.3	3.8
67. BAR VB 577	4.3	3.3	3.3	4.0	3.8
68. BA-70-139	4.3	3.7	3.7	3.7	3.8
69. BA-72-500	5.0	3.7	3.0	3.7	3.8
70. Merion	4.0	3.7	3.3	4.3	3.8
71. Amazon	4.7	3.7	3.0	3.7	3.8
72. NE 80-48	5.0	3.7	3.3	3.3	3.8
73. NE 80-55	5.7	3.3	2.7	3.3	3.8
74. P-104	4.7	4.0	3.0	2.7	3.6
75. Midnight	3.7	3.0	3.7	4.0	3.4
76. Asset	4.7	3.3	2.7	3.0	3.4
77. Cheri	4.7	3.7	2.3	3.0	3.4
78. Compact	4.3	3.0	2.7	3.0	3.3
79. Conni	4.0	3.7	2.7	3.0	3.3
80. NE 80-30	4.7	3.7	2.3	2.7	3.3
LSD 0.05	1.3	0.9	1.7	1.7	0.9

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

Data were not collected in July and August due to complete dormancy during the drought.

Table 3. The 1988 quality ratings for the low-maintenance regional Kentucky bluegrass test established in the fall 1980.

Cultivar	May	June	Aug	Mean
1. Vantage	5.7	4.0	3.3	4.3
2. Parade	6.0	4.3	2.3	4.2
3. Kenblue	4.7	4.3	3.3	4.1
4. Argyle	5.3	4.0	3.0	4.1
5. Piedmont	5.0	4.0	2.7	3.9
6. Escort	5.3	3.7	2.7	3.9
7. Cheri	5.3	3.3	2.7	3.8
8. Kimono	4.7	3.7	3.0	3.8
9. Birka	5.0	3.3	2.7	3.7
10. Monopoly	4.7	3.7	2.7	3.7
11. PSU-173	4.7	3.3	3.0	3.7
12. Plush	5.3	3.0	2.7	3.7
13. Dormie	4.3	3.7	3.0	3.7
14. Mosa	4.7	3.7	2.7	3.7
15. A-34 (Bensun)	4.7	4.0	2.3	3.7
16. Bayside	4.7	3.7	2.7	3.7
17. K3-162	4.7	4.0	2.3	3.7
18. Fylking	4.7	3.3	2.7	3.6
19. PSU-190	5.3	3.7	1.7	3.6
20. Eclipse	4.7	3.3	2.7	3.6
21. K3-178	5.0	3.7	2.0	3.6
22. Kl-152	5.0	3.3	2.3	3.6
23. Ram-I	4.7	3.3	2.3	3.4
24. 243	4.0	3.3	3.0	3.4
25. Wabash	5.0	3.7	1.7	3.4
26. Trenton	5.0	3.3	2.0	3.4
27. Harmony	4.0	3.7	2.7	3.4
28. S.D. Common	3.3	4.0	3.0	3.4
29. Barblue	5.0	3.7	1.7	3.4
30. Enmundi	4.0	3.7	2.3	3.3
31. A20-6	4.7	3.0	2.3	3.3
32. Shasta	5.0	3.0	2.0	3.3
33. Merion	3.7	3.7	2.7	3.3
34. 239	4.0	3.3	2.3	3.2
35. S-21	3.3	4.0	2.3	3.2
36. WW Ag 478	3.7	3.3	2.7	3.2
37. Majestic	4.3	3.3	2.0	3.2
38. Merit	3.7	3.0	3.0	3.2
39. Charlotte	4.3	3.0	2.3	3.2
40. Mer pp 300	4.0	3.3	2.3	3.2
41. BA-61-91	4.0	3.3	2.3	3.2
42. Adelphi	3.7	3.3	2.3	3.1
43. PSU-150	3.7	3.0	2.7	3.1
44. Touchdown	3.3	3.7	2.3	3.1
45. American	4.0	3.0	2.3	3.1
46. Vanessa	4.3	3.3	2.0	3.1
47. Cello	4.0	3.3	2.0	3.1

Table 3. The 1988 quality ratings for the low-maintenance regional Kentucky bluegrass test established in the fall 1980. (continued)

Cultivar	May	June	Aug	Mean
48. Bonnieblue	4.0	3.0	2.3	3.1
49. Columbia	4.0	3.3	2.0	3.1
50. Apart	4.0	3.3	2.0	3.1
51. Mer pp 43	4.3	3.3	1.7	3.1
52. Mona	4.0	3.0	2.3	3.1
53. Enoble	4.3	3.0	2.0	3.1
54. NJ 735	4.7	3.0	1.7	3.1
55. Admiral	3.7	3.0	2.7	3.1
56. Aspen	3.7	3.0	2.3	3.0
57. MLM-18011	4.3	3.0	1.7	3.0
58. CEB VB 3965	4.0	3.0	2.0	3.0
59. Welcome	4.0	3.0	2.0	3.0
60. WW Ag 463	4.0	3.0	2.0	3.0
61. N535	4.3	3.0	1.7	3.0
62. Midnight	4.0	3.0	2.0	3.0
63. Sydsport	4.0	3.3	1.7	3.0
64. Lovegreen	3.3	3.0	2.7	3.0
65. Bristol	4.0	3.0	2.0	3.0
66. Victa	4.3	3.0	1.7	3.0
67. SH-2	4.7	2.7	1.7	3.0
68. K3-179	3.3	3.3	2.3	3.0
69. Glade	3.7	2.7	2.3	2.9
70. Baron	3.7	3.0	2.0	2.9
71. Rugby	3.3	3.0	2.3	2.9
72. SV-01617	3.3	3.0	2.3	2.9
73. Geronimo	3.3	3.0	2.3	2.9
74. Bono	4.0	3.0	1.7	2.9
75. A20	2.7	3.0	3.0	2.9
76. H-7	3.0	2.7	3.0	2.9
77. 225	4.0	3.0	1.7	2.9
78. Nugget	3.3	3.0	2.0	2.8
79. WW Ag 480	3.3	3.0	2.0	2.8
80. A-20-6A	3.3	2.7	2.3	2.8
81. Banff	3.0	3.0	2.0	2.7
82. Holiday	3.0	3.0	2.0	2.7
83. P 141 (Mystic)	3.0	3.0	2.0	2.7
84. I-13	3.3	2.7	1.7	2.6
LSD 0.05	N.S.	0.7.	1.0	0.7

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

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

Low-maintenance Kentucky Bluegrasses

N.E. Christians

Kentucky bluegrass (Poa pratensis L.) is the most widely used of the cool-season turfgrasses in the northern United States. It can be found on lawns, golf course fairways and tees, cemeteries, parks, school grounds, and other areas where a dense grass cover is desired. The reason for its widespread use is that it has a number of advantages over other alternative grasses.

Its primary advantage is its extensive rhizome system. Rhizomes are underground stems that provide Kentucky bluegrass with its tremendous recuperative and reproductive capacity. Rhizomes spread below the soil surface when environmental conditions are conducive to growth. If the aboveground tissue is damaged in some way, new plants can develop from the buds on these rhizomes and the turf area virtually repairs itself. Perennial ryegrass, chewing's fescue, and hard fescue, which are sometimes used in combination with, or as an alternative to Kentucky bluegrass, lack this rhizome system and the capacity for regrowth. Even tall fescue and creeping red fescue, two alternative species that have rhizomes, lack the extensive systems of Kentucky bluegrass.

Kentucky bluegrass develops a high density turf stand, has excellent color, and mows more cleanly than tougher bladed grasses such as perennial ryegrass. It also has a greater tolerance of cold temperatures than either perennial ryegrass or tall fescue. When mowed at the correct mowing height, 2 to 2.5 in, it is very competitive with weeds. Its tolerance of diseases is good when it is properly managed.

A disadvantage of this species is its shallow root system and relatively high demand for water. However, it has the ability to go dormant during extended droughts. A Kentucky bluegrass plant can lose its leaf tissue and part of its root system, but the crown (the region at the soil surface from which the new leaves arise) and the rhizomes can live for several weeks and regrowth will occur when water is available. Some of the other cool-season grasses will remain green for a longer period of time into a drought period, but none have the ability to recover that Kentucky bluegrass displays when the drought ends.

More than 300 cultivars (cultivated varieties) of Kentucky bluegrass have been developed over the past several decades. Each of the cultivars are genetically Kentucky bluegrass, but each has some unique, reproducible characteristic that sets it apart from the rest. These differences include variations in color, leaf angle, texture, and disease resistance, among others. These cultivars are generally divided into two categories: common and improved.

The common types, or 'public varieties' as they are known in the turfgrass seed industry, are the older cultivars or selections from older cultivars, most of which have been in use for many decades. These common cultivars are characterized by an upright growth habit with a narrow leaf angle from vertical, and a relatively high susceptibility to the fungal disease 'leaf spot' when they are intensely managed. Their positive attributes include early spring greenup and relatively good tolerance of environmental stress.

The improved types are newer releases, most of which have been selected or developed in the last few decades. The first of these improved types to be released was Merion, which was selected primarily for its tolerance of leaf spot. Since the release of Merion, many other improved cultivars of Kentucky bluegrass have been selected and today there is a wide variety of these improved types available on the market. As a group, the improved cultivars are known for their more prostrate growth, a slower growth rate, and improved tolerance to a number of grass diseases.

For 25 to 30 years following the release of Merion, most research on Kentucky bluegrass adaptation centered around the improved cultivars. These cultivars are well suited to the intense management typified in this era of inexpensive irrigation water and heavy use of fertilizers. By the end of the 1970's, however, water shortages and the sharp increase in the cost of both water and fertilizer began to turn more attention toward the selection of grasses that are better adapted to less intense management regimes.

The United States Department of Agriculture (USDA) began extensive testing of Kentucky bluegrasses at various locations around the country in 1980. For these tests, the USDA obtained seed from grass breeders and seed distributors, divided the lots, and distributed them to cooperators involved in turfgrass research. Data were collected monthly at each of the sites and were compiled and summarized by the USDA at Beltsville, Maryland.

#1

In 1980, 84 cultivars of Kentucky bluegrass were obtained from the USDA and were established in a low-maintenance Kentucky bluegrass trial at the turfgrass research area at the Iowa State University Horticulture Research Station at Ames, Iowa. Each cultivar plot was replicated three times in the study. The area received 1 lb nitrogen (N)/1000 ft^2 in September and received no other fertilization during the year. The area was not irrigated. In 1981, a second lot of the same 84 cultivars was obtained from the USDA and a high-maintenance trial was established on an adjacent site. This study area received 4 lb N/1000 ft^2 per year divided into four 1 lb treatments. This area was irrigated as needed. Both areas were uniformly mowed at a 2 in mowing height and standard weed control methods were used on both locations.

By 1983, an unexpected but interesting trend began to appear in the data from the two studies. The 1983 season was unusually hot and dry and the grasses in the nonirrigated, low-maintenance trial remained in a summer dormant condition for several weeks. The same 84 cultivars in the high-maintenance study were irrigated as needed through the summer and at no time were allowed to go dormant. The trend involved in the data was a reversal in performance of the common and improved cultivars in the studies (Table 4).

The cultivars acted as would be expected in the high-maintenance study. Improved types such as Majestic, Midnight, and Glade ranked very high. The common types, such as Kenblue, South Dakota Common, and S-21, that generally do not do well under intense management were ranked near the bottom.

However, in the low-maintenance study, the opposite was true. Kenblue, South Dakota Common, and S-21 ranked in the top five and many of the improved types ranked much lower. The reason for the high ranking of the common varieties was the rapid recovery following dormancy. The common types recovered and produced a green cover within 2 to 3 weeks following the late-summer rains, whereas many of the improved types required 4 to 8 weeks to recover and some did not completely recover until spring. This same trend continued through the dry summers of 1984 and 1985 (Iowa State University Turfgrass Research Reports FG-451 and FG-452).

The summers of 1986 and 1987 were much wetter and the common types did not maintain the clear advantage over the improved types in the low-maintenance trial, although they did rank in the upper 50% (ISU Turfgrass Research Reports FG-453 and FG-454). In 1988, the drought was so severe that none of the cultivars in the low-maintenance test had recovered by fall. Recent observations in the spring of 1989 found that the common cultivars were showing more rapid recovery than the improved types, but all of the 84 Kentucky bluegrasses were showing significant damage from the drought.

The 1988 drought did provide some good practical examples of how well the common types of Kentucky bluegrass can survive drought. In many areas of the midwest, bluegrass turf remained in a summer dormant condition for more than 10 weeks. It was the older parks, cemeteries, and lawns that had been established years ago with common cultivars of Kentucky bluegrass that emerged from the drought in the best condition. It was the improved cultivars that were killed by the drought.

The results from the 8 years of observations on the two studies should not have been so surprising given the history of these grasses. Most of the common types were selected prior to World War II, or were selected in later years from grasses commonly used in that time period, when low-intensity management regimes were typically used. Less fertilizer was applied and irrigation was not widely practiced. Kentucky bluegrass was popular because of its ability to avoid drought through dormancy and to recover quickly in the late summer and fall. Those involved in selecting Kentucky bluegrasses at that time would naturally choose the grasses that exhibited the best post-drought recovery. The improved varieties were selected at a time when more intense management regimes were becoming widely used and cultivars were selected more for their ability to tolerate diseases and to provide a dense, dark green sward, than for their ability to recover in the fall. The differences were always there, it was just that little attention was paid to them until the l980's.

#2 In 1985, a third Kentucky bluegrass trial was established at the Horticulture Research Station in an area adjacent to the high- and low-maintenance studies. This trial was part of a new USDA study that included 80 cultivars, many of which had been included in the earlier studies. This trial received 4 lb N/1000 ft^2/yr like the high-maintenance trial, but was irrigated. Weed control was performed as in the other two trials. The management regime was meant to represent the conditions that exist in many nonirrigated Kentucky bluegrass lawns in the northern region that are treated by professional lawn care companies. These lawns are generally allowed to go into dormancy in the summer and to recover in fall.

The 1985 study suffered some winter damage the first year and some reseeding was done in the fall of 1986. Although some data were collected in 1987, the area did not fully mature and complete data collection was not begun until the spring of 1988. The Kentucky bluegrasses in this highly fertilized, nonirrigated trial went into summer dormancy in June 1988 because of the severe drought and remained dormant until August. As was the case in the low-maintenance study in dry summers, it was the common varieties that survived the drought in the best condition (Table 5). Kenblue and South Dakota Common showed excellent recovery in October after a heavy rain in August, whereas many of the improved types had not recovered by the end of the season.

The observations from these trials have resulted in some changes in Kentucky bluegrass cultivar recommendations at Iowa State University. There was a time when the best cultivars from high-maintenance, irrigated trials were listed in extension bulletins and no distinctions were made as to the type of area on which the grasses were to be used. This is no longer the case, and different cultivars are recommended for high-maintenance areas than for low-maintenance areas.

#3 The improved cultivars of Kentucky bluegrass are clearly the best choice when the area is to be irrigated, or when natural rainfall is sufficient to prevent summer dormancy. Under intense management regimes, the common cultivars prove to be disease prone and they will not perform as well as improved types. However, if the area is to receive a less intense management regime and is expected to go into summer dormancy during dry summers, the common cultivars will likely give more satisfactory results. Parks, school grounds, cemeteries, grassed areas along airport runways, low-maintenance home lawns, and other areas that may spend extended periods in dormancy would be best suited to the common types. Cultivars currently recommended for high- and low-maintenance areas are listed in table 6.

There are still questions that need to be answered and future recommendations will likely change as more is learned. For instance, would the blending of seed from high- and low-maintenance cultivars provide a quality turf that will better adapt to its environment? Over how wide a geographical area do these observations apply? What is there about the structure and physiology of these low-maintenance grasses that allow them to recover from dormancy so quickly? Further work will be conducted on low-maintenance grasses. It is likely that an increased amount of attention will be paid to this subject throughout the country as costs rise and the availability of water for turf irrigation decreases.

Table 4. Kentucky bluegrass cultivar rankings for the low- and high-maintenance trials in 1983. Number 1 is the top ranked cultivar in each study and number 84 is the bottom ranked cultivar.

Cultivar	Low-maint.	High-maint.	Cultivar	Low-maint.	High-maint.
K3-162	1	80	Adelphi	43	40
Kenblue	2	84	Birka	44	28
S-21	3	73	Trenton	45	52
Vantage	4	79	Touchdown	46	53
S.D. Common	5	77	Welcome	47	45
Argyle	6	60	Merit	48	16
Ram-1	7	6	Shasta	49	47
Vanessa	8	49	SLH-2	50	72
Mosa	9	46	NH-735	51	76
Monopoly	10	82	Merion	52	70
PSU-173	11	21	Admiral	53	31
Plush	12	41	Cheri	54	33
Wabash	13	78	239	55	20
PSU-190	14	15	SV-01617	56	23
Piedmont	15	75	Banff	57	42
Victa	16	18	Geronimo	58	66
Fylking	17	19	WWAg463	59	67
Enmundi	18	8	Bono	60	26
Parade	19	57	Midnight	61	3
Harmony	20	58	Sydsport	62	17
Mystic	21	50	Lovegreen	63	83
Eclipse	22	12	K3-178	64	51
Barblue	23	13	K1-152	65	65
PSU-150	24	14	Rugby	66	34
MLM-18011	25	25	Majestic	67	1
WWAg478	26	29	Bonnieblue	68	7
BA-61-91	27	38	Glade	69	4
Baron	28	22	WWag480	70	54
Charlotte	29	27	Cello	71	74
Apart	30	48	N535	72	5
A-34	31	61	Mona	73	37
Mer pp 43	32	71	225	74	63
K3-179	33	64	A20	75	68
Kimono	34	10	H-7	76	81
Dormie	35	43	Columbia	77	30
Aspen	36	24	Bristol	78	9
CEBVB3965	37	11	243	79	2
American	38	59	Nugget	80	56
Mer pp 300	39	36	K3-179	81	64
Enoble	40	62	Holiday	82	44
Bayside	41	39	I-13	83	69
Escort	42	32	A20-6A	84	35

Table 5. The 1988 quality ratings for the nonirrigated, highly-fertilized Kentucky bluegrass trial established in the fall of 1985.

