1988 Illinois Turfgrass Research Report

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This report was compiled and edited by Jean E. Haley, Associate Horticulturist, Department of Horticulture, University of Illinois.

Foreword

This report presents the results of turfgrass research investigations conducted in Illinois during 1988. Contributors to the report include scientists from the Departments of Horticulture and Plant Pathology at the University of Illinois and the Department of Crop and Soil Sciences at Southern Illinois University. When interpreting the data please keep in mind that the 1988 growing season was particularly stressful. High temperatures and severe drought influenced all experiments.

We hope the information presented in this research report will aid turfgrass managers throughout Illinois when making management decisions. Nevertheless, information about products and procedures contained in this report are not intended as turfgrass management recommendations. All uses of pesticides must be registered by appropriate State and Federal agencies before they can be recommended. In addition, commercial companies are mentioned in this publication solely for the purpose of providing specific information. No endorsement of products is implied or intendend.

Turfgrass research in the state of Illinois would not be possible without the continuous and generous support of the Illinois turfgrass industry. Thanks and appreciation are due to all individuals, organizations and businesses that support and participate in our projects.

Jean Haley

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UNDERSTANDING THE DATA

Most of the data presented in this report is subjected to statistical analysis. Statistical procedures are a combination of logic and arithmetic that allow us to interpret information gathered from experiments. We most frequently use Fisher's Least Significant Difference Test to explain our test data.

Fisher's Least Significant Difference Test is a statistical procedure that determines if the difference found between two treatments is due to the treatment or if the difference is simply due to random chance. For each set of data a value ($LSD_{0.05}$) is calculated at a chosen level of significance. If the difference between two treatment means is greater than this calculated value then it is said to be a 'significant difference' or a difference not due to random chance. For each set of data, a letter(s) is placed by each treatment mean to show its relationship to every other treatment mean. If two means have one or more letters in common, it is probable that any difference between them is not significant but is a result of random chance. The level of significance that we use is 0.05 ($LSD_{0.05}$). In other words, 95% of the time these treatments are compared this difference will occur. If no letters accompany the means and 'NS' is reported for the $LSD_{0.05}$ then no significant difference was found among the means in this group of data.

BENTGRASS BLENDS FOR PUTTING GREEN TURF

J. E. Haley and D. J. Wehner

INTRODUCTION

There are advantages and disadvantages associated with using vegetatively propagated bentgrass selections for putting green turf. The main advantage is that the putting green will be very uniform since every plant is genetically identical to every other plant. The main disadvantage is that any factor which affects the given cultivar can affect the entire green. Disease outbreaks have the potential of being more severe on vegetatively propagated areas because the susceptibility of all plants is basically the same. Seeded bentgrass cultivars offer an advantage over vegetative strains in that they are genetically more diverse. A seeded variety may be composed of several different individuals which possess agronomically similar characteristics.

Blending two or more bentgrass varieties to gain genetic diversity is a sound principle in theory. Problems may arise however because the two varieties may not have similar enough growth rates or morphological characteristics. Past attempts to blend vegetatively propagated bentgrass varieties have not always been successful. Swirling or excessive grain has sometimes occurred on these areas. After seeing severely damaged Toronto greens it was felt that an evaluation of blends of seeded bentgrass cultivars would be worthwhile. This would be an attempt to produce a quality putting surface and at the same time increase the genetic diversity of the stand.

MATERIAL AND METHODS

All possible two-way blends of the cultivars Penncross, Penneagle, Seaside, and Emerald were established at the Ornamental Horticulture Research Center in Urbana on 21 August 1981. Each blend and the four individual components were established in 6 x 10 ft plots with three replications. The turf is maintained at a 0.25 inch height of cut and is irrigated as necessary to prevent wilt. During the 1988 growing season the turf was fertilized with 3.0 lbs N/1000 sq ft and was on a preventative fungicide program. The area was lightly topdressed 4 times during the growing season with a 8-1-1 sand-soil-peat mixture.

RESULTS

There was no difference in rate of establishment among the components and blends. In 1982 and 1983 turfgrass quality was highest in plots containing Penneagle, alone or in a blend. In 1983 Seaside and Emerald had a higher incidence of dollar spot prior to fungicide application and had poorer color throughout the season. In 1984, the same trends were apparent.

During 1985 the best quality was observed with Penneagle and all blends containing Penneagle. Throughout the season the cultivars Seaside, Emerald and the Seaside/Emerald blend had the lowest quality of all cultivars and blends tested. Poor quality of all creeping bentgrass cultivars was observed in May prior to spring fertilization.

During the 1986 growing season Penneagle and all blends containing Penneagle continued to have the highest quality ratings. Test plots of Emerald, Seaside and the Emerald/Seaside blend showed further deterioration especially in late August.

Bentgrass quality was fair to good during the 1987 growing season. As in previous years the best quality was observed with Penneagle and blends containing Penneagle. Annual bluegrass infestation was highest in plots of Emerald, Seaside and the Emerald/Seaside blend.

Although there was little winter injury, early 1988 bentgrass quality was only fair (Table 1). Quality improved only slightly by mid-May. The best mid-summer quality was observed with Penneagle, Penncross and the Penneagle/Seaside and Penneagle/Penncross blends. Over all rating dates, plots of Emerald or Seaside blended with Penneagle were of better quality than those where Emerald and Seaside were planted alone.

At this time no cultivar segregation is apparent in the blends; however, plots will be further evaluated to see if any segregation occurs.

Table 1. The evaluation of creeping bentgrass cultivars and blends mowed at 0.25 inch height of cut during the 1988 growing season.[1]

Cultivar/Blend	Quality [2] 3/03	5/12	7/06	All Dates[3]
Penneagle	6.3a	7.0a	8.0a	7.1a
Penneagle/Emerald	6.3a	6.3ab	6.7bc	6.4bc
Penneagle/Seaside	5.7ab	6.0bc	7.7a	6.4bc
Penneagle/Penncross	6.7a	6.3ab	7.7a	6.9ab
Penncross	5.7ab	5.7b-d	7.3ab	6.2cd
Penncross/Emerald	5.0b	6.0bc	6.7bc	5.9c-e
Penncross/Seaside	5.0b	6.0bc	6.0cd	5.7de
Emerald	6.0ab	5.0d	6.3cd	5.8de
Seaside	5.0b	5.3cd	5.7d	5.3e
Emerald/Seaside	6.7a	5.0d	6.3cd	6.0cd
$LSD_{0.05}$	1.1	0.9	0.9	0.6

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Quality evaluations are made on a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality.

[3]Values represent the mean of 9 scores obtained from 3 replications and 3 evaluation dates.

FAIRWAY BENTGRASS MANAGEMENT STUDY

J. E. Haley and D. J. Wehner

INTRODUCTION

Creeping bentgrass has not been extensively used for golf course fairways because of its aggressive nature and high maintenance requirements. However, annual bluegrass, a predominant component of many golf course fairways also requires high levels of maintenance to produce quality turf and is susceptible to heat and drought injury. Therefore, creeping bentgrass fairways might be a viable alternative to the often difficult to manage annual bluegrass - Kentucky bluegrass fairways found on many golf courses. The purpose of this research is to evaluate the creeping bentgrass cultivars Prominent, Penncross, Penneagle, Seaside, Emerald, and Highland colonial bentgrass under varying levels of fairway management.

MATERIALS AND METHOD

The large blocks of each cultivar, established in 1981, have been split so that half the area is receiving a preventative fungicide program while the other half receives no fungicide. Perpendicular to the fungicide strips are cultivation treatments consisting of vertical mowing, core cultivation, or no cultivation. These treatments were applied in June during the growing seasons of 1982 through 1985. The plots are monitored for turfgrass quality, annual bluegrass infestation, and disease severity. The turf is mowed at 5/8" and fertilized with 2.5 lbs nitrogen/1000 sq ft/yr.

RESULTS

During 1982, the first year of the study, major quality differences started to appear in June with the incidence of dollar spot. Fungicide treated plots had higher quality ratings than the nonsprayed plots until October when dollar spot activity subsided. Lower overall quality ratings for Penncross and Penneagle resulted from their poorer mowing quality during very warm weather. Emerald lacked the vigor to prevent crabgrass from becoming a problem and thus, received lower quality ratings.

In 1983, dollar spot was not a serious problem on the plots because of the warm dry summer. The plots that were cultivated with a vertical mower received lower quality ratings because they were damaged and the hot weather restricted recovery. The cultivars Penneagle, Penncross, Seaside, and Prominent received the highest quality ratings throughout the year. There was a higher percentage of crabgrass in plots that were core cultivated.

In 1984, dollar spot again was not a serious problem on the plots because of the warm dry summer. The cultivars Penneagle and Penncross received the highest quality ratings throughout the year although Penneagle quality was low in June following cultivation. Highland, because of its poor heat tolerance, and Emerald, because of its poor vigor, received lower quality ratings in 1983 and 1984.

Because of the severity of the crabgrass infestation in 1984, these plots were treated with bensulide in spring of 1985. Crabgrass did not become a problem even in the plots that received cultivation. Differences in the amount of annual bluegrass infestation started to appear during 1985. The percent annual bluegrass in the various cultivars reflects the trends in quality and density that have been seen the previous years. The cultivars with poorer quality and density had the highest percentage of annual bluegrass. The cultivars Penncross and Penneagle received the highest quality ratings in 1985 followed by Prominent and Seaside with Highland and Emerald receiving the lowest ratings.

In 1986, some of the same trends were apparent as found in earlier years. Probably the most noticeable change was the poor quality ratings for Penneagle in May and June. In past years, Penneagle has usually received a low rating for April but high ratings for the rest of the year. The low ratings in May and June may have been a result of the unusual winter conditions during 1985-1986. The percentage of annual bluegrass in the turf continued to increase during 1986 with the highest percentage infestation found in the Highland, Emerald, and Prominent plots. In 1985, the Highland plots contained an average of 23.5% annual bluegrass and in 1986 plots were 41.4% annual bluegrass. Annual bluegrass was also more severe where vertical mowing was used as the cultivation treatment. This procedure is quite disruptive to bentgrass turfs.