Cultivar	May	June	Sept	Oct	Mean
1. Kenblue	4.0	5.0	6.0	6.7	5.4
2. F-1872 (Freedom)	7.0	4.7	4.3	5.3	5.3
3. Aquila	5.0	4.7	5.7	6.0	5.3
4. Able I	5.3	3.3	6.3	5.3	5.1
5. South Dakota	3.7	4.3	6.3	6.0	5.1
6. Monopoly	6.3	4.0	4.7	5.0	5.0
7. Wabash	5.0	4.3	5.3	5.3	5.0
8. Rugby	6.7	4.0	4.3	5.0	5.0
9. Huntsville	5.0	4.7	5.3	4.7	4.9
10. WW Ag 496	6.0	4.0	5.0	4.7	4.9
11. Tendos	5.0	4.3	4.3	5.3	4.8
12. Somerset	5.7	3.7	4.7	5.0	4.8
13. Mystic	4.0	4.0	6.0	5.0	4.8
14. Loft's 1757	5.7	4.0	4.7	4.7	4.8
15. Aspen	4.0	3.7	6.0	5.7	4.8
16. WW Ag 495	6.0	4.3	4.7	4.3	4.8
17. NE 80-14	4.7	3.7	5.7	5.0	4.8
18. Joy	3.3	4.3	5.7	5.3	4.7
19. Victa	4.3	3.3	5.7	5.3	4.7
20. BA-70-242	4.7	3.3	5.3	5.0	4.6
21. K3-178	6.0	3.7	4.7	4.0	4.6
22. NE 80-47	5.0	4.0	4.7	4.7	4.6
23. Parade	7.0	4.7	2.7	3.7	4.5
24. Welcome	4.7	4.3	4.3	4.7	4.5
25. NE 80-110	5.0	4.0	5.0	4.0	4.5
26. Georgetown	6.3	4.3	3.7	3.3	4.4
27. BAR VB 534	5.0	4.7	3.7	4.3	4.4
28. Harmony	4.7	4.0	4.3	4.7	4.4
29. WW Ag 491	4.7	4.0	4.0	5.0	4.4
30. Haga	6.0	4.0	3.3	3.7	4.3
31. Baron	5.0	4.0	4.0	4.3	4.3
32. Cynthia	4.3	3.3	5.0	4.7	4.3
33. Destiny	4.0	3.7	5.0	4.7	4.3
34. Dawn	4.0	4.3	4.3	4.3	4.3
35. 239	6.0	4.0	3.3	3.7	4.3
36. Julia	5.7	4.3	3.7	3.7	4.3
37. Challenger	4.7	3.3	5.0	4.3	4.3
38. Classic	6.3	4.0	3.0	3.3	4.2
39. BA-73-626	4.7	3.7	4.3	4.0	4.2
40. BA-72-441	5.0	3.3	3.7	4.3	4.1
41. BA-73-540	5.7	4.0	3.3	3.3	4.1
42. Liberty	5.3	3.3	3.7	4.0	4.1
43. Glade	4.0	4.0	4.0	4.3	4.1
44. K1-152	6.0	4.0	3.0	3.3	4.1
45. Trenton	6.0	4.0	2.7	3.7	4.1
46. WW Ag 468	4.3	4.0	4.0	4.0	4.1
47. Barzan	5.0	4.3	3.0	3.7	4.0

Table 5. The 1988 quality ratings for the nonirrigated, highly-fertilized Kentucky bluegrass trial established in the fall of 1985. (continued).

Cultivar	May	June	Sept	Oct	Mean
48. Sydsport	5.0	3.7	4.0	3.3	4.0
49. Merit	5.3	3.7	3.3	3.7	4.0
50. Bristol	6.0	3.7	3.0	3.3	4.0
51. BA-69-82	6.0	4.0	3.0	3.0	4.0
52. HV 97	5.0	4.7	3.0	3.3	4.0
53. Eclipse	4.3	3.3	3.7	4.7	4.0
54. Nassau	6.0	3.7	3.3	3.0	4.0
55. Ikone	5.7	4.3	2.7	3.3	4.0
56. PST-CB1	5.0	3.7	3.3	4.0	4.0
57. Park	4.0	4.3	4.0	3.7	4.0
58. Gnome	4.3	4.0	3.7	3.7	3.9
59. A-34 (Bensun)	6.3	4.0	2.7	2.7	3.9
60. Annika	5.0	3.7	3.7	3.3	3.9
61. BA-72-492	6.3	4.0	2.7	2.7	3.9
62. NE 80-88	4.3	4.3	3.3	3.7	3.9
63. America	6.0	3.3	3.0	3.3	3.9
64. Blacksburg	5.0	3.3	3.7	3.7	3.9
65. NE 80-50	6.3	4.0	2.7	2.7	3.9
66. Ram-I	4.7	3.3	3.7	3.3	3.8
67. BAR VB 577	4.3	3.3	3.3	4.0	3.8
68. BA-70-139	4.3	3.7	3.7	3.7	3.8
69. BA-72-500	5.0	3.7	3.0	3.7	3.8
70. Merion	4.0	3.7	3.3	4.3	3.8
71. Amazon	4.7	3.7	3.0	3.7	3.8
72. NE 80-48	5.0	3.7	3.3	3.3	3.8
73. NE 80-55	5.7	3.3	2.7	3.3	3.8
74. P-104	4.7	4.0	3.0	2.7	3.6
75. Midnight	3.7	3.0	3.7	4.0	3.4
76. Asset	4.7	3.3	2.7	3.0	3.4
77. Cheri	4.7	3.7	2.3	3.0	3.4
78. Compact	4.3	3.0	2.7	3.0	3.3
79. Conni	4.0	3.7	2.7	3.0	3.3
80. NE 80-30	4.7	3.7	2.3	2.7	3.3
LSD 0.05	1.3	0.9	1.7	1.7	0.9

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

All cultivars were dormant in July and August and no data were collected in these months.

Table 6. Kentucky bluegrass cultivars recommended for high- and low-maintenance areas.

High-maintenance

1.	Midnight	14.	Aspen	27.	Rugby
2.	Glade	15.	Escort	28.	Shasta
3.	Ram-1	16.	Mosa	29.	Bayside
4.	Majestic	17.	Sydsport	30.	Banff
5.	Enmundi	18.	Victa	31.	Dormie
6.	Bristol	19.	Baron	32.	Trenton
7.	Kimono	20.	Charlotte	33.	Nugget
8.	Merit	21.	Columbia	34.	Enoble
9.	Bonnieblue	22.	Mona	35.	Apart
10.	Eclipse	23.	Adelphi	36.	Touchdown
11.	Holiday	24.	Vanessa	37.	Parade
12.	Cheri	25.	Fylking	38.	Geronimo
13.	Barblue	26.	Admiral	39.	Plush

Low-maintenance

1.	Kenblue	10.	Piedmont
2.	S.D. Common	11.	Fylking
3.	S-21	12.	Victa
4.	Vantage	13.	Monopoly
5.	Argyle	14.	Mosa
6.	Plush	15.	Ram-1
7.	Vanessa	16.	Harmony
8.	Parade	17.	Barblue
9.	Wabash	18.	Kimona

The cultivars are ranked based on their performance over a 4-year period in high- and low-maintenance trials at Iowa State University. The grasses that are listed were chosen as the best from a group of 84 cultivars.

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Growth and Morphological Characterization Study of Low- and High-maintenance Kentucky Bluegrass Cultivars

M.G. Burt and N.E. Christians

Kentucky bluegrass (Poa pratensis L.) is the most extensively used cool-season turfgrass in the United States. It is a very diverse species, and its cultivars are known to differ in many shoot morphology, growth, and root growth characteristics. Since 1950, several hundred cultivars have been selected, developed, and released into the turf seed market. These cultivars can be very broadly classified as common and improved types. The common-type Kentucky bluegrasses were not developed for turf-type characteristics. They were developed mainly for high seed production capabilities and early seed maturation. Improved Kentucky bluegrasses were selected and developed for more desirable turfgrass growth characteristics and improved disease resistance, especially when subjected to lower mowing heights and higher fertility levels.

Data from Kentucky bluegrass studies at Iowa State University have shown that cultivars that performed well in low-maintenance cultivar evaluations tend to perform poorly in the high-maintenance cultivar evaluations. Similarly, the cultivars that performed well in the high-maintenance cultivar evaluations perform poorly in the low-maintenance cultivar evaluations. Ten Kentucky bluegrass cultivars were chosen for this study based solely on their performance over several years in the low-maintenance trial. Five cultivars were chosen that have consistently performed well in the low-maintenance trial. These "low-maintenance" cultivars are K3-162, Kenblue, Vantage, South Dakota Common, and S-21. Conversely, five cultivars were chosen that consistently performed poorly in the low-maintenance trial. These "high-maintenance" cultivars are Bonnieblue, A20, I-13, Lovegreen, and Columbia.

The objective of this research was to determine if certain root and shoot growth and morphological characteristics are common to Kentucky bluegrass cultivars defined as low- or high-maintenance cultivars. This was accomplished by closely observing these ten cultivars in the field, greenhouse, and laboratory. These cultivars were further studied in the greenhouse to determine if their root and shoot growth characteristics changed when grown under low- and high-nitrogen (N) levels.

All field data were collected from the low-maintenance cultivar trial. Data included turf quality ratings based on turf color and percent live green tissue and clipping yields. During the 1987 growing season, the quality ratings of the low- and high-maintenance cultivars did not differ significantly until mid-July. For the remainder of the growing season and for the growing season average, the low-maintenance cultivars were rated higher. This was typical of what has been observed during most of the past growing seasons. The 1988 growing season differed, however. The low- and high-maintenance cultivars did not consistently differ at any time during the growing season or for the growing season average. This could be attributed to the severity of the drought experienced in 1988. None of the cultivars in the low-maintenance cultivar evaluation performed acceptably during 1988.

The first set of greenhouse experiments utilized a clear polyethylene tube in PVC pipe system to closely monitor the root and shoot development of individual cultivar seedlings grown for 10 to 12 weeks in a fritted clay media with slow release fertilizer. The low- and high-maintenance cultivars differed in many of the measured root and shoot growth characteristics. The low-maintenance cultivars rooted to greater depths in the root profile and yielded greater clipping weights at all weeks in all experiments. The low-maintenance cultivars produced greater total root mass, and greater root mass in the 0 to 7 in and 7 to 14 in sections of the root profile. The low-maintenance cultivars yielded a greater percentage of their total root weight in the 7 to 14 in section, and the high-maintenance cultivars yielded a greater percentage of their total root weight in the 0 to 7 in section of the root profile. The low-maintenance cultivars were found to have a lower shoot to root ratio and the shoot tissue of the low-maintenance cultivars contained proportionally less moisture. The low- and high-maintenance cultivars also differed in all measured shoot morphological characteristics. The low-maintenance cultivars had narrower leaf blades, more leaf folding, longer leaf sheaths, a greater leaf angle from horizontal, and fewer leaves per shoot.

Stomatal density count data was taken from field grown tissue harvested from the high-maintenance cultivar evaluation. Nitrocellulose was painted on unmowed, randomly selected, recently emerged leaf blades from each cultivar. When dry, the nitrocellulose layer was peeled from the leaf blade surface and stomatal impressions were observed under the microscope. When averaged, the low-maintenance cultivars were found to have fewer stomata on their abaxial leaf blade surface. But, much variability was observed in abaxial stomata number among the high-maintenance cultivars. This variability among the high-maintenance cultivars accounted for much of the variability among all cultivars.

Another set of greenhouse studies was initiated to assess the effect of a low- and a high-N fertility level on the root and shoot growth characteristics of low- and high-maintenance cultivars. The polyethylene tube in PVC pipe system was again utilized, but a fine, washed sand was used as the rooting media and essential plant nutrients were supplied by a low-N and a high-N nutrient solution. As was observed in the previous greenhouse cultivar growth and morphology character- ization study, the low- and high-maintenance cultivars differed in many of the same growth characteristics. Further, these relative differences between the low- and high-maintenance cultivars did not change when grown under the two N levels.

Kentucky bluegrass cultivars are known to differ in many shoot and root growth characteristics. Observations from this investigation have shown that the differences in many of these characteristics separate clearly into low- and high-maintenance groups. These differences between the low- and high- maintenance cultivars appear to be real and measurable, and observations and data from the field and the nutrient solution greenhouse study show these differences appear to be consistent over high- and low-nitrogen fertility levels.

It is probably a combination of many adaptations that allow some Kentucky bluegrass cultivars to out perform others when grown under low fertility, nonirrigated culture. The root production, root distribution, low shoot to root ratio, and low shoot moisture content characteristics were found consistently among the low-maintenance cultivars, and these characteristics are known drought tolerance mechanisms. These adaptations may best explain the reliable performance of these cultivars under low fertility, nonirrigated management. #1

The ultimate goal of cultivar development programs is to select and develop cultivars with desired shoot characteristics that are well adapted to a wide range of management conditions and environmental stresses. Unfortunately, the low-maintenance cultivars possess many undesirable shoot growth and morphological characteristics. The identification of characteristics common to the low-maintenance cultivars that have no effect on aesthetics, such as the rooting characteristics and low shoot to root ratios, may be beneficial for the selection and development of improved Kentucky bluegrass cultivars, and also for the identification of existing improved Kentucky bluegrass cultivars more tolerant to a wide range of management practices and environmental conditions. #2

Regional Perennial Ryegrass Cultivar Evaluation

R.W. Moore and N.E. Christians

#1 This is the sixth year of data from the trial established in the fall of 1982 in conjunction with several identical trials across the country coordinated by the USDA. The purpose of the trial is to identify regional adaptation of the 48 perennial ryegrass cultivars. Cultivars are evaluated each month of the growing season for turf quality and disease.

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

There are no statistical differences among the first 30 cultivars in Table 7. Notice that several of the top performers in 1988 are experimental numbered cultivars. There has been a considerable amount of breeding and selection of perennial ryegrasses conducted in the past decade and a number of new releases of well adapted cultivars can be expected in future years. Note that some of these numbered cultivars have been given names, in parenthesis.

Table 7. Turf quality of perennial ryegrass cultivars in 1988.

	Ratings[a]						
Cultivar	May	June	July	Aug	Sept	Oct	Mean
1. Diplomat	6.0	8.0	7.3	7.3	7.3	8.0	7.3
2. 282 (Citation II)	6.7	7.3	6.0	7.3	8.0	8.3	7.3
3. Cupido	6.0	7.0	7.7	6.7	7.0	8.0	7.1
4. Omega	6.3	7.0	7.0	7.0	7.0	7.7	7.0
5. HE 168	6.0	8.0	6.7	7.0	6.7	7.3	6.9
6. Manhattan	6.3	6.3	7.0	6.7	7.3	7.7	6.9
7. Prelude	7.0	6.0	7.0	7.3	6.7	7.0	6.8
8. Blazer	6.3	7.7	6.3	6.0	7.3	7.3	6.8
9. 2 EE (Cowboy)	5.3	6.3	6.7	7.7	7.0	7.7	6.8
10. IA 78 (Allstar)	5.7	7.3	6.3	6.7	7.0	8.0	6.8
11. GT-II (Repell)	5.7	7.0	7.3	6.3	7.0	7.7	6.8
12. Palmer	6.3	6.7	6.7	6.3	6.3	7.7	6.7
13. LP 210	6.0	7.3	6.3	6.3	6.7	7.7	6.7
14. Ranger	5.7	7.0	7.0	6.3	6.7	7.3	6.7
15. WWE 19	6.0	7.7	6.7	6.3	6.3	7.3	6.7
16. Cockade	5.7	7.7	6.3	6.3	6.7	7.3	6.7
17. SWRC-1	5.7	6.0	8.0	6.3	7.0	7.3	6.7
18. Manhattan II	5.7	7.3	7.0	6.0	6.3	7.3	6.6
19. Pennant	6.7	7.3	6.7	6.0	6.0	7.0	6.6
20. BT-I (Tara) BT-1?	5.3	6.7	6.3	7.0	6.7	7.5	6.6
21. LP 702 (Mondial)	5.3	7.0	6.7	6.0	6.7	7.3	6.5
22. Regal	5.3	6.7	5.7	6.7	7.0	7.7	6.5
23. Birdie	6.3	6.0	6.0	6.3	7.0	7.3	6.5
24. Premier Premiere?	7.0	6.7	6.0	6.3	6.3	6.3	6.4

Table 7. Turf quality of perennial ryegrass cultivars in 1988. (continued).

Cultivar	Ratings[a]						
	May	June	July	Aug	Sept	Oct	Mean
25. Derby	5.3	7.0	6.3	6.0	7.0	6.7	6.4
26 Crown	6.3	6.0	6.7	6.3	6.0	6.7	6.3
27. Fiesta	6.3	7.0	5.7	5.7	6.3	7.0	6.3
28. Gigil	5.0	6.0	7.0	6.3	6.0	7.3	6.3
29. HR-1	7.0	6.0	6.7	6.0	6.0	6.3	6.3
30. Barry	6.0	6.7	6.0	6.3	6.0	6.3	6.2
31. Yorktown II	5.7	6.3	7.0	6.0	5.7	6.7	6.2
32. LP 736 (Ovation)	6.3	6.3	6.0	6.0	6.0	6.7	6.2
33. LP 792	5.7	6.3	6.3	5.3	6.0	7.3	6.2
34. 2ED (Birdie II)	6.3	5.3	6.7	5.7	6.3	6.7	6.2
35. Delray	5.3	6.3	5.7	6.3	6.0	7.3	6.2
36. HE 178	5.7	7.0	5.7	5.7	5.7	6.7	6.1
37. M 382	4.7	5.3	7.3	6.0	6.0	7.3	6.1
38. Dasher	5.3	5.3	6.0	7.0	6.0	6.3	6.0
39. NK 80389	5.0	5.3	6.7	5.7	6.0	7.3	6.0
40. NK 79307	6.0	6.0	5.3	6.3	5.7	6.7	6.0
41. NK 79309	4.7	6.3	6.3	6.3	5.7	6.7	6.0
42. Acclaim	6.0	7.0	6.3	4.7	5.3	6.3	5.9
43. Citation	5.0	6.0	5.7	6.3	5.7	7.0	5.9
44. Pennfine	4.7	6.3	5.7	5.7	6.3	6.7	5.9
45. Gator	5.3	6.0	6.0	5.7	5.7	6.7	5.9
46. Pippin	4.3	6.3	6.3	5.7	5.7	7.0	5.9
47. Elka	5.3	6.3	6.0	5.0	5.3	6.3	5.7
48. Linn	4.7	6.3	5.7	5.3	5.3	6.0	5.6
Experiment Mean	5.8	6.6	6.5	6.2	6.4	7.1	6.4
LSD 0.05	1.2	1.5	1.1	N.S.	1.4	1.2	0.7

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

Fine Fescue Cultivar Trial

R.W. Moore and N.E. Christians

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

#1

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

Banner/Checker, Shadow, Atlanta, Koket, and Scaldis/Atlanta were the best cultivars under these conditions in 1988 ~~(Table 8)~~. Most of the top ten cultivars in 1988 have consistently rated in the top ten over the past six years of this study. Many of the cultivars have allowed the encroachment of Kentucky bluegrass since 1982. Tournament, Pennlawn, NK 79190, NK 79191, NK 80345, NK 80347, NK 80348, and Duar had 20 to 80% Kentucky bluegrass in two or three of their replications. This may be due to a lack of competitiveness with Kentucky bluegrass. There also may have been some contamination of the experimental cultivars with bluegrass seed at the time of establishment.

This trial will be eliminated in 1989. A new shade study that includes many of the fine fescues was established in the fall of 1987.

Table 8. Turf quality ratings of fine fescue cultivars and blends in 1988.

	Ratings[a]						
Cultivar	May	June	July	Aug	Sept	Oct	Mean
1. Banner/Checker	7.0	6.7	7.0	7.0	7.7	8.0	7.2
2. Shadow	6.7	7.0	6.3	6.7	7.3	7.7	6.9
3. Atlanta	6.0	6.7	6.7	7.3	7.0	7.3	6.8
4. Koket	7.0	6.3	6.0	6.3	7.0	7.3	6.7
5. Scaldis/Atlanta	5.3	7.0	6.7	6.7	7.0	7.7	6.7
6. Agram	7.3	7.0	6.0	6.3	6.3	6.7	6.6
7. Banner	7.3	7.0	6.0	6.0	6.3	6.7	6.6
8. FOF-WC	7.0	7.0	6.0	6.0	6.7	6.3	6.5
9. Jamestown	7.0	7.0	5.7	6.0	6.7	6.7	6.5
10. Checker	6.0	6.3	6.3	6.3	6.7	7.3	6.5
11. Ruby	6.0	6.0	6.0	7.0	6.7	6.7	6.4
12. Barfalla	5.3	6.0	6.7	6.3	6.3	7.3	6.3
13. Pennlawn	7.0	6.0	5.7	6.0	6.3	6.7	6.3
14. Aurora	7.0	7.0	6.0	4.7	6.0	6.3	6.2
15. Ensylva	7.3	6.3	5.7	5.3	6.0	6.3	6.2
16. Dawson	6.0	6.3	5.7	6.3	6.0	6.7	6.2
17. Dawson/Pennlawn	6.0	6.3	6.0	6.0	6.0	6.7	6.2
18. Waldina	6.7	6.3	6.3	5.7	5.3	6.0	6.1
19. Highlight	6.7	6.3	5.3	5.3	6.0	6.3	6.0
20. NK 80346	6.0	6.0	6.0	6.0	5.7	6.0	5.9
21. Biljart	6.7	6.7	5.3	4.3	5.0	6.0	5.7
22. Scaldis	6.0	5.7	5.3	4.7	5.3	6.3	5.6
23. NK 79190	7.3	5.7	5.0	4.7	5.0	5.7	5.6
24. NK 79189	5.3	5.7	5.7	5.7	5.3	5.3	5.5
25. Wintergreen	5.3	5.3	5.3	5.3	5.3	6.0	5.4
26. NK 79191	6.7	5.3	4.7	5.0	5.3	5.7	5.4
27. Fortress	7.0	5.3	4.7	4.0	5.0	5.7	5.3
28. NK 80347	6.0	6.0	5.0	4.0	5.0	5.7	5.3
29. Duar 9116.TGIF	6.3	6.0	5.0	4.3	5.0	5.3	5.3
30. NK 80348	6.0	5.7	5.0	5.0	4.7	5.7	5.3
31. Tournament	7.0	5.7	4.7	4.0	4.7	5.0	5.2
32. NK 80345	6.7	5.3	4.7	4.3	4.7	5.0	5.1
LSD = 0.05	1.2	1.1	N.S.	2.1	1.8	1.7	1.2

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

Fine Fescue Management Study

N.E. Christians and R.W. Moore

The fine fescue management study includes the following cultivars:

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

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

The quality ratings in table 9 are the means of monthly ratings taken on replicated plots from May to October. Again this year, Reliant and Scaldis hard fescue and Jamestown chewings fescue had the best overall quality (Table 9).

These same three grasses performed satisfactorily even under the extreme conditions of a 1 in mowing height and 1 lb N/1000 ft^2/year. This is particularly impressive considering this was the tenth season for this study. There has been no overseeding during that 10 year time period. Some of the other lower rated grasses are being overtaken by creeping bentgrass and other species, but these three grasses have resisted any encroachment from weeds.

Table 9. The effects of mowing height and nitrogen fertilizer on the quality of 10 fine fescues in 1988.

	Mowing Height				
	1 inch		2 inch		
	N Rate		N Rate		Overall
	1 lb[a]	3 lb	1 lb	3 lb	Mean
1. Pennlawn Red Fescue	4.9[b,c]	4.9	4.7	4.9	4.9
2. Scaldis Hard Fescue	6.7	7.1	6.7	6.8	6.8
3. Ruby Red Fescue	4.2	4.4	4.8	5.2	4.7
4. Atlanta Chewings Fescue	5.6	5.1	5.6	5.3	5.4
5. K5-29 Red Fescue	4.4	4.1	4.8	4.2	4.3
6. Dawson Red Fescue	4.7	4.8	5.2	5.4	5.0
7. Reliant Hard Fescue	7.3	7.2	7.1	7.0	7.2
8. Ensylva Red Fescue	4.9	4.8	5.1	5.2	5.0
9. Highlight Chewings Fescue	3.1	3.1	3.6	3.2	3.3
10. Jamestown Chewings Fescue	6.2	6.2	6.0	6.2	6.2

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

Tall Fescue Cultivar Trial

M.L. Agnew and N.E. Christians

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

The data presented in table 10 reflects recovery following the drought of 1988. Sixty-three of the 65 cultivars adequately recovered from the drought. Monthly data will be collected in future years.

Table 10. Quality rating of Tall Fescue following drought (October 1, 1988).

	Tall Fescue Cultivar	Visual Quality		Tall Fescue Cultivar	Visual Quality
1.	Mesa	8.0	35.	PST-50L	7.0
2.	Normarc 25	8.0	36.	Apache	7.0
3.	Trailblazer	8.0	37.	Rebel	7.0
4.	Hubbard 87	8.0	38.	JB-2	7.0
5.	Tribute	8.0	39.	Finelawn I	7.0
6.	Williamette	8.0	40.	BAR Fa 7851	7.0
7.	Finelawn 5GL	8.0	41.	Fatima	7.0
8.	KWS-BG-5	7.7	42.	Falcon	7.0
9.	PST-50L	7.7	43.	Olympic	7.0
10.	PE-7	7.7	44.	Pacer	6.7
11.	Syn Ga	7.7	45.	PST-5AG	6.7
12.	Trident	7.7	46.	Pick SLD	6.7
13.	Legend	7.7	47.	Richmond	6.7
14.	Normarc 99	7.7	48.	Pick DM	6.7
15.	Pick GH6	7.7	49.	Aztec	6.7
16.	Wrangler	7.7	50.	Cimmaron	6.7
17.	Carefree	7.7	51.	Titan	6.7
18.	PE-7E	7.7	52.	PST-5BL	6.7
19.	PST-5AP	7.3	53.	PST-5DM	6.3
20.	KWS-DUR	7.3	54.	Chieftan	6.3
21.	Pick 845PN	7.3	55.	PST-5D1	6.3
22.	Jaguar II	7.3	56.	Bel 86-1	6.3
23.	Arid	7.3	57.	Ky-31	6.3
24.	Rebel II	7.3	58.	Pick TF9	6.3
25.	Thoroughbred	7.3	59.	Sundance	6.3
26.	PST-5F2	7.3	60.	Bel 86-2	6.3
27.	Monarch	7.3	61.	Pick 127	6.3
28.	Adventure	7.3	62.	PST-5HF	6.0
29.	PST-DBC	7.0	63.	Bonanza	6.0
30.	PST-5EN	7.0	64.	PST-5D7	5.3
31.	Tip	7.0	65.	Pick DDF	5.0
32.	Taurus	7.0			
33.	Normarc 77	7.0		LSD (0.05)	1.2
34.	Jaguar	7.0			

Tall Fescue Management Study

R.W. Moore and N.E. Christians

#1

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

#2

The 3 in cut resulted in higher quality turf for all cultivars ~~(Table 11)~~. Turf quality increased with each increment of N for all of the cultivars at both mowing heights. Each cultivar performed best at a 2 in mowing height and 4 lb N/1000 ft^2/yr. The 3 in cut appeared to respond better to the drought in 1988 than the 2 in cut.

Mustang was the best cultivar under higher maintenance conditions in 1988. In general, each of the turf-type cultivars performed better than Kentucky 31.

Table 11. Turf quality of tall fescue cultivars at two clipping heights and three fertility levels in 1988.

Cultivar	Clip Hgt inch	lb N/ 1000 ft^2	Ratings[a] May	June	July	Aug	Sept	Mean
Mustang	2	0	5.0	6.3	5.0	5.0	0.0	5.3
	2	2	6.7	6.3	5.7	6.0	0.0	6.2
	2	4	8.3	8.0	6.7	7.0	0.0	7.5
	3	0	4.3	6.7	5.0	5.0	0.0	5.3
	3	2	6.7	6.3	6.0	6.0	0.0	6.3
	3	4	8.7	8.0	7.0	7.0	0.0	7.7
Houndog	2	0	4.7	6.0	5.3	5.0	4.7	5.1
	2	2	7.0	7.0	5.3	5.7	5.7	6.1
	2	4	8.0	8.0	7.0	6.7	6.0	7.1
	3	0	4.3	6.0	5.3	5.0	4.3	5.0
	3	2	7.0	7.0	5.0	6.0	5.3	6.1
	3	4	8.3	8.0	7.0	7.0	6.0	7.3
Rebel	2	0	5.0	6.0	5.3	5.0	4.3	5.1
	2	2	6.7	7.0	5.7	6.0	5.7	6.2
	2	4	7.7	8.0	6.7	7.0	5.7	7.0
	3	0	4.0	6.0	5.0	5.0	4.7	4.9
	3	2	6.7	7.0	5.7	6.0	5.3	6.2
	3	4	8.3	8.0	6.7	7.0	6.0	7.2
Falcon	2	0	4.7	6.0	5.3	5.3	4.7	5.2
	2	2	6.7	6.7	5.7	6.0	5.3	6.1
	2	4	8.3	7.7	7.0	7.0	6.0	7.2
	3	0	4.3	6.0	5.3	5.3	5.0	5.2
	3	2	6.3	7.0	6.0	6.0	5.3	6.1
	3	4	8.0	8.0	7.0	7.0	6.0	7.2
Kentucky 31	2	0	4.7	6.0	5.0	5.0	4.3	5.0
	2	2	6.0	6.7	5.7	6.0	5.3	5.9
	2	4	8.7	7.7	6.7	7.0	5.7	7.1
	3	0	4.7	6.0	5.0	5.0	4.3	5.0
	3	2	7.0	7.0	5.7	6.0	5.0	6.1
	3	4	8.3	7.7	6.7	7.0	5.7	7.1
LSD cultivar averages			0.3	0.2	0.5	0.2	0.6	0.2
LSD managements			0.8	0.3	0.1	0.6	0.5	0.8

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

Shade Adaptation Study

N.E. Christians

The shade adaptation study was established in the fall of 1989 to evaluate the performance of 35 species and varieties of grasses. The species include creeping red fescue (C.R.F.), hard fescue (H.F.), tall fescue (T.F.), Kentucky bluegrass (K.B.), and rough bluegrass (Poa trivialis).

#1 The area is located under the canopies of a mature stand of Siberian elm trees ~~at the Horticulture Research Station~~. The grasses are mowed at a 2 in height and receive 2 lb nitrogen (N)/1000 ft^2/year. No weed control has been required on the area. Irrigation was used during the fall of 1987 and through the summer of 1988. No irrigation is planned for the area in future years.

#2 Data collection did not begin until full establishment of the plots in June. Monthly quality data were taken through October. Of the first 20 cultivars, 16 were fine fescues (either C.R.F., C.F., or H.F.), three were tall fescues, and one was a rough bluegrass (Poa trivialis) ~~(Table 12)~~. Estica C.R.F. was the highest rated cultivar in 1988. Ram-I was the only Kentucky bluegrass that maintained season long acceptable quality. The five most poorly adapted species were all Kentucky bluegrasses. Reliant hard fescue was sodded in May 1988 and deteriorated in quality during the season due to the drought.

This was the first year of the study. It is anticipated that the ranking order of grasses will change in future years as further maturity occurs.

Table 12. Turf quality ratings of shade trial in 1988. (Seeded in Fall 1987)

Cultivar		June	July	Aug	Sept	Oct	Mean
1. Estica	(C.R.F.)	8.0	7.0	7.7	7.7	8.0	7.7
2. Spartan	(H.F.)	7.7	7.3	7.3	7.7	8.0	7.6
3. Victor	(C.F.)	7.7	7.3	6.3	7.0	8.0	7.3
4. St-2 (SR 3000)	(H.F.)	8.0	7.3	7.0	6.3	7.7	7.3
5. Ensylva	(C.R.F.)	7.0	6.3	7.0	7.3	8.0	7.1
6. Waldina	(C.F.)	6.7	6.7	7.0	7.0	8.0	7.1
7. Banner	(C.F.)	7.0	6.7	6.3	6.3	8.0	6.9
8. Shadow	(C.F.)	7.7	7.0	6.3	6.3	7.3	6.9
9. Jamestown	(C.F.)	7.0	5.7	6.3	6.7	7.7	6.7
10. Biljart	(H.F.)	6.7	5.7	6.7	6.3	8.0	6.7
11. Pennlawn	(C.R.F.)	7.3	6.7	5.7	6.3	7.3	6.7
12. Agram	(C.F.)	7.3	6.0	6.3	6.0	7.7	6.7
13. Rebel	(T.F.)	6.7	5.0	7.3	7.3	7.3	6.7
14. Apache	(T.F.)	6.0	5.0	7.3	7.7	7.3	6.7
15. Atlanta	(C.F.)	7.0	6.3	6.0	6.7	7.0	6.6
16. Falcon	(T.F.)	6.0	4.7	7.7	8.0	6.7	6.6
17. Scaldis	(H.F.)	7.3	6.0	6.0	6.0	7.0	6.5
18. Sabre (<u>Poa trivialis</u>)		6.7	5.7	6.0	7.0	6.7	6.4
19. Koket	(C.F.)	7.3	6.7	5.7	5.3	6.7	6.3
20. Mary	(C.F.)	6.7	5.3	5.7	6.3	7.7	6.3
21. Ram I	(K.B.)	5.7	5.3	6.7	6.7	6.7	6.2
22. Wintergreen	(C.F.)	6.3	5.7	5.7	6.0	6.7	6.1
23. Waldorf	(C.F.)	6.3	5.3	5.7	6.0	7.3	6.1
24. Rebel II	(T.F.)	5.0	4.3	6.7	7.3	6.7	6.0
25. Arid	(T.F.)	4.3	4.3	6.7	6.7	7.0	5.8
26. Bonanza	(T.F.)	5.0	4.3	6.3	6.7	6.7	5.8
27. BAR Fo 81-225	(H.F.)	4.7	5.3	5.7	6.3	6.7	5.7
28. Chateau	(K.B.)	4.7	3.7	6.0	6.3	6.3	5.4
29. Reliant	(H.F.)	8.0	6.0	3.3	4.3	5.0	5.3
30. Highlight	(C.F.)	5.0	4.0	5.0	5.3	6.0	5.1
31. Glade	(K.B.)	4.0	3.3	6.0	6.7	5.7	5.1
32. Coventry	(K.B.)	4.3	3.3	5.0	5.3	6.3	4.9
33. Bristol	(K.B.)	4.3	3.0	5.3	5.3	6.0	4.8
34. Nassau	(K.B.)	4.3	3.0	4.3	5.0	4.7	4.3
35. Midnight	(K.B.)	2.3	2.0	2.0	2.7	3.0	2.4
LSD 0.05		1.3	1.6	2.0	1.8	1.4	1.2

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

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

Evaluation of Fungicides for Control

of Dollar Spot on Penneagle Bentgrass - 1988

M.L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to Penneagle bentgrass maintained at a 5/32 in cutting height with a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized complete block plan with four replications. Treated plots were alternated with untreated plots, so that treated plots did not adjoin each other.

All plots measured 4 ft by 5 ft. Fungicides were applied on a 14-, 21-, or 28-day schedule (~~Table 13~~). Applications began on June 7 and continued through August 15. Plots were evaluated for severity of leaf spot symptoms on July 20 and August 19. Disease ratings for dollar spot were made by counting the number of dollar spot infection centers per plot. No disease developed until August 19, when one dollar spot appeared in two of four check plots. Disease pressure was thus insufficient to make meaningful comparisons among treatments for control of dollar spot.

#1 On July 20, a slightly enhanced green color of turf was noted for SAN 619F at 0.2 g and 0.3 g treatment levels and 21-day spray interval. All three treatments of Spotless 25W showed more pronounced browning of turf than SAN 619F on August 19; however, the degree of browning was still slight to moderate.

Table 13. Evaluation of fungicides for control of dollar spot in Penneagle bentgrass, 1988 .

Company	Treatment	Rate/1000 ft^2	Timing (days)	Disease Rating[a] July 20	Disease Rating[a] Aug. 19
	Check	--	--	0.00 a	0.50 a
NOR-AM	Prochloraz 40 EC	4.5 oz	21	0.00 a	0.00 ab
NOR-AM	Prochloraz 40 EC/X-77	4.5 oz/0.25%	21	0.00 a	0.00 ab
NOR-AM	Prochloraz-MN 40 EC/X-77	3.75 oz/o.25%	21	0.00 a	0.00 ab
NOR-AM	SN-539865 25 WP	0.5 oz	21	0.00 a	0.00 ab
NOR-AM	SN-539865 25 WP	1.0 oz	21	0.00 a	0.00 ab
Sandoz	SAN 619F 40 WG	1.0 g a.i.	21	0.00 a	0.00 ab
Sandoz	SAN 619F 40 WG	1.5 g a.i.	28	0.00 a	0.00 ab
Sandoz	SAN 619F 40 WG	1.5 g a.i.	21	0.00 a	0.00 ab
Sandoz	SAN 619F 40 WG	2.0 g a.i.	28	0.00 a	0.00 ab
Sandoz	SAN 832F 50 WP	31.0 g a.i.	21	0.00 a	0.00 ab
Sandoz	SAN 832F 50 WP	46.5 g a.i.	28	0.00 a	0.00 ab
Sierra	Vorlan 50 WP	1.0 oz	14	0.00 a	0.00 ab
Sierra	Vorlan 50 WP	2.0 oz	14	0.00 a	0.00 ab
Cleary	Spectro 1244	2.0 oz	14	0.00 a	0.00 ab
Cleary	Spectro 1244	4.0 oz	14	0.00 a	0.00 ab
Mobay	Bayleton 25% T & O	0.5 oz a.i.	28	0.00 a	0.00 ab
Mobay	Bayleton 25% T & O/ Daconil 2787	0.5 oz a.i./ 4.0 lb/gal	28	0.00 a	0.00 ab
Mobay	HWG 1608	0.75 oz a.i.	28	0.00 a	0.00 ab
Rhone-Poulenc	Chipco 26019 FLO	3.0 oz	21	0.00 a	0.00 ab
Phone-Poulenc	Chipco 26019 FLO	4.0 oz	21	0.00 a	0.00 ab
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	14	0.00 a	0.00 ab
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	21	0.00 a	0.00 ab
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	28	0.00 a	0.00 ab

[a] Average of ratings from replicated plots. Based on number of dollar spot infection centers per plot.

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

Evaluation of Fungicides for Control

of Brown Patch on Bentgrass - 1988

M.L. Gleason

Trials were conducted on two adjoining bentgrass greens at Veenker Golf Course at Iowa State University, Ames, Iowa. Fungicides were applied to bentgrass maintained at 5/32 in cutting height, using a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized, complete-block plan with four replications. Treated plots were alternated with untreated plots, so that no treated plots were adjacent to each other. All plots measured 4 ft by 5 ft. Fungicides were applied on a 14-, 21-, or 28-day schedule ~~(Table 14)~~. Applications began on June 7 and continued through August 15. Brown patch symptoms appeared on about July 16. Plots were evaluated for percent of diseased turf on July 19 and August 19.