During 1987 turf quality was poor to fair for all cultivars. The best quality was observed with Penneagle and Penncross. Quality was highest in turf treated regularly with fungicides. Highland colonial bentgrass and Emerald creeping bentgrass continued to decline. Plots containing Highland and Emerald contained the greatest percentage of annual bluegrass. Statistically there was no significant difference in annual bluegrass infestation between turf treated with fungicides and turf not treated with fungicides.

Throughout the 1988 growing season most bentgrass quality was fair with the exception of Highland colonial bentgrass which was poor (Table 1). Differences among cultivation treatments, last applied in 1985, were no longer apparant. Although disease was not a serious problem during 1988 turf treated with fungicides was of better quality than turf not treated with fungicides.

Table 1. The evaluation of creeping bentgrass maintained as a fairway turf during the 1988 growing season.[1]

Treatment	Quality[2] 5/13	7/06
Fungicide	6.1a	5.4a
No Fungicide	4.6b	4.4b
$LSD_{0.05}$	0.3	0.5
Highland	3.8c	4.0b
Emerald	5.1b	5.0a
Prominent	5.7ab	5.0a
Seaside	6.0a	4.9a
Penncross	5.9a	5.5a
Penneagle	5.9a	5.0a
$LSD_{0.05}$	0.7	0.8
Core Cultivation	5.4	5.0
Vertical Mowing	5.3	4.8
No Cultivation	5.4	4.9
$LSD_{0.05}$	NS	NS

[1]All values represent the mean of 4 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Quality evaluations are made on a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality.

1985 USDA National Kentucky Bluegrass Trial at Southern Illinois University, Carbondale

K.L. Diesburg and H.L. Portz

INTRODUCTION

In 1980, the United States Department of Agriculture (USDA) initiated a regional Kentucky bluegrass cultivar trial for the northern agricultural experiment stations. Since then, there had been enough releases of new cultivars to warrant this second trial. Kentucky bluegrass (Poa pratensis L.) is the major cool season turfgrass for home lawns in Illinois. However, the climate, soils and pests of southern Illinois place potentially severe stresses on most cultivars causing a decline in vigor and some stand thinning. New cultivars are being developed that are more disease resistant and tolerant of environmental stress. A total of 72 cultivars are being evaluated at Southern Illinois University. Although the trial is located in two adjacent areas for intended different maintenance levels, they were not imposed strongly during 1988. They were therefore combined, doubling the replications.

MATERIALS AND METHODS

The trial was established 13 September 1985 into a Hosmer silt loam with two percent slope. Prior to seeding the area was treated with glyphosate, plowed and allowed to lie fallow for most of 1985. The area was fertilized with 1.5 lb N/1000 sq. ft (12-12-12). Plot size is 5 x 6 feet. After seeding, plots were covered with light straw and irrigated as needed. During 1988, four lb N/100 sq. ft. were applied and weeds were controlled with a preemergent herbicide applied in the spring and summer and a broadleaf herbicide applied in the fall. Due to changes in personnel during the year, data could be recorded only during December 1988.

RESULTS

The color ratings refer to winter, only. Relative rankings in color can change dramatically between summer and winter. Cultivars with higher winter color ratings have a combination of darker green chlorophyll and resistance to discoloration from frost damage. It is interesting to note that many of those cultivars that were poorest in color had the finest texture and density. To a lesser extent the reverse was also true. Some of the darkest cultivars ranked low in texture and density. The sums of ratings reveal that Midnight and Wabash could be the best cultivars, overall, even though they are very different types, especially in color.

Winter Evaluation of Cultivars in the 1985 USDA National Kentucky Bluegrass Trial
January 8.

Cultivar	Color Rating 9 = best	Density Rating 9 = most	Texture Rating 9 = finest	Sum of Ratings
Asset	7.8	5.7	5.5	19.0
Aspen	7.8	5.7	6.0	19.5
Blacksburg	7.2	5.7	6.3	19.2
Nassau	7.2	6.0	5.0	18.2
Destiny	7.2	6.2	4.3	17.7
Tendos	7.0	5.7	4.2	16.9
P-104	6.8	5.8	4.5	17.1
BAR-VB-577	6.7	6.0	5.8	18.5
Able I	6.7	6.2	6.2	19.1
Ram-1	6.5	6.7	6.0	19.2
Parade	6.5	6.8	6.2	19.5
NE 80-88	6.5	6.7	6.0	19.2
WW Ag 495	6.3	6.8	6.3	19.4
Bristol	6.3	6.2	5.3	17.8
Midnight	6.3	7.7	6.5	20.5
239	6.2	6.7	6.0	18.9
Dawn	6.2	6.7	5.5	18.4
Georgetown	6.2	6.3	6.0	18.5
Monopoly	6.2	6.5	5.3	18.0
Classic	6.2	6.7	5.7	18.6
Harmony	6.0	6.5	5.2	17.7
Ba 73-626	6.0	7.2	3.8	17.0
Ikone	6.0	6.7	5.3	18.0
Victa	6.0	6.7	4.2	16.9
Eclipse	6.0	6.8	5.5	18.3
Lofts 1757	5.8	6.8	6.0	18.6
Cynthia	5.8	6.7	7.2	19.7
Glade	5.8	7.3	6.5	19.6
Julia	5.8	6.5	5.5	17.8
Aquila	5.8	6.8	7.3	19.9
BA 73-540	5.7	6.8	5.2	17.7
Welcome	5.7	5.5	6.2	17.4
PST-CB1	5.7	6.8	6.2	18.7
Barzan	5.7	6.5	5.5	17.7
A-34	5.7	6.2	5.5	17.4
Amazon	5.7	5.3	6.0	17.0
K1-152	5.7	7.0	6.2	18.9
Liberty	5.7	6.7	5.3	17.7
Challenger	5.7	6.7	5.5	17.9
Sydsport	5.5	6.5	4.7	16.7
Cheri	5.5	6.5	4.8	16.8
Huntsville	5.5	7.2	6.8	19.5
Ba 72-441	5.5	7.3	4.3	17.1
Gnome	5.5	5.8	4.8	16.1

Winter Evaluation of Cultivars in the 1985 USDA National Kentucky Bluegrass Trial, January 8 continued.

Cultivar	Color Rating 9 = best	Density Rating 9 = most	Texture Rating 9 = finest	Sum of Ratings
K3-178	5.5	6.7	5.7	17.9
F-1872	5.5	6.3	6.3	18.1
Ba 69-82	5.5	6.2	4.8	16.5
Ba 70-242	5.5	5.8	4.5	15.8
Ba 70-139	5.3	6.5	4.8	16.6
Merit	5.3	7.0	4.5	16.8
Haga	5.3	6.5	6.3	18.1
Rugby	5.3	6.5	6.3	18.1
Ba 72-492	5.3	7.2	5.0	17.5
Trenton	5.3	6.2	5.5	17.0
Baron	5.3	6.8	5.3	17.4
BAR VB 534	5.2	6.8	7.2	19.2
BA 72-500	5.2	6.7	4.8	16.7
Annika	5.2	5.0	6.2	16.4
Merion	5.0	6.2	6.0	17.2
Kenblue	4.8	7.7	7.5	17.0
WW Ag 496	4.7	7.5	6.3	18.5
Connie	4.7	6.0	5.7	16.4
America	4.7	7.0	6.8	18.5
WW Ag 491	4.7	6.5	6.3	17.5
HV 97	4.5	6.7	6.8	18.0
S. Dak. Cert.	4.3	6.2	7.5	18.0
WW Ag 468	4.3	6.0	6.3	16.6
Wabash	4.3	8.2	8.2	20.5
Compact	4.0	6.8	6.5	17.3
Joy	4.0	6.5	7.2	17.7
Somerset	3.8	6.7	5.8	16.3
Mystic	3.8	6.5	7.8	18.1
LSD $\alpha = 0.05$	0.9	1.1	1.0	

Evaluation of 10-Year Old Kentucky Bluegrass Turf

K.L. Diesburg and H.L. Portz

INTRODUCTION

Turfgrass trials are usually kept for three to five years and then removed to make room for new research. In such cases, long-term persistence and competitiveness with adjacent plots can never be evaluated. These are qualities sought for by turfgrass managers.

MATERIALS AND METHODS

This trial was established September, 1978 into a Hosmer silt loam with two percent slope. Plot size is 5 x 6 feet. The area was fertilized with 3 to 4 lb N/1000 sq. ft. per year with irrigation as needed. Weeds were controlled with a preemergent herbicide applied in the spring and summer and a broadleaf herbicide applied in the fall, each year.

RESULTS

The degree of extension beyond the original plot borders is a direct indication of the relative aggressiveness or competitive ability of one cultivar with the average competitive ability of twelve adjacent plots, referring to the four sides of each plot in three replications. Only 13 of the 41 cultivars were significantly weak or strong, while the other 28 cultivars literally "held their ground" over the ten years. It is interesting to note that the more aggressive cultivars had low color ratings and high density ratings, while the less aggressive cultivars tended to have lower density ratings.

The color ratings refer to winter, only. Relative rankings in color can change dramatically between summer and winter. Cultivars with higher winter color ratings have a combination of darker green chlorophyll and resistance to discoloration from frost damage.

Evaluation of 10-year old Kentucky bluegrass turf, January 29, 1989.