#1

Brown patch development on July 19 was severe on check plots. By August 19, disease development on check plots was light to moderate. Several treatments had brown patch development that was not significantly less than the check plots. Of these, the most consistently ineffective product was Terraneb SP at the rates tested. Most treatments reduced brown patch symptoms significantly below levels in check plots, and nine of these treatments gave 100% suppression of brown patch on both rating dates.

#2

Several treatments produced a slightly enhanced green color in the turf on both rating dates. These included: SAN 619F, SAN 832F at both rates, and ICIA 0523 at both rates. Spotless 25W, at the 0.25 a.i. rate and both 14- and 21-day treatment intervals, caused a slight browning of the turf in July and August.

Table 14. Evaluation of fungicides for control of brown patch in bentgrass, 1988.

Company	Treatment	Rate/1000 ft^2	Timing (days)	Disease Ratings[b] July 19	Disease Ratings[b] August 19
--	Check	--	--	3.50 a	1.50 a
NOR-AM	Flutolanil 50WP/SN 596	2.0 oz/1.0 oz	21	0.25 f	0.00 b
NOR-AM	Flutolanil 50WP/SN 99731	2.0 oz/1.0 oz	21	0.00 f	0.00 b
NOR-AM	Flutolanil 20SC	10.0 oz	21	1.25 cdef	0.00 b
NOR-AM	SN539865 25WP	2.0 oz	21	2.50 abc	0.00 b
NOR-AM	Flutolanil 50WP	4.0 oz	21	0.25 f	0.25 b
Sandoz	SAN 619F 40WG	2.0 g a.i.	14	0.00 f	0.00 b
Sandoz	SAN 832F 50WP	48.0 g a.i.	14	0.00 f	0.00 b
Sandoz	SAN 832F 50WP	62.0 g a.i.	14	0.00 f	0.00 b
Sierra	Vorlan 50WP/Fungo 50 WP	1.0 oz/1.0 oz	14	1.75 cde	1.50 a
Sierra	Vorlan 50WP/Fungo 50WP	2.0 oz/2.0 oz	14	0.50 ef	0.50 ab
Cleary	Spectro 1244	2.0 oz	14	0.75 def	0.00 b
Cleary	Spectro 1244	4.0 oz	14	0.25 f	0.00 b
ICI Americas	ICIA 0523 10% WG/X-77	6.0 g a.i./0.5%	14	0.00 f	0.00 b
ICI Americas	ICIA 0523 10% WG/X-77	8.0 g a.i./0.5%	14	0.00 f	0.00 b
Rhone-Poulenc	Chipco 26019 FLO	3.0 oz	21	2.00 bcd	0.00 b
Rhone-Poulenc	Chipco 26019 FLO	4.0 oz	21	1.50 cdef	0.50 ab
Valent	Spotless 25 W/ X-77	0.05 oz a.i./ 8.0 oz/100 gal	14	0.00 f	0.00 b
Valent	Spotless 25 W/ X-77	0.05 oz a.i./ 8.0 oz/100 gal	28	2.00 bcd	0.25 b
Valent	Spotless 25 W/ X-77	0.25 oz a.i./ 8.0 oz/100 gal	14	0.00 f	0.00 b
Valent	Spotless 25 W/ X-77	0.25 oz a.i./ 8.0 oz/100 gal	28	0.00 f	0.00 b
Kincaid	Terraneb SP	2.0 oz	14	1.50 cdef	0.75 ab
Kincaid	Terraneb SP	3.5 oz	14	3.25 ab	0.75 ab
Kincaid	Terraneb SP	5.0 oz	14	3.25 ab	0.75 ab

[a] Rating represents mean of disease severity ratings. N = 4. Rating scale is as follows: 0 = no disease; 1 = 0 to 10% of plot area covered by brown patch; 2 = 11 to 20% of plot area covered by brown patch; 3 = 21 to 30% of plot area covered by brown patch; 4 = over 40% of plot area covered by brown patch.
Means adjacent to the same letter do not differ significantly (DMRT, P = 0.05).

Evaluation of Fungicides for Control

of Leaf Spot on Park Bluegrass - 1988

M.L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to Park bluegrass, maintained at a 2 in cutting height, with a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized, complete-block plan with four replications. Treated plots were alternated with untreated plots, so that treated plots did not adjoin each other. All plots measured 4 ft by 5 ft. Fungicides were applied on a 7-, 14-, 21-, or 28-day schedule ~~(Table 15)~~. Applications began on June 7 and continued through August 15. Plots were evaluated for severity of leaf spot symptoms on July 20 and August 19.

Leaf spot was present at very low (trace) levels on both rating dates. Although two treatments had leaf spot levels significantly below the check on July 19, disease pressure was insufficient to make meaningful comparisons among treatments for leaf spot control on either rating date. No

#1 phytotoxicity symptoms were noted on either rating date.

Table 15. Evaluation of fungicides for control of leaf spot in Park bluegrass, 1988.

Company	Treatment	Rate/1000 ft^2	Timing (days)	Disease Rating[a] July 20	Disease Rating[a] Aug. 19
--	Check	--	--	1.00 a	0.25 a
NOR-AM	Prochloraz 40 EC	4.5 oz	14	0.50 ab	0.00 a
NOR-AM	Prochloraz 40 EC/X-77	4.5 oz/0.25%	14	0.00 b	0.00 a
NOR-AM	Prochloraz-MN 50WP/X-77	3.75 oz/0.25%	14	0.75 ab	0.00 a
NOR-AM	SN-539865 25 WP	1.0 oz	14	0.50 ab	0.25 a
NOR-AM	SN-539865 25 WP	2.0 oz	14	0.50 ab	0.25 a
Cleary	3336 F	4.0 oz	14	1.00 a	0.25 a
Cleary	3336 F	8.0 oz	14	0.50 ab	0.00 a
Cleary	Bromosan	5.0 oz	14	0.50 ab	0.50 a
Cleary	Bromosan	8.0 oz	14	0.25 ab	0.00 a
Mobay	Dyrene 4F	4.0 oz	14	0.50 ab	0.25 a
Rhone-Poulenc	Chipco 26019 FLO	3.0 oz	21	0.25 ab	0.00 a
Phone-Poulenc	Chipco 26019 FLO	4.0 oz	21	0.00 b	0.00 a
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	14	0.25 ab	0.25 a
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	21	0.75 ab	0.25 a
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	28	0.75 ab	0.25 a

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

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

Evaluation of Fungicides for Control of Dollar Spot on Park Bluegrass - 1988

M.L. Gleason

Trials were conducted on the Turfgrass Research Plots at the Horticulture Research Station of Iowa State University near Ames, Iowa. Fungicides were applied to Park bluegrass maintained at a 2 in cutting height with a modified bicycle sprayer at 30 psi and a dilution rate of 5 gal/1000 ft^2. The experimental design was a randomized block plan with four replications. Treated plots were alternated with untreated plots, so that treated plots did not adjoin each other. All plots measured 4 ft by 5 ft. Fungicides were applied on a 7-, 14-, 21-, or 28-day schedule ~~(Table 16)~~. Applications began on June 7 and continued through August 15. Plots were evaluated for severity of disease symptoms on July 20 and August 19.

#1

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

Dollar spot appeared in early July. Disease pressure was very low on the first rating date, and low to moderate when the second rating was made. Symptoms took the form of generalized browning and yellowing within plots, rather than the infection centers that often typify dollar spot outbreaks. Two treatments, Dyrene 4F at the 4 oz rate and Chipco 26019 FLO at the 4 oz rate, did not suppress disease development significantly better than the check treatment. All other treatments gave control that was significantly better than the check during at least one of the rating periods. The best disease suppression over both rating times was obtained with: Spotless 25W at 0.4 oz a.i., 14-day interval; 3336 F, 8 oz rate, 14-day interval; and Prochloraz 40 EC, 4.5 oz rate, 14-day interval. No phytotoxicity symptoms were observed during either rating time.

#2

Table 16. Evaluation of fungicides for control of dollar spot in Park bluegrass, 1988[a].

Company	Treatment	Rate/1000 ft^2	Timing (days)	Disease Rating[b] July 20	Aug. 19
--	Check	--	--	1.25 a	2.25 a
NOR-AM	Prochloraz 40 EC	4.5 oz	14	0.00 d	0.50 de
NOR-AM	Prochloraz 40 EC/X-77	4.5 oz/0.25%	14	0.50 bcd	0.75 cde
NOR-AM	Prochloraz-MN 50WP/X-77	3.75 oz/0.25%	14	0.50 bcd	1.50 abc
NOR-AM	SN-539865 25WP	1.0 oz	14	0.25 cd	0.50 de
NOR-AM	SN-539865 25WP	2.0 oz	14	0.00 d	0.50 de
Cleary	3336 F	4.0 oz	14	0.25 cd	0.50 de
Cleary	3336 F	8.0 oz	14	0.25 cd	0.00 e
Cleary	Bromosan	5.0 oz	7	0.75 abc	0.75 cde
Cleary	Bromosan	8.0 oz	7	0.75 abc	0.50 de
Mobay	Dyrene 4F	4.0 oz	14	0.75 abc	1.75 ab
Rhone-Poulenc	Chipco 26019 FLO	3.0 oz	21	1.00 ab	1.00 bcd
Phone-Poulenc	Chipco 26019 FLO	4.0 oz	21	1.00 ab	1.50 abc
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	14	0.00 d	0.00 e
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	21	0.00 d	1.00 bcd
Valent	Spotless 25 W/ X-77	0.4 oz a.i./ 8.0 oz/100 gal	28	0.75 abc	0.50 de

a Fungicides were selected to test efficacy against another disease, leaf spot. However, dollar spot also appeared, and dollar spot development is rated in this table.

b Average of ratings from four replicated plots. Ratings were based on the following scale: 0 = no disease; 1 = trace; 2 = low disease; 3 = moderate disease; 4 = severe disease.

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

Reactions of Creeping Bentgrass Cultivars

to Dollar Spot - 1987-88

M.L. Gleason and N.E. Christians

Three creeping bentgrass cultivars were sown June 4, 1985, in a study originally designed to evaluate effects of Pythium root dysfunction. The experimental design was a split plot, randomized, complete-block design, in which main plots (20 ft by 60 ft) were Pythium treatments and subplots (6.7 ft by 20 ft) were cultivars. Prior to seeding, the entire plot was rototilled; materials incorporated
#1 into main plots were Pythium arrhenomanes growing on 50 kg cornmeal, 50 kg cornmeal alone, or no added material. The substrate consisted of 80% mason sand, 10% soil (Nicollet, fine-loamy, mixed mesic), and 10% hypnum peat. The turfgrass was maintained at 5/32 in cutting height and fertilized with 3 lb nitrogen (N)/1000 ft^2/yr. The plots were irrigated, and a single application of a fungicide (Chipco 26019, 2 oz/1000 ft^2) was made immediately after the 1987 rating date. Dollar spot evaluations were made using a visual rating system where 0 = no disease, 1 = 0 to 2% coverage by dollar spots, 2 = 2 to 5% coverage, 3 = 5 to 10%, 4 = 10 to 20%, 5 = 20 to 30%, 6 = 30 to 40%, 7 = 40 to 50%, 8 = 50 to 70%, and 9 = 70 to 100%. Weather preceding the
#2 evaluations was warm and moist in 1987 and hot and dry in 1988.

#3 Development of dollar spot was moderate to severe in 1987 and light in 1988. Significant differences between cultivars were observed in both years. No symptoms of P. arrhenomanes infection appeared at any time, and there was no significant effect of Pythium treatment on
#4 development of dollar spot and no significant treatment x cultivar interaction (ANOVA, P = 0.05).

Table 17. Disease rating of dollar spot on three creeping bentgrass cultivars.

Cultivar	Disease Rating (Dollar Spot)* Jul 24, 1987	Aug 26, 1988
Penncross	5.1 a	1.1 b
Penneagle	3.7 b	1.1 b
Emerald	5.7 a	2.7 a
LSD (P = 0.05)	0.9	1.1

* Means followed by the same letter are not significantly different according to the LSD test (N = 9).

Preemergence Annual Grass Control Study - 1988

M.G. Burt and N.E. Christians

#1 The 1988 preemergence annual grass control study was located at the Horticulture Research Station on a Park Kentucky bluegrass turf that had been established on a Nicollet (fine-loamy, mixed mesic, Aquic Hapludall) soil with a pH of 7.2, 15 lb/A phosphorus, 120 lb/A potassium, and 2.3% organic matter.

The area had a natural stand of crabgrass in the 1987 growing season. However, to assure sufficient weed pressure, the turfgrass on the plot area was mowed at 1 in, the area was vertical mowed, and seeded with crabgrass at a rate of 0.5 lb/1000 ft^2 on April 14, 1988.

#2 The treatments included Balan, Team, and Gallery from Elanco, Dacthal from Fermenta; Bensulide from Stauffer; Prodiamine from Sandoz Chemical; Pendimethalin from Lesco; Weedgrass Control, Turf Weedgrass Control, and Turf Fertilizer (34-4-4) + Pre-E from O. M. Scott; DFF and Ronstar from Rhone-Poulenc; Mon 15151 from Monsanto; and Crab-Spray with Team from Spring Valley. ~~(Table 18)~~.

Treatments were applied to 25 ft^2 plots in three replications on April 15~~, 1988~~ in the equivalent of 3 gal water/1000 ft^2. The repeat application of Ronstar ~~(Treatment 19)~~ was made on May 24. The repeat applications of Team, Pre-M, and Balan ~~(Treatments 4, 5, 6)~~ were made on June 16, 1988.

The 1988 growing season was unusually dry and hot. The area was irrigated to keep the bluegrass from going dormant, but the dry conditions resulted in very little late summer crabgrass germination. The crabgrass and Oxalis counts were made only on August 1, 1988. No change in weed infestation was observed by September, and no additional ratings were required at that time.

Many treatments provided very effective season long crabgrass control. These included Gallery at both rates, and Gallery in combination with Team and Pre-M, Balan, Team, Prodiamine at both rates, Bensulide, Turf Fertilizer (34-4-4) + Pre-E, Turf Weedgrass Control, Ronstar in both formulations, and Mon 15151 at the four highest rates.

#3

Several treatments in the study provided unacceptable crabgrass control. These included Dacthal, Pendimethalin, Weedgrass Control, DFF, Mon 15151 at the three lowest rates, and the Spring Valley 'Team' products.

No significant treatment differences were found in control of Oxalis. No phytotoxicity was observed on any of the treated plots at any time during the season.

Table 18. Preemergence annual grass control study - 1988.

Treatment	Rate (lb ai/A)	Crabgrass plants/plot	August 1 Percent crabgrass control	Oxalis plants/plot
1. Control	----	89	0	4
2. Gallery 75 DF	0.75	6	93	4
3. Gallery 75 DF	1.0	2	97	1
4. Gallery 75 DF + Team 2G + [Team 2G]*	0.75 + 1.5 + [1.5]	0	100	1
5. Gallery 75 DF + Pre-M 60 DG + [Pre-M 60 DG]*	0.75 + 1.5 + [1.5]	0	100	0
6. Balan 2G + [Balan 2G]*	2.0 + [2.0]	3	97	2
7. Team 2G	3.0	2	98	1
8. Dacthal 75 WP	10.5	41	54	0
9. Bensulide 4E	7.5	2	98	3
10. Prodiamine 65 WDG	0.5	6	93	2
11. Prodiamine 65 WDG	0.75	5	94	2
12. Pendimethalin 60 WP	1.5	31	65	0
13. Turf Fertilizer (34-4-4) + Pre-E 1.3%	1.5	3	97	0
14. Turf Weedgrass Control 1.71%	1.5	4	96	0
15. Weedgrass Control 60 WDG	1.5	21	76	0
16. DFF 4.17 F	0.4	71	20	0
17. Ronstar 50 ME	3.0	10	89	0
18. Ronstar 50 WP	1.5	5	94	1
19. Ronstar 50 WP + [Ronstar 50 WP]**	0.75 + [0.75]	1	99	1
20. Mon 15151 1 EL	0.125	39	56	1
21. Mon 15151 1 EL	0.188	23	74	1
22. Mon 15151 1 EL	0.25	18	80	2
23. Mon 15151 1 EL	0.38	4	96	3
24. Mon 15151 1 EL	0.5	1	99	0
25. Mon 15151 1 EL	0.75	1	99	0
26. Mon 15151 1 EL	1.0	0	99	0
27. Spring Valley 'Team' 10%	2.0	65	27	1
28. Spring Valley 'Team' 10%	3.0	63	30	0
LSD 0.05		24	27	NS

* [second application] -- applied June 16.

** [second application] -- applied May 24.

Original treatments were applied on April 15, 1988. All plots measure 5 ft by 5 ft = 25 ft^2

The study is located on the SE side of the Turfgrass Research area, ISU Hort Research Station, on a stand of Park Kentucky bluegrass.

The area was seeded with crabgrass on April 14, 1987, at a rate of 0.5 lb/1000 ft^2.

Postemergence Annual Grass Control Study - 1988

M.G. Burt and N.E. Christians

#1) The 1988 postemergence annual grass control study was located at the Horticulture Research Station on a stand of Park Kentucky bluegrass. The soil on the site is a Nicollet (fine-loamy, mixed mesic, Aquic Hapludall) with a pH of 7.2, 15 lb/A phosphorus, 120 lb/A potassium, and 2.3 percent organic matter.

The turfgrass on the plot area was mowed down to 1 in, and the area was overseeded with crabgrass at a rate of 0.5 lb/1000 ft^2 on April 28. At time of treatment application, the area had a uniform stand of crabgrass at the 3-leaf to 1-tiller stage.

Treatments included American Hoechst's Acclaim in the EC and EW formulations, and an experimental - HOE 360. Acclaim 1EC also was used in combination with Turflon amine, Breakthru, and dicamba. Other treatments included a Monsanto experimental Mon 15151 alone and in combination with Acclaim 1EC, and the BASF experimental BAS 51400H alone and in combination with Acclaim 1EC ~~(Table 19)~~.

#2 The herbicides were applied on June 16, 1988. All treatments were applied in the equivalent of 3 gal water/1000 ft^2 with the exception of the Acclaim EC, Acclaim EW, HOE 360, and Acclaim in combination with Breakthru, Turflon amine, and dicamba, which were applied in the equivalent of 130 gal water/A.

No phytotoxicity was observed on any of the plots during the trial.

The crabgrass count was taken on August 1, 1988. A second crabgrass count was planned in September, but due to the extreme summer drought there was very little late summer crabgrass germination so a second count was not necessary.

The only treatments providing adequate or near adequate crabgrass control were the experimental from BASF at the high rate alone and in combination with Acclaim, and the Mon-15151 at both rates and in combination with Acclaim.

#3 The less than favorable summer moisture levels resulted in poor postemergence crabgrass control by many of the products in this study. Acclaim in both formulations, at all rates, and in combination with the broadleaf herbicides provided little crabgrass control. The experimental HOE 360 at each rate, and the BAS 51400H at the lowest rate also provided little crabgrass control. The crabgrass control for the MON 15151 improved as the chemical rate increased, but inadequate crabgrass control was obtained at all rates up to 0.75 lb. a.i./A.