Cultivar	Growth from Plot Border (in)	Ratings Color 9=darkest	Texture 9=finest	Density 9=most
AH1	11.3	3.7	5.7	8.7
M24	10.7	3.0	6.0	7.7
I4	8.7	4.3	7.0	8.7
J41	8.7	4.0	5.7	7.7
M12	6.3	4.3	6.3	8.0
I13	4.3	4.3	5.7	8.7
M4	4.0	3.7	6.7	7.3
Brunswick	2.7	4.7	6.3	7.3
I22	2.7	5.0	6.3	8.0
WH7	2.7	5.3	6.0	7.7
I34	2.0	5.0	6.7	8.7
Rugby	1.3	5.0	6.0	8.0
Trenton	1.0	5.7	6.3	8.3
H6	1.0	5.3	5.7	8.7
VVB	0.7	5.7	5.3	9.0
K2-161	0.3	4.0	6.3	8.7
Cheri	0.0	5.3	5.0	7.3
W-A-20	0.0	4.7	5.7	8.3
Bensun	-0.3	5.3	5.7	7.0
Bonnieblue	-0.3	4.7	5.7	8.0
I12	-0.3	6.0	6.0	8.7
SV0161	-0.7	5.3	5.0	8.0
Common	-1.0	4.0	6.7	8.3
I20	-1.3	5.3	6.0	8.3
Touchdown	-1.3	5.7	7.7	5.7
HT1	-1.7	4.0	5.0	7.0
K6-81	-1.7	4.7	6.3	8.3
Victa	-2.0	5.3	4.7	7.7
Adelphi	-2.0	6.0	6.0	7.0
Vantage	-2.0	5.0	5.0	7.3
Sydsport	-2.3	6.0	5.3	7.0
Parade	-2.3	6.3	6.3	7.0
O5	-3.3	5.3	6.7	8.0
Majestic	-3.3	5.0	5.3	7.0
H4	-3.7	4.7	6.3	7.7
O4	-4.0	5.0	7.0	6.7
Bristol	-4.7	6.0	5.7	7.0
Baron	-6.7	6.0	6.0	6.7
M20	-6.7	4.7	6.3	7.3
O3	-7.0	5.0	6.7	6.7
Aspen	-7.7	5.0	5.3	7.3
LSD α 0.05	6.1	1.1	0.8	1.3

KENTUCKY BLUEGRASS CULTIVAR EVALUATION AT URBANA

J. E. Haley, T. B. Voigt, D. J. Wehner and T. W. Fermanian

INTRODUCTION

Kentucky bluegrass (Poa pratensis) is the most widely used turfgrass in Illinois. Its fine texture, cold and drought tolerance, ability to form a dense sod and ability to adapt to a wide range of cultural programs make it suitable for home lawns, parks, atheletic fields, golf courses or any area where a high quality turf is desired. The many available cultivars of Kentucky bluegrass differ considerably in quality, color, texture, stress tolerance, and resistance to pests. The purpose of this evaluation is to evaluate the response of 54 Kentucky bluegrass cultivars to the environment found in central Illinois.

MATERIAL AND METHODS

Fifty-four Kentucky bluegrass cultivars were planted at a seeding rate of 1.8 lbs seed/1000 sq ft on 13 September 1988. Prior to establishment, the existing vegetation was killed with glyphosate (Roundup, Monsanto Agricultural Co.), the area was rototilled, raked, and fertilized with 1 lb N/1000 sq ft. Following planting, the plots were mulched with straw and irrigated as needed for germination and establishment. Plot size is 5 x 6 ft and each cultivar is replicated 3 times in a randomized complete block design.

DISCUSSION

Each Kentucky bluegrass cultivar and sponsor is listed in Table 1. During the next growing season the cultivars will be evaluated for such characteristics as density, color, quality, heat and drought tolerance as well as resistance to turfgrass pests.

Table 1. 1988 Kentucky bluegrass cultivar evaluations - cultivars and sponsors.

Cultivar	Sponsor	Cultivar	Sponsor
Compact	E.F. Burlingham & Sons	Dawn	Lesco Inc.
Haga	E.F. Burlingham & Sons	Baron	Loft's Seed Inc.
Opal	E.F. Burlingham & Sons	Georgetown	Loft's Seed Inc.
Sydsport	E.F. Burlingham & Sons	Loft's 1757	Loft's Seed Inc.
Amazon	Jacklin Seed Co.	Mystic	Loft's Seed Inc.
Destiny	Jacklin Seed Co.	Somerset	Loft's Seed Inc.
Freedom	Jacklin Seed Co.	Aspen	Northrup King Co.
229	Jacklin Seed Co.	Trenton	Northrup King Co.
Adelphi	Jacklin Seed Co.	Abbey	O.M. Scott & Sons
Cheri	Jacklin Seed Co.	Ba-70-242	O.M. Scott & Sons
Classic	Jacklin Seed Co.	Bristol	O.M. Scott & Sons
Eclipse	Jacklin Seed Co.	Chateau	O.M. Scott & Sons
Fylking	Jacklin Seed Co.	Coventry	O.M. Scott & Sons
Glade	Jacklin Seed Co.	Estate	O.M. Scott & Sons
H76-1034	Jacklin Seed Co.	Victa	O.M. Scott & Sons
Huntsville	Jacklin Seed Co.	Alpine	Pickseed West Inc.
Ikone	Jacklin Seed Co.	America	Pickseed West Inc.
Julia	Jacklin Seed Co.	Bronco	Pickseed West Inc.
Liberty	Jacklin Seed Co.	Merit	Pickseed West Inc.
Monopoly	Jacklin Seed Co.	Gnome	Turf Merchants, Inc.
Nassau	Jacklin Seed Co.	Tendos	Turf Merchants, Inc.
Nutop	Jacklin Seed Co.	Blacksburg	Turf-Seed, Inc.
Ram I	Jacklin Seed Co.	CB1	Turf-Seed, Inc.
S-21	Jacklin Seed Co.	Challenger	Turf-Seed, Inc.
Suffolk	Jacklin Seed Co.	Midnight	Turf-Seed, Inc.
Wabash	Jacklin Seed Co.	Abel-1	Warren's Turf Nursery
84-403		Bel 21	International Seed

USDA NATIONAL PERENNIAL RYEGRASS CULTIVAR EVALUATION AT URBANA

J. E. Haley, T. B. Voigt, T. W. Fermanian and D. J. Wehner

INTRODUCTION

In the past, perennial ryegrass has been included in seed mixtures as a temporary lawn or nursegrass. In Illinois, deterioration of the turf during the summer months has prevented perennial ryegrass from becoming an important permanent turfgrass. Improved varieties with better color, density, mowing quality, and disease resistance have challenged the traditional image of perennial ryegrass. The turf program at the University of Illinois is participating in a USDA national perennial ryegrass trial. This nationwide test will evaluate the performance of perennial ryegrass cultivars under a broad range of climate and cultural programs.

MATERIALS AND METHODS

The Urbana trial, established 10 June 1987, includes 65 perennial ryegrass cultivars, some that are experimental and others that are commercially available. Plots measure 5 x 6 ft and each cultivar is replicated 3 times. Prior to establishment the seedbed was treated with glyphosate (Roundup, Monsanto Agricultural Co.), the debris was removed with a vertical mower, and the soil surface was raked and fertilized with 1 lb N/1000 sq ft. The seeding rate was 4.5 lbs/1000 sq ft. After seeding, siduron was applied at 6 lbs ai/A and the area was mulched with straw. Once established, the ryegrass was maintained at a mowing height of 1.5 inches and fertilized with 2.5 lbs N/1000 sq ft. The turf was irrigated as needed to prevent wilt.

RESULTS

Few differences were observed in the establishment rates of the 65 ryegrass cultivars. During August, 1987, most cultivar quality was poor to fair. Turf quality improved during September and October. Cultivars that scored poorly on all three rating dates in 1987 included Delray, Regal and Linn.

During 1988 early spring quality ranged from poor to fair (Table 1). By mid-spring turf quality had improved slightly. The cultivars Tara, PST-2PM, PST-259, Manhattan II, Barry, Repell, KWS-A1-2, Pick 600, ISI-851, Gator, Bar Lp 410, PST-250, PST 2H7, PST-M2E, Palmer, Manhattan, Pick 715 and Pick 647 had ratings of 7.0 (good) or higher. In spite of high summer temperatures turf quality remained fair to good for most ryegrass cultivars. In late July red thread (Laetisaria fuciformis) was a problem for several cultivars. Perennial ryegrass cultivars with an average red thread rating of 5.0 or lower (indicating susceptibility) were Diplomat, Manhattan, J207, Pavo and Linn.

This did not seriously effect late October quality, with the exception of Linn which had very poor turf quality.

Table 1. The evaluation of perennial ryegrass cultivars during the 1988 growing season.[1]

Cultivar	Quality[2] 3/30	5/13	7/06	10/27	Red Thread[3] 7/22
Acrobat (HE 177)	5.7b-d	6.7b-d	6.0c-f	6.0b-e	5.7e-h
Allaire	5.0de	6.7b-d	6.0c-f	7.0a-d	6.0d-g
BAR Lp 410	5.7b-d	7.0a-c	6.0c-f	6.7a-d	5.7e-h
BAR Lp 454	6.7a	6.3c-e	7.0a-c	6.3a-d	6.3c-g
Barry	6.3ab	7.3ab	5.3e-g	6.3a-d	5.7e-h
Belle	6.0a-c	6.7b-d	6.0c-f	7.0a-d	7.3a-d
Birdie II	5.7b-d	6.7b-d	6.7a-d	6.3a-d	6.3c-g
Brenda	5.7b-d	5.0gh	6.0c-f	6.7a-d	6.7b-f
Caliente	5.3c-e	6.3c-e	6.7a-d	7.0a-d	6.7b-f
Citation II	5.0de	6.3c-e	7.0a-c	7.0a-d	6.7b-f
Cowboy	5.0de	5.0gh	5.3e-g	5.3de	6.7b-f
DEL 946	5.7b-d	5.3fg	5.3e-g	6.0b-e	7.0a-e
Delray	3.7g	4.0i	4.7g	4.3e	6.0d-g
Derby	5.7b-d	6.3c-e	5.7d-g	6.7a-d	6.0d-g
Diplomat	5.0de	6.0d-f	5.7d-g	6.3a-d	5.0gh
Gator	5.3c-e	7.0a-c	6.7a-d	7.0a-d	7.3a-d
Goalie	5.7b-d	5.7e-g	6.7a-d	6.0b-e	7.0a-e
ISI-K2	5.3c-e	6.7b-d	5.0fg	6.3a-d	5.7e-h
ISI-851	5.7b-d	7.0a-c	6.0c-f	6.3a-d	7.0a-e
J207	6.0a-c	6.0d-f	5.0fg	6.0b-e	5.0gh
J208	6.0a-c	5.3fg	5.3e-g	5.3de	5.7e-h
KWS-A1-2	5.0de	7.3ab	6.0c-f	6.3a-d	5.3f-h
Linn	2.0h	2.7j	3.0h	2.3f	3.3i
Manhattan	5.0de	7.0a-c	4.7g	7.0a-d	5.0gh
Manhattan II	4.7ef	7.3ab	7.3ab	6.7a-d	6.7b-f
Mom Lp 763	6.0a-c	5.7e-g	5.7d-g	7.0a-d	6.3c-g
NK 80389	4.7ef	5.7e-g	6.3b-e	7.0a-d	6.0d-g
Omega II	4.7ef	6.7b-d	7.7a	7.7ab	6.3c-g
Ovation	6.0a-c	6.0d-f	7.3ab	7.0a-d	6.0d-g
Palmer	6.7a	7.0a-c	6.3b-e	7.3a-c	6.3c-g

(continued)

Table 1. The evaluation of perennial ryegrass cultivars during the 1988 growing season (continued).[1]

	Quality[2]				Red Thread[3]
Cultivar	3/30	5/13	7/06	10/27	7/22
Patriot	5.0de	6.0d-f	6.3b-e	7.7ab	6.3c-g
Pavo (WW E 14)	5.7b-d	6.3c-e	5.3e-g	6.3a-d	4.3hi
Pennant	6.3ab	6.3c-e	7.0a-c	6.3a-d	8.3a
Pennfine	5.3c-e	5.3fg	6.3b-e	7.0a-d	6.3c-g
Pick 233	5.0de	6.0d-f	6.3b-e	6.3a-d	7.3a-d
Pick 300	5.3c-e	6.7b-d	6.3b-e	7.3a-c	7.3a-d
Pick 600	5.7b-d	7.0a-c	6.7a-d	7.7ab	6.3c-g
Pick 647	6.0a-c	7.0a-c	7.0a-c	7.7ab	7.3a-d
Pick 715	4.7ef	7.0a-c	6.7a-d	7.3a-c	7.3a-d
Prelude	5.7b-d	6.7b-d	5.7d-g	6.0b-e	6.7b-f
PST-M2E	5.7b-d	7.0a-c	7.0a-c	6.3a-d	7.3a-d
PST-2DD	4.7ef	6.0d-f	6.7a-d	6.7a-d	7.0a-e
PST-2HH	5.0de	6.3c-e	6.7a-d	7.7ab	6.7b-f
PST-2H7	5.7b-d	7.0a-c	7.3ab	7.3a-c	7.7a-c
PST-2PM	5.7b-d	7.7a	6.7a-d	7.7ab	7.0a-e
PST-250	4.7ef	7.0a-c	7.0a-c	6.0b-e	7.3a-d
PST-259	5.7b-d	7.3ab	6.7a-d	7.0a-d	7.0a-e
PSU-222	6.0a-c	6.0d-f	6.3b-e	6.3a-d	7.3a-d
PSU-333	5.7b-d	5.0gh	7.0a-c	6.7a-d	7.0a-e
Ranger	5.7b-d	6.3c-e	6.0c-f	6.3a-d	7.0a-e
Regal	4.0fg	4.3hi	5.7d-g	4.3e	6.3c-g
Regency	5.0de	6.0d-f	6.0c-f	6.3a-d	7.0a-e
Repell	5.7b-d	7.3ab	6.0c-f	6.7a-d	7.0a-e
Rival (HE 178)	5.7b-d	6.7b-d	6.3b-e	6.3a-d	5.3f-h
Rodeo	5.7b-d	6.7b-d	5.3e-g	6.0b-e	5.7e-h
Ronja (WW E 31)	5.0de	6.7b-d	6.0c-f	5.7c-e	5.7e-h
Runaway (HE 145)	6.0a-c	6.3c-e	4.7g	7.0a-d	5.7e-h
Sheriff	5.3c-e	5.3fg	5.7d-g	6.0b-e	6.0d-g
SR 4000	5.7b-d	6.7b-d	6.7a-d	7.0a-d	7.7a-c
SR 4031	5.0de	5.3fg	5.7d-g	6.0b-e	6.0d-g

(continued)

Table 1. The evaluation of perennial ryegrass cultivars during the 1988 growing season (continued).[1]

Cultivar	Quality[2] 3/30	5/13	7/06	10/27	Red Thread[3] 7/22
SR 4100	5.7b-d	6.3c-e	7.0a-c	8.0a	8.0ab
Sunrye (246)	4.7ef	5.3fg	4.7g	7.0a-d	6.0d-g
Tara	5.7b-d	7.7a	7.0a-c	7.0a-d	7.0a-e
Vintage-2DF	6.0a-c	5.3fg	5.0fg	6.3a-d	6.3c-g
Yorktoswn II	5.3c-e	6.3c-e	6.7a-d	6.0b-e	7.0a-e
$LSD_{0.05}$	0.9	0.9	1.3	1.7	1.4

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Quality evaluations are made on a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality.

[3]Red thread evaluations are made on a 1-9 scale where 9 = no disease visible and 1 = complete necrosis of the turf as a result of disease infection.

USDA NATIONAL TALL FESCUE CULTIVAR EVALUATION AT URBANA

J. E. Haley, T. B. Voigt, T. W. Fermanian, and D. J. Wehner

INTRODUCTION

In Illinois, tall fescue (Festuca arundinacea) is used primarily on low maintenance sites such as roadways and playgrounds. Tall fescue has excellent heat, drought and wear tolerance. A coarse texture prevents its use in areas where a high quality turf is desired. A bunch type growth habit prevents its use in mixtures with other turf species. In recent years tall fescue breeders have bred and selected cultivars with finer texture, improved color, and better disease and cold resistance. The University of Illinois is one of 40 participants in a national test sponsored by the USDA that will examine some of the improved "turf" type tall fescue cultivars over a wide range of environments and cultural programs.

MATERIALS AND METHODS

Sixty-five tall fescue cultivars were seeded 22 September 1987 at a rate of 3.7 lbs/1000 sq ft. Prior to planting the area had been treated with glyphosate (Roundup, Monsanto Agricultural Co.), the debris was removed with a vertical mower, and the area was raked and fertilized with 1 lb N/1000 sq ft. Plot size is 5 x 6 ft and each cultivar is replicated 3 times in a randomized complete block design. Following seeding, the area was mulched with straw and irrigated as necessary to insure germination and establishment. During 1988 the trial was fertilized with 3 lbs N/1000 sq ft and applications of both preemergence crabgrass control and postemergence broadleaf weed control herbicides were made. The turf is maintained at 1.5 inches height of cut and irrigated as needed.

During 1988 early June quality was fair to good for most cultivars (Table 1). In July quality remained high with only the cultivars, Bel 86-2, JB-2, Ky-31, Syn Ga and Tip rating 6.0 (fair quality) or lower. August quality was slightly lower for most cultivars. By late October tall fescue cultivars had recovered from any stress suffered during the summer. Cultivars that consistantly exhibited high quality were Apache, Bonanza, Hubbard 87, Jaguar, Normarc 25, Normarc 77, Olympic, PE-7E and PST-5HF.

Table 1. The evaluation of tall fescue cultivars during the 1988 growing season.[1]

	Quality[2]			
Cultivar	6/08	7/06	8/23	10/27
Adventure	7.7ab	7.3a-c	6.3b-d	7.7ab
Apache	7.7ab	8.3a	7.0a-c	7.7ab
Arid	6.3d-e	6.7cd	6.7a-d	7.0b-d
Aztec	6.7c-e	8.0ab	7.0a-c	7.7ab
BAR FA 7851	7.0b-d	7.7a-c	6.3b-d	7.0b-d
Bel 86-1	7.3a-c	7.3a-c	7.0a-c	7.7ab
Bel 86-2	7.0b-d	6.0de	6.3b-d	7.0b-d
Bonanza	7.7ab	8.0ab	7.3ab	8.0a
Carefree	7.0b-d	7.0b-d	6.0cd	7.3a-c
Chieftan	7.0b-d	6.7cd	7.0a-c	7.7ab
Cimmaron	7.3a-c	7.3a-c	7.0a-c	7.3a-c
Falcon	7.3a-c	7.0b-d	6.3b-d	7.0b-d
Fatima	7.0b-d	7.3a-c	7.3ab	6.3de
Finelawn I	7.3a-c	7.3a-c	6.3b-d	6.7c-e
Finelawn 5GL	7.7ab	7.3a-c	6.3b-d	6.7c-e
Hubbard 87	7.0b-d	7.7a-c	7.7a	7.7ab
Jaguar	7.3a-c	7.7a-c	7.7a	8.0a
Jaguar II	7.3a-c	7.3a-c	7.0a-c	7.3a-c
JB-2	7.3a-c	5.3e	6.7a-d	7.0b-d
KWS-BG-6	6.3de	7.3a-c	4.7e	7.0b-d
KWS-DUR	7.0b-d	7.7a-c	7.3ab	7.7ab
Ky-31	7.0b-d	5.3e	6.3b-d	6.0ef
Legend	7.0b-d	6.7cd	6.7a-d	7.0b-d
Mesa	7.3a-c	7.7a-c	7.0a-c	7.7ab
Monarch	7.0b-d	8.0ab	7.0a-c	7.3a-c
Normarc 25	7.7ab	8.3a	7.7a	7.7ab
Normarc 77	7.7ab	7.7a-c	7.7a	7.7ab
Normarc 99	6.0e	7.7a-c	7.0a-c	7.7ab
Olympic	7.7ab	7.3a-c	7.7a	7.7ab
Pacer	6.7c-e	6.7cd	6.7a-d	6.7c-e

(continued)

Table 1. The evaluation of tall fescue cultivars during the 1988 growing season (continued).[1]