Table 19. Postemergence annual grass control study - 1988.

Treatment	Rate (lb ai/A)	August 1 Percent crabgrass control
1. Control	----	0
2. Acclaim 1EC	0.18	30
3. Acclaim 0.5 EW	0.18	35
4. Hoe 360 0.5 EW	0.09	23
5. Hoe 360 0.5 EW	0.12	30
6. Acclaim 1EC (1986)	0.18	32
7. Acclaim 1EC	0.25	27
8. Acclaim 1 EC + Breakthru + Turflon Amine + Dicamba	0.25 + 0.125 + 2.5 pts/A + 0.1	18
9. Acclaim 1EC + Breakthru + Turflon Amine	0.25 + 0.125 + 2.5 pts/A	28
10. Acclaim 1EC + Turflon Amine	0.18 + 2.5 pts/A	25
11. Acclaim 1EC + Turflon Amine	0.25 + 2.5 pts/A	25
12. Mon - 15151 1EC	0.25	12
13. Mon - 15151 1EC	0.38	43
14. Mon - 15151 1EC	0.50	57
15. Mon - 15151 1EC	0.75	63
16. Mon - 15151 1EC + Acclaim 1EC	1.25 + 0.09	98
17. Mon - 15151 1EC + Acclaim	0.25 + 0.09	77
18. BAS 51400H 50 WP	0.5	17
19. BAS 51400H 50 WP	1.0	93
20. BAS 51400H WP + Acclaim 1EC	1.0 + 0.18	85
LSD 0.05		33

Plots measure 5 ft x 5 ft.

All treatments were applied on June 16, 1988.

The study is located on a stand of Park Kentucky bluegrass.

This area was seeded with crabgrass on April 28. At time of spraying, this area had a uniform stand of crabgrass at the 3-leaf, 1-tiller stage.

1987 - 1988 Poa annua Control Study

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

The objectives of the 1987 - 1988 Poa annua control study were to observe the effects of Prograss (Ethofumesate) on the population of Poa annua in a Penncross creeping bentgrass green.

The location of the study was the practice green at Veenker Memorial Golf Course in Ames, Iowa. #4 The soil on the site is a Coland clay loam (fine-loamy, mixed, mesic Cumulic Haploquoll) with a pH of 7.7, 19 ppm phosphorus (P), 116 ppm potassium (K), and 5.3% organic matter. The area receives approximately 4 lb nitrogen (N)/1000 ft^2/yr. The Poa annua population ranged from 30 to 60% of the green's surface in the fall of 1987.

The treatments were applied at rates and on dates specified in table 20 in the equivalent of 3 gal water/1000 ft^2. All plots were 5 ft by 5 ft and the study was replicated three times.

Soil temperatures were monitored at the 2 in depth and were recorded as follows:

Date	Soil temp	Air temp
	F	
9/19	59	60
10/12	53	75
11/5	45	74
4/6	52	75
5/10	68	72
6/3	73	76

There was severe winter kill of Poa annua on the entire green during the winter of 1987-88. By June 1988, much of the Poa annua had germinated and populations on much of the green ranged from 15 to 30% of the greens' surface. Counts were taken on 6 in by 6 in grids divided into 2 in by 2 in squares that were randomly tossed on three areas of each plot in June and September of 1988 (~~Table 20~~). The control plots contained an average of 25 P. annua plants/sq ft in June. No P. annua plants were found in any of the other plots. By September, the population in the control plots had increased to 86 plants/sq ft ~~in the control plots~~ and some increase in P. annua population was observed in treatments 2, 3, and 4. No P. annua was found in plots treated with a follow-up application of Prograss in June ~~(treatment 5)~~ or in plots treated in the spring with Bensulide ~~(treatment 6)~~.

#1 #2 #2

Observation of P. annua recovery in the spring of 1988 indicated that much of the spring germination took place after the May Prograss treatment ~~(No. 4)~~ and before the June treatment ~~(No. 5)~~. Complete control with Prograss was established on plots treated after all P. annua had germinated, or on plots treated with the preemergence herbicide Bensulide. #3 #3

No phytotoxicity was observed on any of the plots at any time during the study.

Table 20. Poa annua counts in June and September of 1988 on Penncross creeping bentgrass greens treated with Prograss.

								Poa annua plant counts	
	Rate	Date of application						June	Sept
Material	lb ai/A	Sept*	Oct	Nov	Apr	May	June	1988	1988
								-plants/sq ft-	
1. Control	---							25	86
2. Prograss	.75	X	X	X				0	9
3. Prograss	.75	X	X	X	X			0	3
4. Prograss	.75	X	X	X		X		0	12
5. Prograss	.75	X	X	X			X	0	0
6. Prograss +	.75	X	X	X				0	4
Bensulide	8.00				X			0	0
LSD 0.05								5	37

* September 1987 to June 1988.

Fertilizer and Herbicide Applications on

Dormant Kentucky Bluegrass Lawns

M.G. Burt and N.E. Christians

The severe, prolonged drought of 1988 presented some unique situations to lawn care specialists and turfgrass managers. In much of Iowa, nonirrigated turfgrass was completely dormant for much of the summer. Most lawn care companies were faced with making at least one program application over completely dormant turfgrass. Homeowners and lawn care companies questioned the benefits, and many feared a possible detrimental effect of this practice. A study was conducted at Iowa State University to determine the effect of the application of fertilizer and fertilizer plus various herbicides on the recovery of dormant Kentucky bluegrass turf.

This study was located ~~at the Horticulture Research Station~~ on a stand of nonirrigated Ram-I Kentucky bluegrass. The soil on the site is a Nicollet (fine-loamy, mixed mesic, Aquic Hapludoll) with a pH of 7.2, 15 lb/A phosphorus, 120 lb/A potassium, and 2.3 percent organic matter.

#1

Treatments were set up to represent several potential lawn care summer programs. These treatments included a control, urea at two rates, sulfur-coated urea, and urea in combination with Pendimethalin, Dacthal, Trimec, and Pendimethalin + Trimec ~~(Table 21)~~.

Treatments were applied on July 8, 1988, over the turf plot area which had been completely dormant for seven weeks. It was 95°F and sunny on the day of application and the treatments were not watered in. Daytime temperatures remained in the mid 90s for one week following treatment. Treatments were applied in the equivalent of 3 gal $H_2O/1000\ ft^2$. One week after treatment the plot area was irrigated to bring the Kentucky bluegrass out of dormancy and to determine treatment effects.

#2

The plot area was monitored for treatment differences every few days until the Kentucky bluegrass had completely recovered from summer dormancy. There were no visible treatment differences observed at any time during the recovery period with the exception of a slight greening of turf that was treated with nitrogen ~~(N)~~ fertilizer.

This study suggests that the application of fertilizer and fertilizer in combination with various herbicides to dormant Kentucky bluegrass does not have a detrimental effect on the recovery of the turf from summer dormancy. An evaluation of positive effects of these dormancy treatments will require further study. Although little response was observed in treated plots in this study, work in an adjacent area did demonstrate increased recovery on treated areas. If the drought continues, more work will be conducted on this subject during 1989.

Table 21. Fertilizer and herbicide applications on dormant Kentucky bluegrass lawns.

Treatment	Rate
1. Control	----
2. Urea	0.5 lb N/1000 ft^2
3. Urea	1.0 lb N/1000 ft^2
4. Sulfur-coated urea	0.5 lb N/1000 ft^2
5. Urea + Pendimethalin 60DG	0.5 lb N/1000 ft^2 + 1.5 lb ai/A
6. Urea + Dacthal 75WP	0.5 lb N/1000 ft^2 + 10.5 lb ai/A
7. Urea + Trimec	0.5 lb N/1000 ft^2 + 3.5 pt ai/A
8. Urea + Pendimethalin 60DG + Trimec	0.5 lb N/1000 ft^2 + 1.5 lb ai/a + 3.5 pts ai/A

All plots measured 25 ft^2.

Treatments were applied on July 8, 1988, to a nonirrigated stand of Ram-I Kentucky bluegrass which had been completely dormant for seven weeks prior to treatment application. It was 95°F and sunny at the time of treatment application and treatments were not watered in. Treatments were applied in the equivalent of 3 gal H_2O/1000 ft^2 with the exception of sulfur-coated urea that was applied as a granule.

One week after treatment application the plot area was irrigated to bring the Kentucky bluegrass out of dormancy and to determine treatment effects.

Soil Percolator Test Results

R.G. Roe and N.E. Christians

~~The purpose of this~~ study ~~was~~ to determine if the Ross Daniels product, Soil Percolator (R & D number of 88:1117), has an effect on the movement of water and nutrients in the soil. It was compared with an industry standard, the product 'Aqua Gro' liquid by Aquatrols Corporation. The test was conducted on Glade Kentucky bluegrass turf established on a Nicollet (fine-loamy, mixed #1 mesic, Aquic Hapludall) soil with a pH of 6.9, 9.05 ppm phosphorus (P), 98.48 ppm potassium (K), and 2.3% organic matter. Individual treatment cells measured 5 ft by 5 ft and were randomized in a complete-block design with three replications. The turf was mowed at 2 in and water was applied as required. Treatments are listed in table 22.

Treatments were applied on October 12, 1988, with the use of a backpack carbon dioxide sprayer, followed by 15 minutes of irrigation. Each plot also received 2 lb P/1000 ft^2 (Triple Super Phosphate 0-46-0) and 2 lb K/1000 ft^2 (potassium chloride 0-0-60) on October 13 followed by 1 in of irrigation. An additional 2 in of irrigation was applied in two applications at weekly intervals. The area also received approximately 9/10 in of rainfall prior to the taking of core samples the week of November 14 and November 21. The treatments were replicated three times.

The set of soil cores taken on November 14 was cut at the soil line, removing the thatch and grass. The second set, taken the following week, included the thatch with the grass cropped to the thatch line. These cores were then tested in the lab using the water percolation test following the methods #2 developed by the United States Golf Association. This equipment tests the rate at which water flows through the soil cores. Intact cores, in copper tubes, are placed on an infiltration rack and water is passed through at a constant hydraulic head. Output is measured for three consecutive time periods of the same length.

Soil samples were taken on November 18 for P and K analysis. Five samples per treatment cell were collected from the 2-, 4-, and 6-in depths. These samples were analyzed by the Iowa State University Soil Testing Lab for P and K.

Tables 23 and 24 contain the data obtained from the core samples that were tested using the water percolation test equipment. The results are reported as water flow through the core in ml per 5 minutes of percolation time.

Aqua Gro was the only material to significantly improve water movement as compared with the control in the first test (Table 23). Results of test 2 were highly variable and no significant differences were observed (Table 24).

The following graphs show the results obtained from the soil samples. These graphs show the levels of P and K per treatment, as well as the levels of P and K at 2-, 4-, and 6-in depths. There is no significant difference in the level of P retained in the soil. There is an improvement in the level of #3 K retained at the 8 oz/1000 ft^2 rate of R & D 88:1117 ~~(Graph 1)~~. There appears to be little difference in the movement of P through the soil, however the movement of K to the 4- and 6-in depths appears to be enhanced at the 8 oz/1000 ft^2 rate of R & D 88:1117 ~~(Graphs 2 and 3)~~.

The Ross Daniels Soil Percolator provided no improvement in water or nutrient movement in the Nicollet soil at the recommended rates for application for this product. When Soil Percolator was #4 applied at the 8 oz/1000 ft^2, a rate equivalent to the industry standard - Aqua Gro, some improvement in water and K movement was observed, but it showed no advantage over the Aqua Gro.

Table 22. Treatments for Soil Percolator test.

Treatment	Rate	Actual application	Water
1. Water			285 ml
2. Soil Percolator	1 oz/10,000 ft^2	0.074 ml	285 ml
3. Soil Percolator	2 oz/10,000 ft^2	0.148 ml	285 ml
4. Soil Percolator	4 oz/10,000 ft^2	0.296 ml	285 ml
5. Soil Percolator	6 oz/10,000 ft^2	0.444 ml	285 ml
6. Soil Percolator	8 oz/ 1,000 ft^2	5.92 ml	285 ml
7. Aqua Gro	8 oz/ 1,000 ft^2	5.92 ml	285 ml

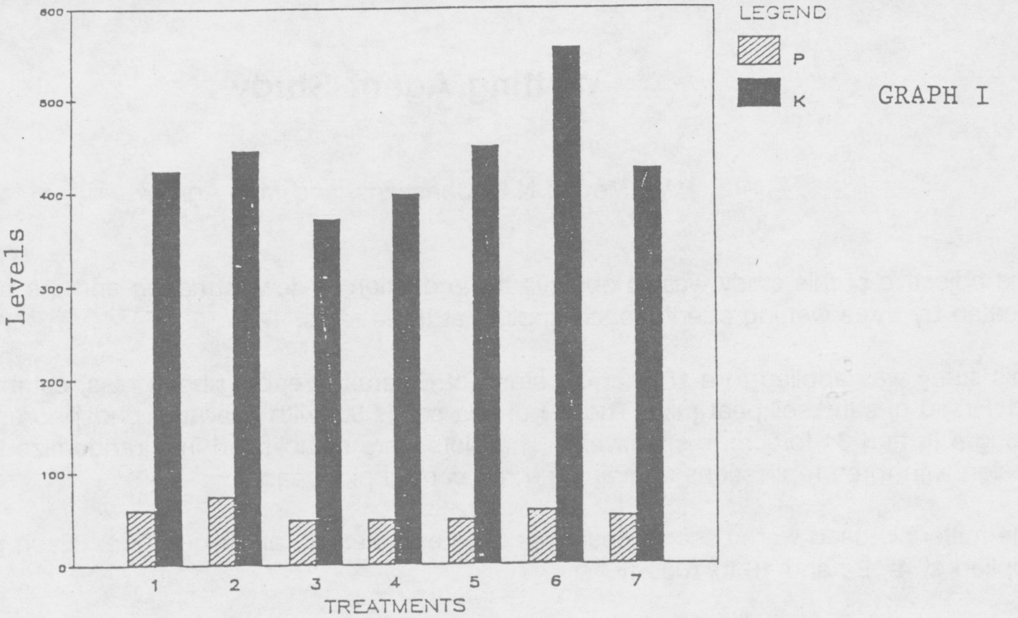
Table 23. Results obtained from the first set of core samples, without thatch.

Treatment	Rate	Average ml water/5 minutes
1. Water		4.0
2. Soil Percolator	1 oz/10,000 ft^2	0.5
3. Soil Percolator	2 oz/10,000 ft^2	1.0
4. Soil Percolator	4 oz/10,000 ft^2	5.2
5. Soil Percolator	6 oz/10,000 ft^2	2.0
6. Soil Percolator	8 oz/ 1,000 ft^2	10.8
7. Aqua Gro	8 oz/ 1,000 ft^2	24.9
LSD 0.05		15.3

Table 24. Results obtained from the second set of core samples, with thatch.

Treatment	Rate	Average ml water/5 minutes
1. Water		54.5
2. Soil Percolator	1 oz/10,000 ft^2	71.3
3. Soil Percolator	2 oz/10,000 ft^2	58.5
4. Soil Percolator	4 oz/10,000 ft^2	32.2
5. Soil Percolator	6 oz/10,000 ft^2	51.6
6. Soil Percolator	8 oz/ 1,000 ft^2	45.5
7. Aqua Gro	8 oz/ 1,000 ft^2	66.2
LSD 0.05		NS*

* NS = no significant difference.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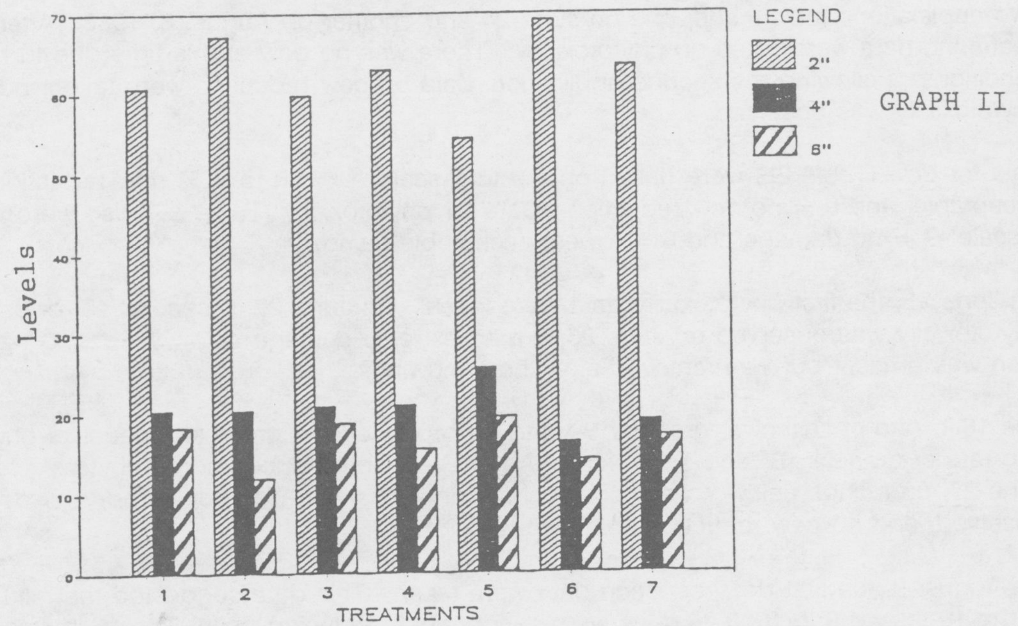
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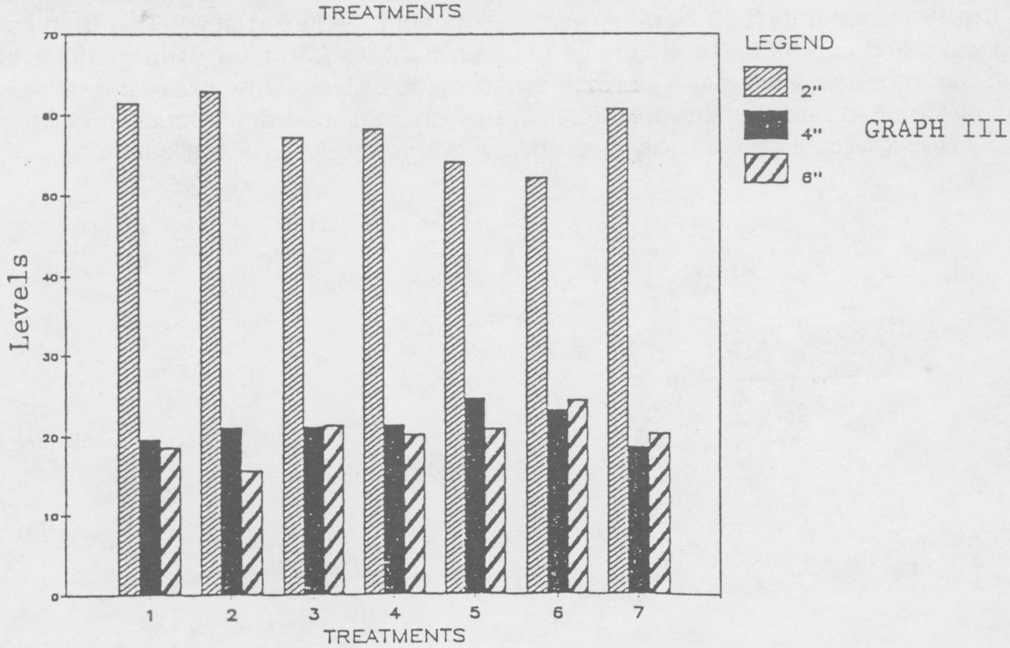
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Wetting Agent Study

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

The objective of this study was to observe the reduction of dew formation and the phytotoxicity created by three wetting agents, each applied at three rates.

#1 This study was applied to a 10-year-old stand of Emerald creeping bentgrass, established on a 1:1:1 ratio of sand:soil:peat mix. The pH of this soil is 8.1 with available phosphorus and potassium being 4 lb and 34 lb/acre, respectively. The plots were established in a randomized, complete-block design with three replications containing three control plots each.

The materials used were Lesco's Lescowet "A", Lescowet "B", and Aqua Gro. Each product was applied at 4-, 8-, and 16 lb/1000 ft^2.

Two applications were made, one on June 24 and another on August 8, 1988. After the first treatment, data were taken on phytotoxicity. There was no dew at this time due to hot and dry conditions. Following the second application, data on dew reduction were taken, but no significant phytotoxicity was observed.

Data for dew (Table 25) were based on a 9 to 1 scale: 1 = 90 to 95% dew reduction, 4 = acceptable, and 9 = no dew reduction. Data for phytotoxicity (Table 26) also were based on a 9 to 1 scale: 9 = no damage and 6 = lowest acceptable rating.

#2 On June 25, the first phytotoxicity data were taken. On June 27, a second set of data were taken. Phytotoxicity was observed on June 25, but no extreme damage ~~below a 6 rating~~ was evident. Tip burn was present but was removed after three mowings.

The 16-lb rate of Lescowet granular "A" and "B" produced the greatest amount of phytotoxicity. The 8-lb rate of granular "B" and 16-lb rate of Aqua Gro also produced some phytotoxic symptoms. On June 27, no ratings below 7 were observed. Conditions were too hot and dry for dew to be observed, and no dew reduction data were taken.

#3 On August 9, the first dew reduction data were taken. This data suggested that all three products at the 16 lb and 8 lb/1000 ft^2 rates were successful in reducing dew. The 16-lb rates received the highest rating ~~of 1~~ while the 8-lb rates received a moderate ~~2.7 and 3~~ rating. The granular "B" product at the 4-lb rate received ~~a 3.7 rating which~~ is an acceptable level. One week later on August 15, granular "B", at the 16-lb rate was the only treatment which continued dew reduction at an acceptable rating ~~of~~ 3. No significant phytotoxicity was observed from the August application.

Table 25. Dew reduction.

Treatment	Rate lb/1000 ft^2	Dew Reduction Rating[a] Aug 9	Aug 15
Control	---	9.0	9.0
Control	---	9.0	9.0
Control	---	9.0	8.7
Granular A	4.0	4.7	8.7
Granular A	8.0	2.7	7.7
Granular A	16.0	1.0	4.7
Granular B	4.0	3.7	7.3
Granular B	8.0	2.7	6.0
Granular B	16.0	1.0	3.0
Aqua Gro	4.0	4.3	8.7
Aqua Gro	8.0	3.0	8.0
Aqua Gro	16.0	1.0	6.0
LSD (0.05)		0.8	1.5

[a] Dew reduction ratings are based on a 9 to 1 rating: 9 = heavy dew, 4 or below = acceptable rating, and 1 = no dew.

Table 26. Phytotoxicity.

Treatment	Rate lb/1000 ft^2	Dew Reduction Rating[a] Aug 9	Aug 15
Control	---	9.0	9.0
Control	---	9.0	9.0
Control	---	9.0	9.0
Granular A	4.0	8.3	8.0
Granular A	8.0	8.0	8.0
Granular A	16.0	6.7	7.0
Granular B	4.0	8.0	8.3
Granular B	8.0	7.0	7.7
Granular B	16.0	6.3	7.0
Aqua Gro	4.0	9.0	8.3
Aqua Gro	8.0	8.0	8.3
Aqua Gro	16.0	7.0	7.0
LSD (0.05)		1.2	1.1

[a] Phytotoxicity rating is based on a 9 to 1 rating: 9 = no damage, 6 or above = acceptable rating, 1 = dead turf.

Cultivation Intensity Study

M.L. Agnew and R.W. Moore

A cultivation study was initiated in the spring of 1986 on a 1-year-old stand of Midnight Kentucky bluegrass. The purpose of this study was to investigate the effects of core cultivation and grooving on thatch prevention and thatch removal.

#1 The turfgrass is maintained at a 2 in mowing height with clippings returned to the soil. The area is fertilized with 4 lb nitrogen (N)/1000 ft^2/growing season using sulfur coated urea.

#2 Thatch depth was measured on May 23, 1987, and May 15, 1988. Measurements were taken by pulling a 6 in diameter core from each plot. The thatch was compressed using a 2 kg weight and the depth was measured in mm. Visual quality ratings were made on September 20, 1988, and shoot density was measured on June 15, 1988. Quality is based on a scale of 1 to 9: 9 = best quality, 6 = acceptable quality, and 1 = dead turf. Shoot density is the number of tillers/15 sq in.

Table 27. The effects of cultivation equipment and timing of application on thatch accumulation, visual quality, and shoot density.

Cultivation equipment	Timing of application	Thatch Accumulation 1986-1987	Thatch Accumulation 1987-1988	Visual quality	Shoot density
none	none	11.3	2.1	9.0	91
coring	May	9.3	2.6	9.0	81
coring	Sept.	10.4	0.9	9.0	85
coring	May, Sept.	9.5	0.8	9.0	72
coring	May, July, Sept.	12.3	2.1	8.3	87
grooving	May	9.8	-0.9	7.8	73
grooving	Sept.	10.3	1.1	8.0	96
grooving	May, Sept.	7.1	-1.4	5.8	95
grooving	May, July, Sept.	4.0	-2.5	6.8	73
LSD (0.05) equip.		2.5	2.2	0.7	NS
LSD (0.05) timing		NS	NS	0.9	NS
LSD (0.05) equip. X timing		NS[e]	NS	NS[e]	NS[e]

[a] Cultivation equipment included coring = Ryan Lawn Aire IV; grooving = Ryan Mat-away.
[b] Thatch accumulation is the thatch depth in May less the original thatch depth.
[c] Visual quality on September 20. Rated on a scale of 1 to 9: 9 = best quality, 6 = minimum acceptable level, and 1 = dead turf.
[d] Shoot density = number of tillers per 15 sq in.
[e] Significant at the 0.10 level.

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

M.L. Agnew and R.W. Moore

This study compares the effects of core cultivation on the performance of four granular nitrogen sources. It was established on May 20, 1988, and is to continue for three years. The turf is Park Kentucky bluegrass that was established in the fall of 1987. The grass is mowed at 2 in and watered to prevent drought stress. Other than preemergence crabgrass control, no pesticides are applied to the treatment area. The four nitrogen (N) sources are milorganite, Blue Chip, methylene urea (41-0-0), and an experimental organic product (listed as ISU Exp). #1

Treatments were applied on May 20 and August 15, 1988. Each fertilizer source was applied at a 2 lb N/1000 ft^2 rate. Fertilizers were applied following core cultivation and without any cultivation to plots measuring 5 ft by 10 ft. Quality ratings were taken on a monthly basis. Visual quality is rated on a scale of 1 to 9: 9 = best quality, 6 = acceptable quality, and 1 = no live grass. Shoot density #2 based on the number of tillers/15 sq in was measured on June 15, 1988. Both the quality and density data are included in table 28. Clippings were collected with each mowing. These were #3 dried and weighed and are represented as biomas in table 29.

The quality data in table 28 suggest that methylene urea provided quick greenup and maintained quality through mid-June. The ISU experimental was slower to greenup but maintained quality #4 through the first of July. Other fertilizer treatments did not give the same level of quality. This could be due to the dry subsoil condition during 1988. There was very little effect of core cultivation for the first year. Only one treatment date showed any response to cultivation.

The clipping data in table 29 suggest that the ISU experimental and methylene urea have the ability to provide nitrogen on a continual basis. The release of nitrogen from blue chip and milorganite was greatest following fertilizer application. There were no responses to the cultivation treatment.

Table 28. Effects of fertilizer source and core cultivation on the quality of Park Kentucky bluegrass.

Fertilizer Source	Cult	Quality Rating[a] 5/28	6/02	6/12	6/28	7/24	8/26	9/07	10/19	Shoot Density[b]
None	None	6.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	53.7
None	Coring	6.0	5.0	5.0	4.7	5.0	4.0	4.0	3.0	52.8
Milorg.	None	6.3	7.3	7.0	7.7	7.0	7.0	7.0	6.7	54.0
Milorg.	Coring	6.3	7.3	7.0	8.0	7.0	6.3	7.0	6.7	56.7
Blue Chip	None	6.7	6.7	6.0	5.7	6.0	7.0	6.0	5.3	42.2
Blue Chip	Coring	7.0	7.3	6.0	6.0	6.0	6.7	6.3	5.0	38.7
M. urea	None	8.0	8.7	8.0	7.3	7.0	7.0	7.3	7.7	61.5
M. urea	Coring	8.0	8.7	7.7	7.3	7.0	7.3	7.7	8.0	52.3
ISU Exp	None	6.0	8.0	8.0	8.3	7.3	7.3	8.0	7.7	58.2
ISU Exp	Coring	6.0	8.3	8.0	8.7	7.0	7.7	9.0	8.0	52.3
LSD (0.05)	Fert	0.4	0.6	0.2	0.6	0.2	0.9	0.6	0.6	8.6
LSD (0.05)	Cult	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.3	N.S.	N.S.

[a] Visual quality is rated on a scale of 1 to 9: 9 = best quality, 6.5 = acceptable quality, and 1 = no live grass.

[b] Shoot density = number of tillers/15 sq in. Data collected on July 15, 1988.

Table 29. Effects of fertilizer source and core cultivation on the biomas of Park Kentucky bluegrass.

Fertilizer Source	Cult	Biomas[a]												
		6/16	6/23	7/07	7/14	7/22	7/29	8/12	9/02	9/09	9/16	9/23	10/03	10/19
None	None	32.8	7.6	2.0	3.7	4.7	4.1	3.6	7.0	4.3	5.8	3.9	2.0	2.1
None	Core	17.1	6.9	2.1	2.1	4.0	3.9	4.3	4.7	3.6	4.9	3.0	1.9	1.6
(MEAN Fert)	24.9	7.3	2.1	2.9	4.4	4.0	4.0	5.9	4.0	5.4	3.5	1.9	1.9	
Milorg.	None	35.2	20.0	4.1	8.5	8.8	6.6	7.2	18.1	11.4	12.3	8.2	6.9	4.0
Milorg.	Core	32.1	20.0	4.1	8.5	9.4	7.3	5.5	11.6	11.6	8.7	7.3	7.9	4.1
(MEAN Fert)	33.6	20.0	4.1	8.5	9.1	6.9	6.4	14.8	11.5	10.5	7.8	7.4	4.1	
Blue Chip	None	31.0	13.5	4.9	4.0	6.4	8.8	5.8	22.1	10.9	8.3	6.5	4.9	2.9
Blue Chip	Core	30.1	11.8	2.5	3.2	5.3	5.3	6.6	11.9	7.2	8.9	5.0	3.9	2.4
(MEAN Fert)	30.6	12.7	3.7	3.6	5.8	7.1	6.2	17.0	9.0	8.6	5.8	4.4	2.6	
M. urea	None	70.3	29.6	7.1	11.0	14.1	7.7	11.7	19.0	11.8	12.6	12.1	9.4	6.7
M. urea	Core	45.5	23.1	3.2	8.6	9.7	6.9	8.0	25.3	16.8	15.7	11.0	8.7	6.8
(MEAN Fert)	57.9	26.4	5.2	9.8	11.9	7.3	9.9	22.2	14.3	14.2	11.6	9.0	6.8	
ISU Exp	None	70.3	35.7	4.8	13.1	13.7	11.3	10.0	26.2	18.9	14.1	14.7	11.1	8.0
ISU Exp	Core	58.6	33.2	7.4	12.0	17.7	12.5	12.2	37.2	26.5	16.5	16.6	13.3	7.3
(MEAN Fert)	64.5	34.5	6.1	12.6	15.7	11.9	11.1	31.7	22.7	15.3	14.4	12.2	7.7	
LSD (0.05)	Fert	20.7	6.7	N.S.	4.1	5.6	2.7	5.2	12.5	5.7	4.6	4.8	3.2	2.8
LSD (0.05)	Cult	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

[a] Biomas is the dry weight of the clippings that were removed from an 11.25 $ft.^2$ area.

1988 Ringer Corporation Project

M.A. Boyle and N.E. Christians

The objective of this study was to observe the effects of Turf Restore® and Greens Restore® (granular materials from the Ringer Corporation) on thatch reduction, water infiltration rates, soil chemistry, and turf quality. Included for comparison are urea and an experimental ISU (ISU Exp) product. Data collected included water infiltration rates, bulk density, salt reduction, cation exchange capacity, nutrient availability, thatch reduction, and turf quality.

The study was initiated in May 1988 and will continue over a 3-year period. It is being conducted at the Iowa State University Horticulture Research Station Turfgrass Plots north of Ames, Iowa. The turf was established in 1984 on a Nicolett (fine-loamy, mixed mesic, Aquic Hapludoll) soil (pH 7.5, 2.3% organic matter). Twenty-one 5 ft by 10 ft plots of Glade Kentucky bluegrass make up the test area. The turf is irrigated as needed to prevent drought stress.

The study was designed in a randomized, complete-block arrangement with three replications each of seven treatments. Three applications were applied throughout the first year (May, July, and September) at the rates of nitrogen (N) listed in table 30. The last two applications in July and September of Turf Restore® and Greens Restore® were 1 lb N and 0.6 lb N, respectively. The granular materials were all applied by hand and the urea was sprayed.

Field data for infiltration rates and bulk density were taken with a 'nondisturbed' soil core sampler and tests were conducted at ISU. The thatch layer was cut from the top of each core and measured when compacted. Cheesecloth was secured to the bottom of the cylinders with rubber bands to keep the soil in place. The cores were placed on a USGA specified infiltration rack and water was passed through them for 24 hours. Water infiltration rates were measured at 5 min intervals with three replications and an average was calculated. Infiltration rates were adjusted to ml/hr with the following formula:

$$R = \frac{QL}{51.5^{*} \times H}$$

R = infiltration in/hr
Q = the averaged rate ml/hr
L = 2.3125 = length of cylinder (inches)
H = 3.43 = hydraulic head (inches)

* 51.5 = πr^2 (16.4 cc/cu in)

Bulk densities were calculated by:

$$\frac{\text{oven dried wt.} - \text{cylinder wt. (cheesecloth + rubber band)}}{\text{volume} = 119.1\ \text{cm}^{-3}}$$

An average of 10 cores from each plot were obtained with the use of a 1 in diameter soil probe, combined, and subsamples were submitted to Harris Laboratories, Inc., Lincoln, Nebraska, for chemical analysis.

No significant differences among treatments, other than visual quality, were found in the study. Tables 31, 32, and 33 list the May 1988 data taken prior to any treatments and the October 1988 data taken at the end of the season. Table 30 lists the amount of water in inches passing through the soil in one hour. The October 1988 results are highly variable. This may be because of the difficulty in obtaining soil cores without cracks or small holes. Tables 31 and 32 list bulk density (gm cm^{-3}) and thatch (mm). There were no significant changes between treatments. The soil test results are in tables 33 and 34 with data prior to treatments and data taken at year's end, respectively. In these tables, soluble salts are reported in mmhos/cm. Sodium, phosphorus, potassium, magnesium, and calcium are in ppm. Potassium, magnesium, calcium, and sodium with an asterisk are all listed in percent of total CEC. These data also show no significant difference between treatments.

All treatments provided acceptable visual quality through the latter part of the season (Table 35). The Turf Restore® at 2 lb N/tmt and the ISU-2 at 2 lb N/tmt provided the highest quality ratings throughout the fall.

All data submitted in this report are from the first year of a planned 3-year study. The lack of significant differences is not unusual in the first year of this type of study. The study will be continued in 1989.

Table 30. Infiltration (in/hr).

	Rate (lb N/1000 ft^2)	May 88	October 88
1. Urea	0.5 lb N	.34	23.41
2. Turf Restore (10-4-4)	1.5 lb N	.30	00.42
3. Turf Restore (RenPro) (10-4-4)	2.0 lb N	.22	00.25
4. Greens Restore (6-1-3)	0.9 lb N	.28	13.92
5. ISU-1 (10% N)	1.0 lb N	.92	00.53
6. ISU-2 (10% N)	2.0 lb N	.75	06.38
7. Urea	1.0 lb N	.15	18.75
LSD 0.05		NS	NS

Table 31. Bulk Density (gm-1 cm-3).

	Rate (lb N/1000 ft^2)	May 88	October 88
1. Urea	0.5 lb N	1.73	1.72
2. Turf Restore (10-4-4)	1.5 lb N	1.77	1.76
3. Turf Restore (RenPro) (10-4-4)	2.0 lb N	1.75	1.77
4. Greens Restore (6-1-3)	0.9 lb N	1.73	1.74
5. ISU-1 (10% N)	1.0 lb N	1.68	1.73
6. ISU-2 (10% N)	2.0 lb N	1.67	1.69
7. Urea	1.0 lb N	1.76	1.77
LSD 0.05		NS	NS

Table 32. Thatch (mm).

	Rate (lb N/1000 ft^2)	May 88	October 88
1. Urea	0.5 lb N	14.0	12.7
2. Turf Restore (10-4-4)	1.5 lb N	13.7	15.0
3. Turf Restore (RenPro) (10-4-4)	2.0 lb N	16.3	13.0
4. Greens Restore (6-1-3)	0.9 lb N	14.3	15.0
5. ISU-1 (10% N)	1.0 lb N	15.0	13.7
6. ISU-2 (10% N)	2.0 lb N	15.0	14.0
7. Urea	1.0 lb N	14.0	13.3
LSD 0.05		NS	NS

Table 33. Soil Test (May 88). Prior to first application.