Cultivar	Quality[2] 6/08	7/06	8/23	10/27
PE-7	7.3a-c	8.0ab	6.3b-d	7.7ab
PE-7E	6.7c-e	8.0ab	7.3ab	8.0a
Pick DDF	7.0b-d	8.0ab	5.7de	7.0b-d
Pick DM	7.0b-d	7.3a-c	6.0cd	8.0a
Pick GH6	6.7c-e	7.7a-c	7.0a-c	7.3a-c
Pick SLD	6.3de	7.3a-c	6.0cd	6.3de
Pick TF9	6.7c-e	8.0ab	6.3b-d	7.7ab
Pick 127	7.3a-c	8.0ab	7.0a-c	7.3a-c
Pick 845PN	7.0b-d	7.7a-c	6.7a-d	7.7ab
PST-DBC	7.3a-c	7.3a-c	7.0a-c	7.0b-d
PST-5AG	7.7ab	8.0ab	6.0cd	7.3a-c
PST-5AP	7.0b-d	7.7a-c	6.3b-d	7.3a-c
PST-5BL	6.7c-e	7.3a-c	6.0cd	6.3de
PST-5DL	7.3a-c	7.3a-c	6.0cd	7.7ab
PST-5DM	6.7c-e	7.7a-c	7.0a-c	7.3a-c
PST-5D7	6.3de	7.7a-c	6.7a-d	6.7c-e
PST-5EN	7.7ab	7.3a-c	7.0a-c	7.0b-d
PST-5F2	7.0b-d	7.0b-d	7.0a-c	6.7c-e
PST-5HF	7.7ab	7.7a-c	7.0a-c	7.7ab
PST-5MW	6.7c-e	7.7a-c	6.7a-d	7.0b-d
PST-5OL	7.0b-d	7.3a-c	6.7a-d	7.3a-c
Rebel	7.0b-d	6.7cd	7.0a-c	7.0b-d
Rebel II	7.3a-c	7.0b-d	7.0a-c	7.3a-c
Richmond	6.7c-e	7.3a-c	6.3b-d	7.3a-c
Sundance	7.3a-c	7.0b-d	7.7a	7.0b-d
Syn Ga	6.3de	6.0de	6.7a-d	5.3f
Taurus	7.3a-c	7.7a-c	7.0a-c	7.3a-c
Thoroughbred	6.3de	7.3a-c	7.0a-c	7.7ab
Tip	6.3de	6.0de	6.3b-d	7.0b-d
Titan	8.0a	7.3a-c	7.7a	6.7c-e

(continued)

Table 1. The evaluation of tall fescue cultivars during the 1988 growing season (continued).[1]

	Quality[2]			
Cultivar	6/08	7/06	8/23	10/27
Trailblazer	7.3a-c	8.0ab	6.0cd	7.3a-c
Tribute	6.3de	7.0b-d	7.0a-c	7.3a-c
Trident	7.0b-d	7.3a-c	7.3ab	7.0b-d
Willamette	6.7c-e	6.7cd	6.3b-d	6.3de
Wrangler	7.0b-d	7.3a-c	6.7a-d	7.7ab
$LSD_{0.05}$	0.9	1.0	1.2	0.9

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Quality evaluations are made on a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality.

NCR-10 REGIONAL ALTERNATIVE TURFGRASS SPECIES TRIAL

T. B. Voigt and J. E. Haley

INTRODUCTION

Interest in tough, tolerant grasses has recently increased in light of recent hot, dry weather conditions, budgetary constraints and turf watering restrictions imposed by several Illinois communities. Many acres of roadsides, industrial settings, airports, and little-used park areas where environmental conditions are below optimum could utilize low maintenance turfgrasses.

A USDA-sponsored group of turf researchers from Midwestern universities, the NCR-10 working group, has combined to evaluate sixteen turfgrasses that are rarely grown as turfgrass, or are used primarily as low-maintenance turfs. These turfgrasses will be evaluated throughout the Midwest for turf quality under unirrigated conditions. Additionally, they will be maintained at three mowing heights in an attempt to define appropriate maintenance regimes.

MATERIALS AND METHODS

Sixteen turfgrasses (Table 1) were planted into a firm, Flanagan silt loam seed bed 7 September 1988. Prior to seeding, existing vegetation was killed with glyphosate (Roundup, Monsanto Agricultural Co.) and the soil was rototilled, raked and rolled. Seeding rates for the 3 x 10 ft plots, each replicated three times, are listed in Table 1. One lb N/1000 sq ft was spread following seeding, and irrigation was supplied as needed during germination and establishment. The plots were not mulched. The buffalograss plugs were spread evenly over the test area.

Beginning in 1989, the plots will not be irrigated and a mowing trial will start. Each plot will be split into three mowing heights stripped across the replications. The heights are two inch, four inch, and unmowed. Data will be collected for a minimum of three years.

Table 1: Turfgrasses and seeding rates evaluated in the NCR-10 Regional Alternative Turfgrass Species Trial.

Common Name	Scientific Name	Seeding Rate lbs seed/M
Fairway Crested Wheatgrass	Agropyron desertorum 'Fairway'	4.3
Emphraim Crested Wheatgrass	Agropyron desertorum 'Emphraim'	4.2
Sodar Streambank Wheatgrass	Agropyron riparium 'Sodar'	4.2
Ruff Crested Wheatgrass	Agropyron desertorum 'Ruff'	6.2
Reubens Canada Bluegrass	Poa compressa 'Reubens'	4.3
Durar Hard Fescue	Festuca ovina var. duriuscula 'Durur'	4.2
Covar Sheep Fescue	Festuca ovina 'Covar'	4.5
Alta Tall Fescue	Festuca arundinacea 'Alta'	4.5
Sheep Fescue	Festuca ovina	4.2
Bulbous Bluegrass	Poa bulbosa	4.2
Alpine Bluegrass	Poa alpina	4.0
Reton Red Top	Agrostis alba 'Reton'	4.0
Colt Rough-stalked Bluegrass	Poa trivialis 'Colt'	4.0
Exeter Colonial Bentgrass	Agrostis tenuis 'Exeter'	3.8
Texoka Buffalograss	Buchloe dactyloides 'Texoka'	plugs[1]
NE 84-315 Buffalograss	Buchloe dactyloides 'NE 84-315'	plugs[1]

[1]Plots were established with 4, 2 inch plugs per plot.

1988 PERENNIAL WILDFLOWER EVALUATION

T. B. Voigt

INTRODUCTION

The use and popularity of wildflowers in the landscape is increasing. These plants are presently grown in low maintenance plantings, natural gardens, roadsides, landscape plantings, industrial settings, commercial sites, and golf course rough areas. When combined with native grasses, wildflowers create a permanent plant mix that is relatively inexpensive to purchase and establish, can control erosion, and has high visual impact and interest.

The University of Illinois is a participant in a national wildflower evaluation. Twenty-five perennial wildflowers (Turf Seed, Inc., Hubbard, OR) will be evaluated to their suitability in a wide range of climates, soils, and geographic areas.

MATERIALS AND METHODS

Twenty-five perennials were seeded, following rototilling and light rolling, 20 April 1988. Plot size was 2 x 5 ft and each was replicated twice. After planting into a Flanagan silt loam, the plots were rolled a second time to insure proper soil-to-seed contact. Each plot (except those planted with purple cone flower, yellow prairie cone flower, and Roman chamomile) was planted with 19.4 lbs seed/A. The plots of purple cone flowers were planted at a rate of 34 lbs seed/A. The yellow prairie cone flower, and Roman chamomile plots were planted at a rate of 38.9 lbs seed/A. The plots were irrigated and hand-weeded as necessary. No fertilizers, mulches, or herbicides were used.

OBSERVATIONS

The plots were evaluated for emergence, weed competition, and flowering duration (Table 1). This past growing season began cold and dry. The drought continued throughout much of the summer, and temperatures were above normal throughout much of the period. Weather conditions may have been responsible for the erratic and inconsistent germination of many of these perennials. Emergence continued into late summer for several wildflowers. Plant survival will be evaluated in future years.

Several weed species were particularly troublesome in these plantings. Early season henbit populations were large and competitive. Later in the growing season, crabgrass purslane, bindweed, prostrate spurge, foxtail, lambsquarters, fall panicum, and pigweed competed with the perennials. Both replications were hand-weeded in early June and one replication was hand-weeded again in mid-July. The twice-weeded plots had greater perennial density, produced larger plants, and more flowering than the once-weeded plots. As the density of the twice-weeded plots increased, weed competition decreased. Wildflower plugs may provide a better alternative to seed when establishing these plants in areas of great weed competition.

Table 1. Perennial wildflower emergence and flowering period during the 1988 growing season.

Perennial	Scientific Name	Emergence	Flowering Start	Flowering End
White Yarrow	Achillea millefolium	yes	9/12	11/1
Red Yarrow	Achillea millefolium rubra	yes	8/12	11/1
Roman Chamomile	Anthemis sp.	yes	7/19	11/14
Dwarf Columbine	Aquilegia vulgaris	yes		
Snow-in-Summer-	Cerastium biebersteinii	yes		
Siberian Wallflower	Cheiranthus allionii	yes	7/5	11/14
English Wallflower	Cheiranthus cheiri	yes		
Dwarf Lance-Leaved Coreopsis	Coreopsis lanceolata	yes		
Sweet William	Dianthus barbatus	yes		
Maiden Pinks	Dianthus deltoides	yes (small number)		
Purple Coneflower	Echinacea purpurea	no		
Dames Rocket	Hesperis matronalis	yes		
Gilia	Ipomopsis rubra	yes	8/12	11/1
Blue Flax	Linum perenne lewisii	yes	9/2	9/31
Forget-Me-Not	Myosotis sylvatica	no		
Tall Evening Primrose	Oenothera lamarkiana	yes	7/19	8/31
Missouri Primrose	Oenothera missouriensis	yes		
Rocky Mountain Penstemon	Penstemon strictus	yes (small number)		
Prairie Coneflower	Ratibida columnifera	no		
Black-Eyed Susan	Rudbeckia hirta	yes	7/12	10/25
Small Burnet	Sanguisorba minoryes			
Creeping Zinnia	Sanvitalia procumbens	yes	7/12	11/1
Soapwort	Saponaria ocymoides	yes		
Wild Thyme	Thymus serpyllum	yes		
Johnny Jump Up	Viola cornuta	yes	7/5	11/29

EVALUATION OF EXPERIMENTAL FERTILIZER SOURCES

D. J. Wehner and J. E. Haley

INTRODUCTION

Milorganite, an activated sewage sludge fertilizer with an analysis of 6-2-0, has been available for many years. The Milwaukee Sewerage Commission is developing some new fertilizers for the turfgrass market. The purpose of this study was to evaluate 12 experimental fertilizers on Kentucky bluegrass. Sulfur coated urea (SCU), ammonium nitrate, urea, and a sulur + urea treatment were included for the purpose of comparison.

MATERIALS AND METHODS

All treatments except MIL 1 were applied at the rate of 1 lb nitrogen/1000 sq ft on 14 April, 13 June, 15 September and 11 November 1988 to a blend of Adelphi, Glade and Parade Kentucky bluegrass. MIL 1 was applied at the rate of 4 lbs nitrogen/1000 sq ft on 14 April 1988. The sulfur + urea treatment received sulfur at a rate equivalent to that found in the SCU treatment. The test area consisted of a clay loam soil on which sod was layed in order to simulate the typical conditions found on a home lawn. Clippings were collected from a 21" strip lengthwise through the center of each 3 x 12 ft plot and color ratings were assigned using a 1 to 9 scale with 9 = dark green turf on a weekly basis through the growing season.

RESULTS AND DISCUSSION

The color ratings given during 1988 are presented in Table 1. Among the experimental treatments, turf fertilized with MIL 7 consistently received the highest color ratings while turf fertilized with MIL 1 received the lowest color ratings. The turf fertilized with the urea + sulfur treatment received higher color ratings than the turf fertilized with SCU for the first two or three weeks after fertilization, but the SCU fertilized turf was rated higher during the rest of the season. This indicates that the stronger color associated with SCU application is due to the nitrogen release pattern rather than the presence of sulfur.

The clipping weights collected during 1988 are presented in Table 2. The trends in the clipping weight data were similar to those indicated for the color ratings.

Table 1. The effect of Milorganite fertilizers on the color of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season.[1]

	Color[2]						
Fertilizers	4/05	4/12	4/19	4/26	5/03	5/10	5/16
Milorganite 1	2.7i	2.7h	3.3h	3.7f	3.7h	4.0h	6.3e
Milorganite 2	3.7gh	4.3g	5.0g	5.3e	5.3e-g	6.3e-g	7.0c-e
Milorganite 3	3.3hi	4.3g	5.0g	5.3e	5.3e-g	6.0fg	6.3e
Milorganite 4	4.7d-f	5.3d-f	6.0ef	6.7cd	7.0bc	7.3cd	7.7bc
Milorganite 5	5.0c-e	5.7c-e	6.3d-f	6.7cd	6.7cd	7.3cd	7.7bc
Milorganite 6	4.3e-g	5.3d-f	5.7fg	6.7cd	6.0de	6.7d-f	7.0c-e
Milorganite 7	4.7d-f	6.0b-d	6.7c-e	7.7ab	7.0bc	7.3cd	8.3ab
Milorganite 8	3.3hi	4.7fg	5.0g	6.0de	5.7ef	6.0fg	6.7de
Milorganite 9	3.7gh	4.7fg	5.7fg	6.3cd	6.7cd	6.0fg	7.3cd
Milorganite 10	4.0f-h	5.0e-g	6.0ef	6.3cd	5.7ef	7.0de	7.0c-e
Milorganite 11	4.3e-g	6.0b-d	6.3d-f	5.3e	5.0fg	5.7g	7.0c-e
Milorganite 12	4.7ef	6.0b-d	6.3d-f	5.3e	4.7g	6.0fg	7.3cd
Ammonium Sulfate	6.0ab	7.0a	8.0a	8.0a	8.0a	8.0bc	8.3ab
Ammonium Nitrate	6.3a	7.0a	7.7ab	8.0a	8.0a	8.7ab	9.0a
Urea	5.0c-e	6.7ab	7.0b-d	8.0a	7.7ab	8.7ab	8.3ab
SCU	5.7a-c	6.7ab	7.3a-c	7.0bc	7.3a-c	8.0bc	9.0a
Urea + Sulfur	5.3b-d	6.3a-c	7.0b-d	8.0a	8.0a	9.0a	8.3ab
Check	1.3j	1.7i	2.3i	2.0g	2.0i	2.0i	2.3f
$LSD_{0.05}$	0.9	0.9	0.8	0.8	0.8	0.7	0.8

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 1. The effect of Milorganite fertilizers on the color of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season (continued).[1]

	Color[2]						
Fertilizers	5/25	5/31	6/06	6/14	6/21	6/29	7/06
Milorganite 1	6.3d	6.0d	5.7e	5.7c	5.0f	4.7e	4.3e
Milorganite 2	6.7cd	6.3cd	6.3cd	6.3a-c	6.7c-e	6.7cd	6.3cd
Milorganite 3	7.0bc	6.0d	6.0de	6.0bc	6.0e	6.7cd	6.3cd
Milorganite 4	7.3b	7.0ab	7.0b	6.7ab	7.7b	7.3a-c	6.7b-d
Milorganite 5	7.0bc	6.3cd	6.7bc	6.7ab	7.3bc	7.0bc	6.3cd
Milorganite 6	7.0bc	6.0d	7.0b	7.0a	6.7c-e	6.7cd	6.0d
Milorganite 7	7.3b	7.0ab	7.7a	7.0a	8.7a	7.7ab	7.0a-c
Milorganite 8	6.3d	6.0d	6.0de	6.3a-c	6.3de	6.0d	6.0d
Milorganite 9	7.3b	6.7bc	7.0b	6.7ab	6.7c-e	6.7cd	6.0d
Milorganite 10	7.0bc	7.0ab	7.0b	7.0a	7.0b-d	6.7cd	6.3cd
Milorganite 11	7.0bc	6.0d	6.7bc	6.3a-c	6.3de	6.7cd	6.7b-d
Milorganite 12	7.0bc	6.0d	7.0b	6.7ab	6.3de	6.7cd	6.7b-d
Ammonium Sulfate	7.3b	7.3a	7.0a	6.7ab	9.0a	8.0a	7.7a
Ammonium Nitrate	8.0a	7.0ab	6.7bc	6.7ab	9.0a	8.0a	7.0a-c
Urea	8.0a	6.0d	6.0de	6.3a-c	9.0a	8.0a	7.0a-c
SCU	8.0a	7.3a	8.0a	7.0a	7.3bc	7.3a-c	7.3ab
Urea + Sulfur	7.3b	6.7bc	7.0b	6.0bc	8.7a	7.7ab	6.7b-d
Check	2.3e	3.7e	3.0f	4.0d	4.0g	4.0e	4.0e
$LSD_{0.05}$	0.6	0.6	0.5	0.8	0.8	0.8	0.7

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 1. The effect of Milorganite fertilizers on the color of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season (continued).[1]

	Color[2]						
Fertilizers	7/13	7/19	7/26	8/03	8/11	8/23	8/30
Milorganite 1	4.0e	4.7c	4.7c	5.0d	5.0	5.0	5.7ab
Milorganite 2	6.0cd	6.0b	6.3ab	6.0bc	5.7	6.0	6.0a
Milorganite 3	6.0cd	6.0b	6.0b	6.0bc	6.0	5.7	6.0a
Milorganite 4	6.0cd	6.0b	6.3ab	6.0bc	5.3	5.3	6.0a
Milorganite 5	6.0cd	6.0b	6.0b	6.3a-c	5.3	5.0	5.7ab
Milorganite 6	6.0cd	6.0b	6.0b	6.0bc	5.0	5.0	6.0a
Milorganite 7	7.0ab	6.7ab	7.0a	6.7ab	6.0	5.3	5.7ab
Milorganite 8	5.7d	6.0b	6.0b	5.7cd	6.0	5.0	6.0a
Milorganite 9	6.0cd	6.3ab	6.0b	6.3a-c	6.0	5.7	6.0a
Milorganite 10	5.7d	6.3ab	6.3ab	6.3a-c	6.3	5.7	6.0a
Milorganite 11	6.0cd	7.0a	6.3ab	6.3a-c	6.0	5.0	6.0a
Milorganite 12	6.0cd	6.3ab	6.7ab	6.0bc	5.7	5.0	5.7ab
Ammonium Sulfate	6.7a-c	6.0b	6.3ab	6.3a-c	5.7	5.7	5.3bc
Ammonium Nitrate	7.0ab	6.7ab	6.3ab	6.3a-c	5.7	5.7	5.3bc
Urea	6.3b-d	6.3ab	6.0b	6.3a-c	5.7	5.7	5.7ab
SCU	7.3a	7.0a	7.0a	7.0a	6.3	5.3	6.0a
Urea + Sulfur	6.3b-d	6.0b	6.0b	6.0b-c	5.7	5.0	5.0c
Check	3.7e	4.7c	3.0d	4.0e	4.0	4.7	6.0a
$LSD_{0.05}$	0.8	0.9	0.7	0.8	NS	NS	0.6

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 1. The effect of Milorganite fertilizers on the color of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season (continued).[1]

	Color[2]						
Fertilizers	9/08	9/15	9/22	9/29	10/14	10/20	10/27
Milorganite 1	6.3	6.0	6.0b	5.0e	5.3ef	5.0d	4.7d
Milorganite 2	6.3	6.0	6.0b	6.7a-c	7.0a-c	6.7bc	6.7a-c
Milorganite 3	6.0	6.0	6.0b	5.7c-e	6.0de	6.0c	6.0c
Milorganite 4	5.7	6.0	6.0b	6.0c-e	6.7b-d	7.0ab	6.3bc
Milorganite 5	6.0	6.0	6.7ab	6.7a-c	6.3cd	6.7bc	6.0c
Milorganite 6	6.0	6.0	6.0b	5.7c-e	6.3cd	6.7bc	6.0c
Milorganite 7	5.7	6.0	6.7ab	7.3ab	6.7b-d	7.7a	7.3a
Milorganite 8	6.3	6.0	6.3ab	6.0c-e	6.0de	6.7bc	6.7a-c
Milorganite 9	6.3	6.0	6.7ab	6.3b-d	6.7b-d	6.7bc	6.3bc
Milorganite 10	6.3	6.0	6.3ab	5.7c-e	6.3cd	6.7bc	6.3bc
Milorganite 11	6.0	6.0	6.0b	5.7c-e	6.3cd	6.0c	6.7a-c
Milorganite 12	6.0	6.0	6.0b	6.3b-d	6.7b-d	7.0ab	7.0ab
Ammonium Sulfate	5.7	6.0	7.0a	7.3ab	7.7a	7.7a	6.7a-c
Ammonium Nitrate	6.0	6.0	6.7ab	7.3ab	7.3ab	7.3ab	7.3a
Urea	6.0	6.0	7.0a	7.7a	6.7b-d	7.0ab	7.0ab
SCU	6.3	6.0	6.0b	6.0c-e	6.7b-d	7.3ab	7.3a
Urea + Sulfur	6.0	6.0	7.0a	7.7a	6.7b-d	7.3ab	6.3bc
Check	7.0	6.0	6.0b	5.3de	5.0f	5.0d	4.0d
$LSD_{0.05}$	NS	NS	0.8	1.1	0.8	0.9	0.8

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 2. The effect of Milorganite fertilizers on the fresh clipping weight of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season.[1]