	Rate (lb N/1000 ft^2)	pH	SS+	NA	CEC	KK*	MGG*	CAA*	NAA*	OM	P	K	MG	CA
			mmhos							-%-	lb/A			
1. Urea	0.5 lb N	6.9	0.13	25.7	13.0	1.9	27.5	69.7	0.87	2.5	11.0	98.0	438	1851
2. Turf Restore (10-4-4)	1.5 lb N	6.9	0.11	18.3	13.0	1.9	28.6	68.8	0.63	2.7	10.0	98.0	439	1760
3. Turf Restore (RenPro) (10-4-4)	2.0 lb N	6.8	0.16	15.3	12.0	1.8	26.9	70.7	0.57	2.5	16.0	85.0	403	1737
4. Greens Restore (6-1-3)	0.9 lb N	6.9	0.16	34.7	14.0	1.9	27.6	69.4	1.07	2.4	12.0	106.0	464	1961
5. ISU-1 (10% N)	1.0 lb N	7.0	0.12	36.7	14.0	1.8	28.0	69.0	1.07	2.3	11.0	101.0	479	1976
6. ISU-2 (10% N)	2.0 lb N	6.9	0.12	20.0	13.0	1.8	28.6	69.0	0.67	2.5	8.0	93.0	457	1845
7. Urea	1.0 lb N	6.8	0.14	25.0	12.0	1.7	27.4	70.0	0.90	2.8	14.0	80.0	386	1639
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

+ Soluble salts.

* Actual percent of total CEC.

Table 34 . Soil Test (October 88). At end of the season.

	Rate (lb N/1000 ft^2)	pH	SS+	NA	CEC	KK*	MGG*	CAA*	NAA*	OM	P	K	MG	CA
			mmhos							-%-	lb/A			
1. Urea	0.5 lb N	7.1	0.16	23.3	15.0	1.8	26.5	71.0	0.67	2.6	6.0	104.0467		2089
2. Turf Restore (10-4-4)	1.5 lb N	7.0	0.18	25.3	14.0	1.8	27.5	69.9	0.77	2.6	8.0	101.0476		2014
3. Turf Restore (RenPro) (10-4-4)	2.0 lb N	7.0	0.17	25.3	14.0	1.8	27.5	70.0	0.77	2.6	8.0	99.0	377	2015
4. Greens Restore (6-1-3)	0.9 lb N	7.0	0.16	34.3	14.0	1.9	27.3	70.0	1.07	2.7	9.0	108.0	371	2003
5. ISU-1 (10% N)	1.0 lb N	7.1	0.17	28.7	15.0	1.7	27.5	70.0	0.80	2.7	7.0	100.0	501	2127
6. ISU-2 (10% N)	2.0 lb N	7.1	0.16	22.3	15.0	1.6	28.1	69.7	0.63	3.0	6.0	89.0	499	2065
7. Urea	1.0 lb N	7.2	0.16	24.0	14.0	1.8	27.0	70.5	0.73	2.7	5.0	98.0	467	2032
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

+ Soluble salts.

* Actual percent of total CEC.

Table 35. 1988 Ringer visual quality*.

	Rate (lb N/1000 ft^2)	9/9	9/16	9/23	9/30	10/6	10/14	Mean
1. Urea	0.5 lb N	6.0	5.7	6.0	6.0	5.3	5.3	5.7
2. Turf Restore (10-4-4)	1.5 lb N	7.3	6.7	7.7	6.7	6.7	6.7	6.9
3. Turf Restore (RenPro) (10-4-4)	2.0 lb N	8.3	7.7	8.7	7.7	7.7	7.0	7.8
4. Greens Restore (6-1-3)	0.9 lb N	5.7	5.7	6.7	6.0	5.3	6.0	5.9
5. ISU-1 (10% N)	1.0 lb N	6.3	6.7	7.7	7.0	6.7	7.0	6.9
6. ISU-2 (10% N)	2.0 lb N	8.3	8.0	8.7	8.0	7.7	7.7	8.1
7. Urea	1.0 lb N	7.0	7.0	7.0	7.0	5.7	6.3	6.7
LSD 0.05		1.3	1.3	0.9	0.5	1.0	0.8	0.7

* Quality based on a scale from 1 to 9: 9 = best quality, 5 = acceptable quality, 1 = dead turf.

1988 NBPT Field Study

G.T. Spear and N.E. Christians

Urea is an organic nitrogen (N) fertilizer source with several properties that make it a desirable source of N for the turf industry. Urea is a highly soluble granule that tank mixes with many lawn pesticides for one step application. It has a relatively low salt index and is one of the least expensive sources of N available for the turf industry.

Unfortunately, urea has weak points, too. Application of granular urea to moist turf can burn the leaves unless it is washed off. Loss of surface-applied urea N to the atmosphere in the form of gaseous ammonia (NH_3) can also be a problem (Terman, 1979).

Many approaches have been taken to lessen the risk of losing urea N as NH_3. They include using a chemical to inhibit soil urease activity, coating urea to decrease its rate of dissolution, and improving urea management techniques (Hauck, 1984).

The effectiveness of N-(n-Butyl) thiophosphoric triamide (NBPT) for retarding urea hydrolysis in soil was shown by Bremner and Chai in several studies (Bremner and Chai, 1986; Chai and Bremner, 1986). From these studies NBPT was shown to merit consideration as a fertilizer amendment for retarding hydrolysis of urea by urease in turfgrass sod.

#1 This study was designed to test the effects of NBPT-treated granular urea from Enichem Americas versus untreated urea on Kentucky bluegrass in hot, dry weather. Observations included both color quality and tipburn that may result from application of the fertilizers at varied rates. Also, clipping dry weights were measured periodically to compare growth following the treatments.

The turf used in the study had been established on a Nicollet (Aquic Hapludoll, fine-loamy, mixed mesic) soil (pH 7.5, 2.3% organic matter) with Park Kentucky bluegrass (Poa pratensis L.). The investigation was conducted in 1988. The turf was irrigated regularly to prevent drought stress. Experimental units were 5 ft by 5 ft each with three replications of seven different treatments.

The study was arranged in a randomized, complete-block design with two treatments and repeated measurements on the same plot areas in three replications. The treatments included granular urea applied at 1 lb N/1000 ft^2 (49 kg N/ha) and 1.5 lb N/1000 ft^2 (73.5 kg N/ha) with NBPT at 0, 0.25, and 0.5% of the weight of N. No urea was applied to the control treatments. The treatments were initially applied the last week of May and were repeated the third week of July. Treatments were applied manually in two different directions to obtain uniform application. Data on color and tipburn ratings were based primarily on visual evaluations. #2 Color and tipburn ratings were taken weekly following the treatments, until symptoms ceased. Clipping weights were recorded weekly, as growth conditions permitted, at a 2 in (5 cm) mowing height.

#3 The effect of NBPT on turf color and the occurrence of tipburn varied with the NBPT rate ~~(Tables 36 and 37)~~. Treatment effects were fairly consistent between both applications and among weeks following the treatment. Color ratings of the NBPT treatments were not different from the corresponding urea treatments and tipburn was greater in plots that received the NBPT treatments. Clipping yield was not affected by NBPT ~~(Table 38)~~. Clipping yield decreased steadily in the weeks following application of treatments but relative treatment effects remained constant throughout the study.

Bremner, J.M. and H.S. Chai. 1986. Evaluation of N-butyl phosphorothioric triamide for retardation of urea hydrolysis in soil. Commun. Soil Sci. Plant Anal. 14:905-913.

Chai, H.S. and J.M. Bremner. 1986. Effects of phosphoramides on ammonia volatilization and nitrite accumulation in soils treated with urea. Agronomy Abstracts. p. 176.

Hauck, R.D. 1984. Technological approaches to improving the efficiency of nitrogen fertilizer use by crop plants. In R.D. Hauck (ed.) Nitrogen in Crop Production. American Society of Agronomy, Madison, WI. pp. 551-560.

Terman, G.L. 1979. Volatilization of nitrogen as ammonia from surface-applied fertilizers, organic amendments and crop residues. Advanced Agronomy 31:189-223.

Table 36. Average color[a] ratings of Kentucky bluegrass for 1988.

Treatment	Rate (lb N/1000 ft^2)	6/2	6/7	6/14	6/23	7/1	7/28	8/10	8/17	8/24	MEAN
1. Control	0.0	4.0	4.0	3.7	3.3	3.3	3.7	3.7	3.3	4.0	3.7
2. Urea	1.0	7.0	6.0	5.7	6.0	6.0	6.0	6.0	5.0	5.3	5.9
	1.5	8.0	8.0	7.7	7.0	6.7	8.0	8.0	6.0	6.0	7.3
3. Urea + NBPT 0.25%	1.0	6.0	6.0	6.0	6.0	5.3	6.0	6.0	5.3	6.0	5.9
	1.5	6.3	6.7	7.0	7.3	6.7	7.3	7.7	6.3	7.0	6.9
4. Urea + NBPT 0.50%	1.0	5.7	5.7	6.0	6.0	6.0	5.7	6.7	5.7	5.7	5.9
	1.5	6.3	7.7	7.0	7.0	7.0	7.0	8.0	6.7	6.3	7.0
LSD 0.05		0.9	0.7	0.7	0.8	0.8	0.6	0.7	0.7	0.9	0.4

[a] Color rating based on a scale of 9 to 1: 9 - best color, 6 - acceptable color, and 1 - dead turf.

Table 37. Average tipburn[a] ratings of Kentucky bluegrass for 1988.

Treatment	Rate (lb N/1000 ft^2)	6/2	6/7	6/14	6/23	7/1	7/28	8/10	8/17	8/24	MEAN
1. Control	0.0	9.0	9.0	9.0	----[b]	---	9.0	9.0	----	----	9.0
2. Urea	1.0	8.0	7.0	5.0	----	---	7.0	6.3	----	----	6.7
	1.5	7.3	7.7	7.0	----	---	8.0	6.0	----	----	7.2
3. Urea + NBPT 0.25%	1.0	6.3	6.0	4.7	----	---	6.0	6.7	----	----	5.9
	1.5	6.3	6.7	5.7	----	---	5.0	6.3	----	----	6.0
4. Urea + NBPT 0.50%	1.0	5.7	6.0	5.0	----	---	6.3	6.3	----	----	5.9
	1.5	4.7	5.3	6.3	----	---	5.0	6.3	----	----	5.5
LSD 0.05		1.1	0.8	1.9	----	---	1.0	0.8	----	----	0.5

[a] Tipburn rating based on a scale of 9 to 1: 9 - best color, 6 - acceptable color, and 1 - dead turf.

[b] No visible damage.

Table 38. Average dried clipping weights[a] of Kentucky bluegrass for 1988.

Treatment	Rate (lb N/1000 ft^2)	6/2	6/7	6/14	6/23	7/1	7/28	8/10	8/17	8/24	MEAN
1. Control	0.0	---[b]	---	206.0	149.0	104.0	347.0	280.0	----	----	217.0
2. Urea	1.0	---	---	403.0	358.0	202.0	875.0	854.0	----	----	533.0
	1.5	---	---	556.0	477.0	238.0	1240.0	1226.0	----	----	748.0
3. Urea + NBPT 0.25%	1.0	---	---	376.33	405.0	215.0	919.0	861.0	----	----	399.0
	1.5	---	---	537.0	499.0	266.0	1233.0	1136.0	----	----	734.0
4. Urea + NBPT 0.50%	1.0	---	---	434.0	354.0	210.0	754.0	754.0	----	----	532.0
	1.5	---	---	449.0	467.0	214.0	1151.0	1022.0	----	----	660.0
LSD 0.05		---	---	94.0	104.0	64.0	175.0	100.0	----	----	41.0

[a] Clipping weights in g/plot.

[b] Insufficient clippings.

Fertilizer Burn Study

M.L. Agnew and R.W. Moore

This is the second year of a 2-year study designed to compare the effects of three fertilizer sources and three water dilution rates on fertilizer burn. The three fertilizer sources include N-Sure, formolene, and urea. Each fertilizer source was diluted into 1-, 2-, and 4-gal of water/1000 ft^2. Each fertilizer/water dilution rate was applied to a 5 ft by 5 ft plot at a rate of 1 lb nitrogen (N)/1000 ft^2. Treatments were applied on Kentucky bluegrass (Poa pratensis) cv. Ram-I. Irrigation was provided to the plots to prevent drought stress. All plots were maintained at a cutting height of 2 in.

#1

Treatments were applied on July 29, 1988, and August 8, 1988, on separate sites. The fertilizer sat in solution for seven days before the July 29, 1988, treatment and two hours before the August 8, 1988, treatment. Visual quality data were collected four days after fertilizer application. Visual quality for this study is a measurement of discoloration due to fertilizer treatments ~~(9 = no visual discoloration and 1 = dead grass)~~.

There was a significant interaction between fertilizer source and water dilution rate for the August 8 application date (~~Table 39~~). Formolene diluted into 1 gal of water caused significantly more injury than when diluted in either 2 or 4 gal of water. The temperatures during this time period were extremely hot. N-Sure applied at the same date did not cause any appreciable damage.

#2

In summary, urea caused the most burn damage at all water dilution rates, while N-Sure caused the least amount of injury. Leaving the formolene in solution for over seven days obviously caused polymerization, thereby lessening damage.

Table 39. Effects of fertilizer source and water volume on foliar burn of Kentucky bluegrass.

Fertilizer Source	Water Volume	Burn Rating[a] July 31	Aug. 12
Urea	1 gal	6.7	5.0
Urea	2 gal	7.0	5.7
Urea	4 gal	7.0	5.0
N-Sure	1 gal	8.3	8.7
N-Sure	2 gal	8.0	9.0
N-Sure	4 gal	9.0	8.7
Formolene	1 gal	7.7	5.0
Formolene	2 gal	7.7	8.0
Formolene	4 gal	8.0	8.3
LSD fertilizer (0.05)		0.6	0.6
LSD water		N.S.	0.6
LSD fertilizer by water		N.S.	0.7

[a] Burn ratings are based on a scale of 1 to 9: 9 = no burn, and 1 = dead turfgrass.

Summer Slow-Release Nitrogen Sources Comparison Study

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

The purpose of this study was to compare eight slow-release nitrogen (N) sources when applied during the late spring and summer. This study was initiated in the spring of 1985 and will be terminated in the spring of 1989. The turf is Glade Kentucky bluegrass, established in September 1984. In all years except 1988, the turf was watered to prevent drought stress. Periodic drought stress was allowed during the drought of 1988. Individual treatment cells measured 5 ft by 5 ft and were randomized in a complete-block design with three replications. The turf was mowed at 2 in and preemergence herbicides were used to prevent crabgrass.

#1 Treatments included eight slow-release N sources (~~Table 40~~) applied at 2 lb N/1000 ft^2/season split into two equal applications on May 20 and August 10. Each treatment received 2 lb N/1000 ft^2/season of urea (46-0-0) split into two equal applications on April 10 and September 20. One additional treatment, using combinations of Powder Blue and urea, was applied for comparison. This treatment applied 0.25 lb N (Powder Blue)/0.75 lb N (urea) in April and September, and 0.5 lb N (Powder Blue)/0.5 lb N (urea) in May and August. The N-Sure treatments began in 1986, while all other treatment began in 1985.

Visual quality data were taken on May 5, May 25, June 27, July 24, and October 19, 1988. Water was withheld from plots during August and early September. Data taken on May 25, June 27, and July 24, reflect the spring application of fertilizers. In this case, all treatments responded equally. Following the drought, the Powder Blue/urea treatment provided the best quality, while there was #2 little or no difference between other fertilizer sources.

Thatch depth and quality will be measured in the spring of 1989, after which time this study will be terminated. A new fertilizer trial comparing fertilizer sources and programs is planned for the spring of 1989.

Table 40. Effects of nitrogen source in summer fertilization of Kentucky bluegrass.

Nitrogen source	Visual Quality[a]					Shoot Density[b]
	5/05	5/25	6/27	7/24	10/19	
Powder Blue	5.0	8.0	8.0	8.0	7.3	61.2
Fluf	5.3	8.0	8.0	8.0	6.7	62.3
Formolene	5.0	8.0	8.0	8.0	6.3	67.0
N-Sure	5.3	8.0	8.0	8.0	7.0	64.0
IBDU	6.0	8.0	8.0	8.0	6.7	65.5
SCU/TVA	5.3	8.0	8.0	8.0	7.0	57.2
SCU/CIL	5.3	8.0	8.0	8.0	6.7	62.7
Azolone	5.3	8.0	8.0	8.0	7.0	64.2
Powder Blue/Urea	5.7	8.0	8.0	8.0	8.0	64.7
LSD (0.05)	N.S.	N.S	N.S.	N.S.	0.7	N.S.

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

[b] Shoot density = number of tillers/15 sq in. Data collected on July 15, 1988.

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

M.L. Agnew and R.W. Moore

The purpose of this study was to evaluate the performance of 13 granular nitrogen (N) sources. This study was established in June 1988. The grass is a Park Kentucky bluegrass that was established in the fall of 1987. It is mowed at 2 in and watered to prevent drought stress.

The treatments include urea, urea + .25% NBPT, urea + .50% NBPT, sulfur-coated urea CIL, sulfur-coated urea TVA, O.M. Scott sulfur-coated urea, IBDU (fine), Blue Chip, Milorganite, Triazone experimental (a product of Arcadian), methylene urea 41-0-0, Nu Tech, ISU experimental (organic N source), and a control with no fertilizer. All treatments were applied at 1 lb N/1000 ft^2 on June 6, August 15, and September 15. This study is replicated three times in a randomized, complete-block design. Plot size is 4 ft by 8 ft. #1

~~Table 41 provides the data on the monthly quality ratings.~~ The quality data of June 12, 1988, reflect the immediate effect of the fertilizer on quality. The fertilizers containing high levels of water insoluble N, i.e. IBDU, Blue Chip, and Milorganite, were slow to greenup. All formulations of urea, sulfur-coated urea, and methylene urea provided immediate green color. In addition, the urea formulations, sulfur-coated urea, and methylene urea fertilizer sources generally provided better quality throughout the growing season. #2

Table 41. Effects of 13 granular fertilizer sources on the visual quality of Park Kentucky bluegrass.

Fertilizer Source	Visual quality[a]						
	6/12	6/28	7/24	8/26	9/07	10/19	Ave.
Urea	8.0	7.3	7.3	7.0	8.0	7.3	7.5
Urea+.25% NBPT	8.0	8.0	8.0	8.0	8.3	6.7	7.8
Urea+.50% NBPT	8.0	7.7	8.0	7.3	8.3	7.3	7.8
SCU (CIL)	7.7	8.0	8.0	7.7	8.3	6.3	7.7
SCU (TVA)	7.3	7.3	7.7	8.3	8.3	7.7	7.8
SCU (Scotts)	8.0	7.3	7.7	7.7	8.7	8.0	7.9
IBDU	5.0	6.3	7.0	6.7	8.0	5.3	6.4
Blue Chip	6.0	6.0	6.7	6.3	6.0	4.0	5.8
Milorganite	5.7	7.0	7.3	5.7	7.0	4.7	6.2
Triazone (exp)	6.7	7.3	8.0	5.7	7.0	6.7	7.0
Methylene Urea (41-0-0)	7.3	7.3	7.7	6.7	8.0	7.3	7.4
Nu Tech	7.0	7.0	7.0	7.0	7.3	5.7	6.8
ISU (exp)	7.3	7.7	7.3	6.3	7.3	6.0	7.0
Control (no fertilizer)	5.3	5.3	6.0	4.3	4.0	3.0	4.7
LSD (0.05)	0.6	0.8	0.9	1.7	1.1	1.2	0.7

[a] Visual quality is rated on a scale of 1 to 9: 9 = best quality, 6.5 = acceptable quality, and 1 = no live grass.