	Weight[2]						
Fertilizers	4/20	4/28	5/05	5/11	5/18	5/26	6/01
Milorganite 1	2.0fg	1.2d	3.1hi	4.1hi	22.6j	36.6f	19.5j
Milorganite 2	4.6e-g	4.5cd	8.0g-i	14.8f-h	58.5i	76.0de	38.3i
Milorganite 3	4.7e-g	4.6cd	8.1g-i	12.9gh	56.3i	72.9de	40.2i
Milorganite 4	6.0d-g	5.9b-d	17.8e-g	26.6d-f	109.3d-f	91.4b-e	50.8e-i
Milorganite 5	13.9c-e	10.7bc	21.4ef	33.8d	114.1c-f	102.4a-c	60.3c-f
Milorganite 6	12.7c-f	13.6b	23.4e	29.4de	90.1f-h	94.2b-d	49.9e-i
Milorganite 7	21.0bc	10.5bc	44.3d	49.9c	126.5c-e	106.1ab	75.9ab
Milorganite 8	6.9d-g	4.9cd	12.8e-i	16.6fg	68.0hi	70.9de	42.5hi
Milorganite 9	6.9d-g	5.3cd	17.9e-g	22.0d-g	70.7g-i	79.3c-e	45.7f-i
Milorganite 10	6.4d-g	4.4cd	11.5e-i	18.2e-g	76.9g-i	68.7e	44.1g-i
Milorganite 11	10.5c-g	5.2cd	9.9f-i	11.6g-i	64.3hi	76.3de	43.0g-i
Milorganite 12	16.4cd	6.9b-d	13.9e-h	21.6d-g	99.5e-g	95.7b-d	56.3d-h
Ammonium Sulfate	36.8a	28.7a	78.8a	74.1a	162.6ab	103.8a-c	70.6a-d
Ammonium Nitrate	31.8ab	29.9a	63.7bc	76.2a	165.1ab	92.8b-e	71.4a-c
Urea	27.8ab	27.9a	73.3ab	60.6bc	141.3bc	106.6ab	57.6c-g
SCU	35.8a	22.3a	53.5cd	66.9ab	173.5a	125.6a	84.3a
Urea + Sulfur	35.2a	29.7a	63.2bc	64.7ab	136.6b-d	101.8a-c	61.9b-e
Check	0.7g	0.4d	0.3i	0.5i	1.5j	4.1g	3.7k
$LSD_{0.05}$	11.0	8.3	12.8	12.2	30.2	25.0	14.7

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 17.9 sq ft.

Table 2. The effect of Milorganite fertilizers on the fresh clipping weight of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season (continued).[1]

	Weight[2]						
Fertilizers	6/08	6/16	6/22	6/30	7/07	7/22	7/28
Milorganite 1	8.3g	11.7h	6.4gh	6.9h	5.4g	11.7e	15.6e
Milorganite 2	16.9fg	27.7g	24.2fg	36.4g	34.0f	57.7a-d	44.6d
Milorganite 3	27.7ef	30.0fg	30.2ef	39.4g	38.2ef	56.0a-d	47.4cd
Milorganite 4	28.7ef	51.6c-e	63.0b-d	60.5de	57.7d-f	67.4a-c	55.7b-d
Milorganite 5	41.2b-e	52.1c-e	50.8c-e	58.1d-f	63.1c-e	62.5a-d	49.3cd
Milorganite 6	36.8de	48.8de	42.2d-f	48.5e-g	50.9d-f	54.1a-d	45.3d
Milorganite 7	54.4ab	62.2a-d	82.0b	87.3a-c	93.2b	87.5a	86.8a
Milorganite 8	27.1ef	33.3fg	34.0ef	36.2g	40.2ef	49.7cd	44.7d
Milorganite 9	28.8ef	40.2e-g	43.5d-f	50.3e-g	50.0d-f	62.5a-d	51.1cd
Milorganite 10	25.9ef	30.4fg	38.0ef	41.1g	47.8d-f	52.1b-d	46.2cd
Milorganite 11	27.5ef	32.4fg	26.4fg	42.5fg	49.0d-f	51.8b-d	43.9d
Milorganite 12	34.6de	43.0ef	33.9ef	46.8e-g	56.6d-f	60.7a-d	48.0cd
Ammonium Sulfate	53.4a-c	71.8a	109.8a	102.8a	123.1a	85.9ab	74.2ab
Ammonium Nitrate	50.1a-d	63.2a-c	106.4a	93.3ab	97.9ab	66.7a-c	78.4a
Urea	38.4c-e	60.3a-d	70.1bc	86.9a-c	86.8bc	74.3a-c	68.7a-c
SCU	59.8a	67.8ab	62.8b-d	71.9cd	91.6b	78.6a-c	82.9a
Urea + Sulfur	35.1de	54.2b-e	83.6b	84.0bc	74.7b-d	62.9a-d	48.5cd
Check	2.4g	1.7h	1.9h	1.3h	1.2g	28.8de	3.3e
$LSD_{0.05}$	15.7	14.2	21.1	16.0	28.2	35.2	22.6

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 17.9 sq ft.

Table 2. The effect of Milorganite fertilizers on the fresh clipping weight of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season (continued).[1]

	Weight[2]						
Fertilizers	8/04	8/11	8/18	8/30	9/06	9/13	9/20
Milorganite 1	13.9ef	19.0cd	20.0de	20.2ef	10.1	6.3	5.6b
Milorganite 2	39.9cd	45.1b-d	37.7a-d	39.5a-d	19.0	9.6	16.9b
Milorganite 3	40.4cd	48.5bc	41.0a-d	34.8b-d	17.9	8.9	10.8b
Milorganite 4	46.4b-d	55.9a-c	48.5a-c	45.5ab	18.4	8.4	15.3
Milorganite 5	46.1b-d	57.8a-c	38.1a-d	34.3b-d	16.7	11.1	15.4b
Milorganite 6	37.4c-e	45.1b-d	32.7b-d	33.8b-d	12.6	6.7	9.2b
Milorganite 7	60.5a-c	72.4ab	55.7ab	47.3a	28.8	13.2	27.1ab
Milorganite 8	34.1de	58.1a-c	37.5a-d	34.2b-d	16.7	11.2	16.7b
Milorganite 9	35.3de	54.4a-c	43.1a-d	43.0ab	22.3	12.6	19.3ab
Milorganite 10	41.4cd	48.1bc	40.3a-d	33.9b-d	16.9	7.4	11.7b
Milorganite 11	35.0de	44.7b-d	33.7a-d	30.7c-e	13.0	8.6	7.1b
Milorganite 12	36.1de	52.4a-c	30.3cd	29.7de	13.8	6.7	8.5b
Ammonium Sulfate	74.5a	93.7a	56.7a	45.3ab	29.8	12.9	41.4a
Ammonium Nitrate	70.8a	92.6a	54.7ab	42.7a-c	27.0	15.5	43.1a
Urea	55.0a-d	76.8ab	51.1a-c	40.2a-d	26.5	15.7	43.1a
SCU	67.1ab	92.0a	55.7ab	44.7ab	27.2	13.3	20.9ab
Urea + Sulfur	44.6b-d	56.3a-c	35.4a-d	29.6de	19.7	10.7	27.0ab
Check	4.8f	3.9d	5.4e	8.5f	4.1	4.2	3.7b
$LSD_{0.05}$	24.1	42.2	23.1	12.0	NS	NS	24.3

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 17.9 sq ft.

Table 2. The effect of Milorganite fertilizers on the fresh clipping weight of an improved Kentucky bluegrass turf blend growing on clay soil during the 1988 growing season (continued).[1]

	Weight[2]				
Fertilizers	9/27	10/04	10/11	10/18	10/24
Milorganite 1	7.0f	8.1e	4.0	3.7ef	1.7
Milorganite 2	34.6ef	40.4c-e	14.0	9.4d-f	3.7
Milorganite 3	25.8ef	30.1de	11.8	8.9d-f	3.8
Milorganite 4	32.4ef	35.1c-e	12.2	8.9d-f	4.5
Milorganite 5	39.4d-f	50.3c-e	18.7	11.8b-f	6.2
Milorganite 6	22.2ef	30.5de	10.3	9.2d-f	4.1
Milorganite 7	72.3b-e	78.5a-d	34.6	26.8a-d	10.5
Milorganite 8	35.8ef	43.6c-e	15.8	13.0b-f	4.9
Milorganite 9	42.7d-f	46.9c-e	16.4	12.9b-f	6.2
Milorganite 10	24.2ef	34.6de	11.1	10.3c-f	3.9
Milorganite 11	14.2f	28.1de	34.7	9.7c-f	4.0
Milorganite 12	15.9f	34.9de	15.0	11.4b-f	4.3
Ammonium Sulfate	113.0ab	129.9a	43.3	42.4a	19.8
Ammonium Nitrate	129.9a	140.7a	53.2	32.7a-c	22.3
Urea	106.3a-c	118.1ab	45.0	34.3ab	13.4
SCU	54.4c-f	64.9b-e	36.4	29.5a-d	13.2
Urea + Sulfur	94.0a-d	98.4a-c	40.6	25.9a-e	9.5
Check	3.2f	18.7de	2.6	1.6f	1.5
$LSD_{0.05}$	56.4	63.4	NS	23.0	NS

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 17.9 sq ft.

UREASE INHIBITOR STUDY

D. J. Wehner and J. E. Haley

INTRODUCTION

The enzyme urease is responsible for the initial step in the conversion of urea into a form of nitrogen that can be used by the plant. Depending on soil pH, the nitrogen from urea can potentially be held by the soil or lost to the atmosphere by the process of ammonia volatilization. The concept behind a urease inhibitor is to slow the transformation of the N from urea into a form that can be lost by volatilization. The purpose of this study was to evaluate turfgrass response to applications of urea with and without the presence of the urease inhibitor NBPT (N-(n-butyl)thiophosphoric triamide). Ammonium nitrate and sulfur coated urea (SCU) were included in the study to compare turf response from compounds containing N that is not subject to volatilization losses.