Evaluation of Liquid Fertilizer Programs on Three Kentucky Bluegrass Cultivars

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

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

#1

The four fertilizers include Urea, Powder Blue, Fluf, and Formolene. They were applied using different application schedules and three different application rates. Each schedule received a total of 4 lb N/1000 ft^2/growing season. The balanced program received 1 lb N/1000 ft^2 in each of the months of April, May, August, and September. The heavy spring program received 0.5 lb N in April, 1.5 lb in May, and 1 lb N each in August and September. The late fall program required 0.5 lb N in April, .75 lb in May, .75 lb in August, 1 lb in September, and 1 lb in November.

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

The data taken in 1988 include visual quality, clipping weight, thatch depth, and root weights by depth. Treatments were rated for visual quality each month, while clippings were collected, dried and weighed each month on random dates. Thatch depth was taken October 28. Finally, root samples were collected in October 1988.

In comparing the cultivars (Table 42), the overall visual quality ratings were better for Majestic and Vantage than Park. However, Majestic had substantially better quality from mid-July until fall. Majestic produced only one-half to one-third as much clipping weight as Vantage or Park. This difference is not surprising since Majestic is a prostrate-growing cultivar. Furthermore, thatch remains greatest in Majestic (Table 49).

When comparing programs ~~(Table 43)~~, the late fall program had the best visual quality rating at spring greenup, and the lowest clipping yields for most of the season. The balanced program had the best overall visual quality. Majestic treated with the late fall program produced the most thatch ~~(Table 48)~~.

#2

When comparing the individual fertilizer sources, there was little difference in the overall quality of the turf for the season. Urea and Fluf greened up earlier in May than Powder Blue or Formolene ~~(Table 44)~~. Urea demonstrated better visual quality longer into the fall. Urea, Formolene, and Fluf produced the greatest amounts of clippings during the season. Effects of fertilizer source on thatch development or root weights showed greater thatch created by urea (Table 50).

In 1988, few interactions were observed in programs vs materials, materials vs cultivars, programs vs cultivars, or programs vs materials. Overall, thatch was affected significantly by cultivars and programs and interactions of these two variables.

Due to the drought in 1988, irrigation was omitted on this study starting in early May.

Table 42. 1988 visual quality and clipping yield for three Kentucky bluegrass cultivars.

	Visual Quality[a]						
Cultivar	May	June	July	Aug	Sept	Oct	Mean
Vantage	5.1	6.3	6.2	5.2	5.6	6.3	5.8
Park	5.0	6.4	5.5	4.5	5.3	6.0	5.5
Majestic	4.7	6.3	6.3	5.7	5.8	6.7	5.9
LSD 0.05	NS	NS	.42	.49	NS	.43	.26

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

Table 42. 1988 visual quality and clipping yield for three Kentucky bluegrass cultivars. (Continued).

	Clipping Yield[b]									
Cultivar	May 20	June 3	June 16	June 23	July 13	July 28	Aug 22	Sept 2	Sept 24	Oct 14
Vantage	32.8	18.4	29.4	22.4	6.1	6.5	14.0	24.5	29.2	12.7
Park	25.7	17.5	22.4	23.6	6.6	6.2	16.3	22.3	29.7	10.3
Majestic	9.0	6.9	6.3	6.4	2.8	3.5	6.8	12.1	12.4	6.5
LSD 0.05	2.8	1.6	2.3	2.1	0.9	1.2	2.0	4.1	2.8	1.2

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

Table 43. 1988 visual quality and clipping yield for three liquid fertilizer programs.

Program	Visual Quality[a] May	June	July	Aug	Sept	Oct	Mean
Balanced	4.8	6.8	6.1	5.4	5.8	6.6	5.9
Heavy spring	4.4	5.8	6.3	5.3	5.8	6.5	5.7
Late fall	5.5	6.5	5.6	4.8	5.1	5.9	5.6
LSD 0.05	.36	.36	.42	.49	.43	.43	.25

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

Table 43. 1988 visual quality and clipping yield for three liquid fertilizer progrms. (Continued).

Program	Clipping Yield[b] May 25	June 3	June 16	June 23	July 13	July 28	Aug 22	Sept 2	Sept 23	Oct 14
Balanced	25.0	14.9	20.0	17.2	5.4	6.1	12.7	20.7	25.0	10.5
Heavy spring	19.8	13.4	18.2	18.8	5.3	5.5	13.43	21.0	24.0	9.6
Late fall	22.3	14.2	19.3	16.0	4.7	4.5	10.8	16.9	21.9	9.4
LSD 0.05	2.7	NS	NS	2.1	NS	1.2	2.0	NS	NS	NS

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

Table 44. 1988 visual quality and clipping yield for four liquid fertilizers.

	Visual quality[a]						
Material	May	June	July	Aug	Sept	Oct	Mean
Urea	5.1	6.3	6.2	5.2	5.6	6.3	5.8
Powder Blue	5.0	6.4	5.5	4.5	5.3	6.0	5.5
Fluf	4.7	6.3	6.3	5.7	5.8	6.7	5.9
Formolene	4.9	6.2	5.9	4.9	5.5	6.2	5.6
LSD 0.05	.42	.42	.48	NS	.51	.50	.29

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

Table 44. 1988 visual quality and clipping yield for four liquid fertilizers. (Continued).

	Clipping Yield[b]									
Material	May 25	June 3	June 16	June 23	July 13	July 28	Aug 22	Sept 2	Sept 24	Oct 14
Urea	25.4	14.8	22.5	21.6	6.3	6.9	14.0	23.5	30.2	11.7
Powder Blue	19.3	12.6	15.2	12.4	4.1	4.8	10.7	16.6	16.6	7.6
Fluf	21.8	14.09	18.8	17.0	5.0	5.1	12.4	19.0	21.9	9.2
Formolene	22.7	15.2	20.2	18.3	5.1	4.7	11.9	19.0	25.8	10.8
LSD 0.05	3.2	1.8	2.7	2.4	1.1	1.3	2.3	4.7	3.2	1.4

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

Table 45. Visual quality means of three cultivars for 1985 through 1988.

Cultivar	Visual quality means			
	1985	1986	1987	1988
Vantage	7.2	6.8	6.6	5.8
Park	7.0	6.7	6.5	5.5
Majestic	7.6	7.3	6.5	5.9
LSD	0.11	0.13	NS	0.26

Table 46. Visual quality means of three cultivars for 1985 through 1988.

Program	Visual quality means			
	1985	1986	1987	1988
Balanced	7.2	7.0	6.9	5.9
Heavy spring	7.3	7.1	6.5	5.7
Late fall	7.1	6.7	6.6	5.6
LSD	0.11	0.13	0.13	0.25

Table 47. Visual quality means of three cultivars for 1985 through 1988.

Fertilizer	Visual quality means			
	1985	1986	1987	1988
Urea	7.6	7.4	6.6	6.0
Powder Blue	7.0	6.5	6.5	5.5
Fluf	7.1	6.8	6.6	5.7
Formolene	7.3	6.9	6.7	5.6
LSD	0.13	0.16	0.17	0.29

Table 48. Interaction of cultivar and program on thatch depth in October 1988.

Program	Vantage	Park	Majestic	Mean
Balanced	16.8	13.6	16.9	15.8
Heavy spring	17.2	14.4	19.0	16.9
Late fall	15.1	14.6	20.2	16.6
Mean	16.4	14.2	18.7	

Table 49. Effects of three Kentucky bluegrass cultivars on thatch depth.

Cultivar	Thatch depth (May 22, 1987)	Thatch depth (Oct 22, 1988)
	(mm)	(mm)
Vantage	13.3	14.2
Park	14.0	16.4
Majestic	16.0	18.7
LSD 0.05	0.8	1.2

Table 50. Effects of liquid fertilizer on thatch depth.

Fertilizer	Thatch depth (Oct 1988)
	(mm)
Fluf	15.4
Powder Blue	16.0
Formolene	16.3
Urea	18.0
LSD 0.05	1.4

Table 51. Effects of liquid fertilizer programs on thatch depth.

Programs	Thatch depth (Oct 1988)
	(mm)
Balanced	15.8
Heavy spring	17.0
Late fall	16.6
LSD 0.05	NS

Shady Ground Cover Trial

Spring 1989 Data

N.H. Agnew, J.K. Iles, and M.L. Agnew

A shady ground cover trial was established in Spring 1988 for the purpose of evaluating ground cover species performance in Iowa. Plant materials were purchased using funds from a grant supplied by the Iowa Golf Course Superintendents Association.

Performance data including percentage coverage, plant quality, and percentage survival were recorded in Fall 1988 and Spring 1989. Spring 1989 data are presented in table 52. Top-ranked species are listed in table 53. Percentage coverage is the mean of the percentage of plant cover (based on visual observation) for each of the 2 ft by 3 ft replicate plots.

Quality observations were based on a scale from 1 to 9: 9 = excellent quality plants; 6 = acceptable quality plants; and 1 = dead plants. Excellent quality plants were those with a healthy, vigorous appearance, good color, good coverage or potential for coverage, and minimal damage from insects, disease, or environmental stress. Percentage survival was the number of original plants surviving divided by 18 (3 replicates X 6 plants/replicate) established.

Table 52. Performance evaluation of 20 shady ground cover species for Iowa.

Plant no.	Species	Percentage coverage	Quality	Percentage survival
1.	*Aegopodium podagraria* 'Variegatum'	21.7	3.0	61
2.	*Ajuga genevensis* 'Pink Beauty'	20.0	3.7	67
3.	*Ajuga pyramidalis* 'Metallica Crispa'	96.7	9.0	100
4.	*Ajuga reptans* 'Burgundy Glow'	43.3	6.0	100
5.	*Astilbe chinensis* 'Pumila'	16.7	3.0	67
6.	*Bergenia cordifolia*	30.0	4.0	89
7.	*Galium odoratum*	38.3	5.0	78
8.	*Hedera helix* 'Thorndale'	3.3	1.7	33
9.	*Hosta plantaginea* 'Royal Standard'	71.7	8.3	100
10.	*Hosta undulata* 'Albo-marginata'	73.3	8.7	100
11.	*Lamiastrum galeobdolan variegatum* 'Herman's Pride'	46.7	7.3	100
12.	*Lamium maculatum* 'Beacon Silver'	48.3	5.7	94
13.	*Liriope spicata*	46.7	6.7	100
14.	*Lysimachia nummularia*	76.7	6.7	100
15.	*Pachysandra terminalis*	33.3	4.0	94
16.	*Phlox divaricata* 'Fuller's White'	13.3	2.0	89
17.	*Tiarella wherryi*	23.3	3.0	72
18.	*Vinca minor* 'Bowles'	53.3	4.3	100
19.	*Vinca minor* 'Miss Jekyll'	43.3	4.0	100
20.	*Waldsteinia fragarioides*	43.3	5.3	94

Table 53. Top-ranked species.

Plant no.	Species			
3.	*Ajuga pyramidalis* 'Metallica Crispa'	96.7	9.0	100
10.	*Hosta undulata* 'Albo-marginata'	73.3	8.7	100
9.	*Hosta plantaginea* 'Royal Standard'	71.7	8.3	100
11.	*Lamiastrum galeobdolan variegatum* 'Herman's Pride'	46.7	7.3	100
14.	*Lysimachia nummularia*	76.7	6.7	100
13.	*Liriope spicata*	46.7	6.7	100
4.	*Ajuga reptans* 'Burgundy Glow'	43.3	6.0	100

Comparative Effectiveness of Insecticides

Against Annual White Grubs - 1988

D.R. Lewis and N.E. Christians

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

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

The study was conducted on a fairway of the Hyperion Golf and Country Club located in Johnston, Iowa (Polk County). The soil at the Club is a Waukegan loam (fine-silty over sandy, mixed, mesic typic Hapludoll) with 148 lb P/A, 480 lb K/A, and 5% organic matter. The plots were near the bottom of a long, low, south-facing slope. The grass species in the plots was Kentucky bluegrass. The plot area was receiving low maintenance but regular mowing (at approximately 3 in) and irrigation as necessary. There was between one-fourth to one-half in of thatch at the test site.

Grub damage was apparent throughout the plot vicinity at the time of insecticide application. The insecticide treatments were applied on September 21, 1988. Grub population counts were made October 14, 1988.

The experimental design consisted of 14 treatment plots and one untreated check plot, randomly assigned in each of three replications. Each plot consisted of a 5 ft sq area (25 sq ft). All insecticides were applied at the rate specified on the manufacturer's label or product guidelines. Liquid insecticides were applied with a compressed gas, back-pack sprayer, connected to a hand-held, three-nozzle boom. The boom covered a 5 ft wide area, and diluted insecticide spray was applied to the test plots with alternating perpendicular passes over the treatment plot. The amount of water applied to each plot was the equivalent of 175 gal/A. Granular insecticides were premeasured into round, cardboard containers and applied uniformly over the plot by shaking through a perforated lid. The insecticides were watered into the turfgrass immediately after application with approximately one-half in of irrigation.

Annual white grub population counts were made three and one-half weeks after treatment by randomly selecting four 6 in sq sample sites within each plot, cutting the sample with a sharp knife, removing the sod, and counting all live white grubs found. The sod was lifted from the cut area, and the root mass carefully cut apart and examined for living grubs. The soil beneath the cut sod was scratched loose to a depth of 2 in and similarly examined. The total number of white grubs found in each sample was recorded. Population counts in the samples were converted to number of white grubs/sq ft for analysis and reporting.

The insecticides used in this project, the formulation, rate of application and mean number of white grubs/sq ft are given in table 54. Significant differences among treatments and between treatments and the untreated check were determined by analysis of variance (ANOVA). Means followed by the same letter are not significantly different at the 0.05 level.

The average population density in the untreated check plots was only 10 white grubs/sq ft. While this number is lower than population densities encountered in previous years, it was sufficient to cause damage in irrigated, healthy turfgrass.

The ANOVA analysis reported in table 54 shows that Dursban emulsifiable concentrate did not significantly reduce grub populations. This product has been inconsistent in controlling grubs in similar trials. In addition, poor performance of Dursban for grub control is a common complaint within the turfgrass industry. Turcam wettable powder did not provide good grub control at this site again this year. The granular formulation (both 2 and 4 lb ai/A) did, however, significantly reduce grub populations. It is uncertain what this indicates, other than that further experimentation and pooling of observations is needed.

Conclusions from this trial are suspect and must be viewed with caution because of the low number of grubs in the check and the high variability within treatment counts. All treatments except those already mentioned provided suppression of white grubs, even with the lateness of the insecticide application in the season. Those insecticides providing the best control in this trial were Dylox, Mocap, Turcam 2.5G, and the Dow experimental product granules and Sevin, Oftanol, Tempo, and Triumph liquid sprays. Once again, the best performance in this annual trial was with Mocap insecticide.

Table 54. Effects of commercially available insecticides on annual white grubs infesting turfgrass, Polk County, Iowa, 1988.

Insecticide / Formulation	Rate lb ai/A	Mean number white grubs/sq ft
Control		10.0 a
Turcam 76WP	2.1	6.0 ab
Dursban 4E	1.0	6.0 ab
Dylox 80SP	8.2	5.7 b
Dylox 5G	6.0	5.3 bc
Sevin SL	8.0	5.0 bc
Oftanol 2E	2.0	5.0 bc
Tempo 20WP	0.1	3.7 c
Mocap 10G	5.0	3.3 bc
Dow XRM-4902 1G	1.0	3.3 bc
Dow XRM-4902 1G	0.75	3.0 bc
Turcam 2.5G	2.0	2.7 bc
Turcam 2.5G	4.0	2.3 bc
Triumph 4E	2.0	2.0 bc
Mocap 5G	5.0	1.3 c

* Treatment date - September 21, 1988.

Population count date - October 14, 1988.

Introducing

Iowa State University Personnel
Affiliated with the Turfgrass Research Program

Dr. Michael Agnew	Assistant Professor, Extension Turfgrass Specialist. Horticulture Department.
Ms. Mary Boyle	Undergraduate Research Assistant. Horticulture Department. (Christians).
Mr. Michael Burt	Graduate Student and Research Associate. Horticulture Department M.S. (Christians).
Dr. Nick Christians	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
Dr. Mark Gleason	Assistant Professor, Extension Plant Pathologist. Plant Pathology Department.
Ms. Harlene Hatterman-Valenti	Extension Associate. Weed Science Department. Graduate Student Ph.D. (Christians/Owen).
Dr. Clinton Hodges	Professor, Turfgrass Science. Research and Teaching. Horticulture Department.
Dr. Young Joo	Visiting Scientist. Horticulture Department.
Dr. Donald Lewis	Associate Professor, Extension Entomologist. Entomology Department.
Mr. Richard Moore	Research Associate. Horticulture Department.
Mr. Gary Petersen	Jasper County Extension Director and Graduate Student. Horticulture Department M.S. (Agnew, M.).
Mr. Zachary Reicher	Graduate Student and Research Associate. Horticulture Department M.S. (Christians). (Graduated May 1988).
Mr. Roger Roe	Graduate Student and Research Associate. Horticulture Department M.S. (Christians/Agnew N.)
Mr. Grant Spear	Graduate Student and Research Associate. Horticulture Department M.S. (Christians).

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GrassRoots Turf
6143 Southwest 63rd
Des Moines, Iowa 50321

Hawkeye Chemical Company
Post Office Box 899
Clinton, Iowa 52732

International Seeds
820 First Street
Post Office Box 168
Halsey, Oregon 97348

Iowa Golf Course Superintendents
Association

Iowa Professional Lawn Care
Association

Iowa Turf Producers and
Contractors

Iowa Turfgrass Institute

John Deere Company
Moline, Illinois 61265

Lebanon Chemical Corporation
Country Club Fertilizer Division
Post Office Box 180
Lebanon, Pennsylvania 17042

LESCO Incorporated
300 South Abbe Road
Elyria, Ohio 44035

Loft-Kellogg Seed
322 East Florida Street
Post Office Box 684
Milwaukee, Wisconsin 53201

M & A Enterprises
4346 South 90th
Omaha, Nebraska 68127

Milorganite
735 North Water Street
Milwaukee, Wisconsin 53200

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

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

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

Pickseed West Incorporated
Post Office Box 888
Tangent, Oregon 97389

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

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

Ringer Corporation
9959 Valley View Road
Minneapolis, Minnesota 55344

O. M. Scott and Sons
Marysville, Ohio 53040

Par Ex
Swift Agricultural Products Corp.
518 Pauline Drive
Buffalo Grove, Illinois 60090

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

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

Stauffer Chemical Company
10250 Regency Circle
Omaha, Nebraska 68114

Sustance Corporation
1107 Hazeltine Boulevard
Chaska, Minnesota 55318

Terra Chemical Corporation
Box 218
Quimby, Iowa 51049

The Toro Company
Irrigation Division
Riverside, California 92500

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

UAP Special Products
Omaha, Nebraska 68100

* In the rush to prepare this information for the field day report, some companies may have inadvertently been missed. If your company has provided financial or material support for the research program, and is not mentioned above, please contact me so your company name can be added in future reports.

Nick E. Christians

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