MATERIALS AND METHODS

All treatments were applied at the rate of 1 lb nitrogen/1000 sq ft to a mixed stand of Parade, Adelphi, Glade, and Rugby Kentucky bluegrass growing on a Flanagan silt loam soil on 5 May, 7 July, and 25 August 1988. Treatments consisted of: granular urea (46-0-0) with and without NBPT (0.5% by weight of urea); spray applied urea with 0, 5, and 10 g NBPT/1000 sq ft; granular urea watered in immediately after application; SCU (32-0-0); and ammoniun nitrate (33.5-0-0). Granular materials were applied by hand; liquids were applied using a CO_2 powered sprayer with water as a carrier at 3.5 gallons of spray/1000 sq ft. Color ratings were taken weekly after application using a 1 to 9 scale with 9 = dark green turf. Clippings were collected weekly from a 21" wide pass through the middle of each 3 x 10 ft plot and weighed.

RESULTS AND DISCUSSION

The treatments in this study were applied during dry periods to maximize the potential for ammonia volatilization. The color ratings taken during the course of this study are presented in Table 1. Comparison of the ratings for turf treated with granular urea with the ratings for turf receiving granular urea plus inhibitor indicated that there was little difference due to the inhibitor. The same trend was evident when comparing color ratings for turf receiving the liquid applied urea versus the liquid applied urea with the inhibitor at 5 or 10 g/1000 sq ft. There appeared to be a slight advantage to the use of granular urea over liquid applied urea. Turf treated with SCU was not rated higher in color than turf receiving granular urea or ammonium nitrate.

The clipping weights determined in this study are presented in Table 2. The same trends evident from analysis of the color ratings were found from the clipping data. There were no consistent differences due to the presence of the inhibitor. The clipping weights from the SCU treated turf were usually lower than those from the turf treated with urea or ammonium nitrate.

Neither the clipping weights nor color ratings were substantially higher with the inhibitor. This could be due to the fact that the inhibitor was ineffective or that there was minimal volatilization of nitrogen from this study. The treatments were applied during dry periods and not watered in until several days after application. This was done to maximize the amount of nitrogen volatilization from the study. Previous laboratory-based research conducted at the University of Illinois indicated that a liquid-applied urea treatment lost from 3 to 5% of the N through volatilization. If the same magnitude of loss was present in the field, it is doubtful that color ratings or clipping weights would detect the difference due to the presence of the inhibitor.

Table 1. The effect of urease inhibitor on the color of an improved Kentucky bluegrass turf blend during the 1988 growing season.[1]

	Color[2]						
Fertilizers	5/24	6/01	6/06	6/14	6/21	6/29	7/06
Granular urea	7.0b	8.3bc	8.3a	9.0a	8.0bc	6.7ab	7.3a-c
Granular urea w/ inhibitor	6.3c	9.0a	8.0ab	9.0a	8.3ab	7.0a	7.3a-c
Liquid applied urea	7.0b	8.0c	7.0c	8.0b	7.0d	6.3ab	7.0bc
Liquid applied urea w/ powdered inhibitor 5 g/M	6.0c	8.0c	7.0c	8.0b	7.3cd	6.7ab	7.3a-c
Liquid applied urea w/ powdered inhibitor 10 g/M	5.0d	8.0c	7.3bc	8.3ab	8.0bc	6.3ab	7.7ab
Granular urea - watered in	8.0a	8.7ab	8.0ab	7.7b	8.3ab	6.0bc	6.7c
Ammonium nitrate	7.0b	9.0a	8.3a	9.0a	9.0a	7.0a	8.0a
SCU	7.0b	7.0d	6.7c	8.3ab	8.3ab	7.0a	7.3a-c
Check	5.3d	4.0e	4.3d	5.7c	6.0e	5.3c	5.0d
$LSD_{0.05}$	0.4	0.5	0.8	0.7	0.9	0.7	0.9

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 1. The effect of urease inhibitor on the color of an improved Kentucky bluegrass turf blend during the 1988 growing season (continued).[1]

	Color[2]						
Fertilizers	7/13	7/19	7/28	8/03	8/11	8/23	8/30
Granular urea	9.0a	9.0a	8.0a	8.0ab	8.0a	6.3a-c	6.0b
Granular urea w/ inhibitor	7.3c	8.0b	7.3b	8.3a	7.3a-c	7.0a	5.3c
Liquid applied urea	8.0b	7.7b	6.3c	7.7ab	7.3a-c	6.0bc	6.0b
Liquid applied urea w/ powdered inhibitor 5 g/M	8.0b	8.0b	6.3c	8.0ab	8.0a	6.7ab	5.3c
Liquid applied urea w/ powdered inhibitor 10 g/M	8.0b	8.0b	7.3b	7.3ab	7.3a-c	5.7cd	5.3c
Granular urea - watered in	9.0a	9.0a	7.0b	7.7ab	6.7c	6.3a-c	8.0a
Ammonium nitrate	8.7a	8.7a	8.0a	8.0ab	7.7ab	6.7ab	5.3c
SCU	7.7bc	8.0b	8.0a	7.0b	7.0bc	6.0bc	6.3b
Check	4.0d	4.3c	5.0d	4.3c	5.0d	5.0d	5.0c
$LSD_{0.05}$	0.6	0.6	0.7	1.2	0.8	0.8	0.7

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 1. The effect of urease inhibitor on the color of an improved Kentucky bluegrass turf blend during the 1988 growing season (continued).[1]

	Color[2]						
Fertilizers	9/08	9/15	9/22	9/29	10/06	10/14	10/20
Granular urea	9.0a	9.0a	8.3ab	9.0a	6.3a	7.7ab	7.3ab
Granular urea w/ inhibitor	8.0b	8.0bc	9.0a	8.3a-c	6.3a	7.3ab	6.7bc
Liquid applied urea	7.0c	7.0d	8.0b	7.7cd	6.7a	8.0a	6.7bc
Liquid applied urea w/ powdered inhibitor 5 g/M	8.3ab	8.3ab	8.7ab	8.0bc	6.3a	8.0a	6.7bc
Liquid applied urea w/ powdered inhibitor 10 g/M	7.7bc	7.7b-d	9.0a	8.7ab	7.0a	8.0a	7.0ab
Granular urea - watered in	9.0a	9.0a	8.0b	7.0d	6.3a	7.0b	6.0c
Ammonium nitrate	8.0b	8.3ab	8.7ab	8.3a-c	7.0a	7.3ab	7.3ab
SCU	7.0c	7.3cd	8.7ab	9.0a	7.0a	7.7ab	7.7a
Check	4.0d	4.7e	5.0c	4.0e	5.0b	5.0c	4.0d
$LSD_{0.05}$	0.8	0.7	0.7	0.9	0.7	0.7	0.9

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

Table 2. The effect of urease inhibitor on the fresh clipping weight of an improved Kentucky bluegrass turf blend during the 1988 growing season.[1]

Fertilizers	Weight[2]					
	5/26	6/01	6/08	6/16	6/22	6/30
Granular urea	66.4bc	77.9	66.3a	71.8a	50.6	24.9
Granular urea w/ inhibitor	72.7bc	85.2	70.6a	51.3b	37.2	18.8
Liquid applied urea	65.7bc	69.7	53.8ab	41.0bc	34.9	20.4
Liquid applied urea w/ powdered inhibitor 5 g/M	91.0b	95.8	72.7a	41.1bc	31.2	12.4
Liquid applied urea w/ powdered inhibitor 10 g/M	76.4bc	74.5	53.8ab	44.2bc	45.8	25.1
Granular urea - watered in	144.0a	96.1	75.9a	55.9ab	48.1	18.1
Ammonium nitrate	69.8bc	77.8	56.7ab	47.8bc	42.6	17.2
SCU	57.4bc	48.2	39.8bc	49.5b	44.1	20.6
Check	52.9c	33.2	25.5c	29.8c	23.7	15.1
$LSD_{0.05}$	34.0	NS	23.9	19.5	NS	NS

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 14.4 sq ft.

Table 2. The effect of urease inhibitor on the fresh clipping weight of an improved Kentucky bluegrass turf blend during the 1988 growing season (continued).[1]

Fertilizers	Weight[2] 7/06	7/14	7/22	7/29	8/04	8/11
Granular urea	38.4	137.5ab	212.3ab	162.0a	93.4	106.7a
Granular urea w/ inhibitor	35.6	141.0ab	217.1ab	160.5a	96.4	100.9a
Liquid applied urea	34.1	137.7ab	220.4a	161.5a	103.7	109.9a
Liquid applied urea w/ powdered inhibitor 5 g/M	33.0	146.2ab	224.2a	163.4a	98.6	106.8a
Liquid applied urea w/ powdered inhibitor 10 g/M	46.4	161.6a	212.7ab	149.4a	86.5	105.6a
Granular urea - watered in	36.6	158.8a	218.8a	151.6a	82.3	94.0a
Ammonium nitrate	34.8	141.7ab	219.2a	161.5a	89.0	94.1a
SCU	41.5	106.3b	185.5b	149.9a	88.6	110.1a
Check	20.6	42.6c	71.4c	67.5b	49.3	60.6b
$LSD_{0.05}$	NS	47.5	32.9	41.2	NS	28.6

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 14.4 sq ft.

Table 2. The effect of urease inhibitor on thefresh clipping weight of an improved Kentucky bluegrass turf blend during the 1988 growing season (continued).[1]

	Weight[2]					
Fertilizers	8/18	8/24	9/01	9/08	9/15	9/22
Granular urea	64.8	39.8	27.8bc	49.0b	7.3	59.1a
Granular urea w/ inhibitor	58.1	52.2	33.1bc	48.3b	8.5	60.7a
Liquid applied urea	59.8	45.8	30.1bc	40.0bc	8.2	52.6a
Liquid applied urea w/ powdered inhibitor 5 g/M	53.5	43.8	41.8b	53.0b	8.1	63.4a
Liquid applied urea w/ powdered inhibitor 10 g/M	45.5	24.3	26.4c	40.5bc	9.7	63.2a
Granular urea - watered in	45.7	42.9	79.5a	78.1a	11.0	50.5a
Ammonium nitrate	44.8	43.3	30.0bc	51.4b	9.2	61.4a
SCU	52.5	38.3	20.0c	30.4c	5.6	57.8a
Check	45.5	42.7	22.8c	15.0d	4.0	10.1b
$LSD_{0.05}$	NS	NS	15.2	15.1	NS	19.3

(continued)

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 14.4 sq ft.

Table 2. The effect of urease inhibitor on the fresh clipping weight of an improved Kentucky bluegrass turf blend during the 1988 growing season (continued).[1]

	Weight[2]				
Fertilizers	9/29	10/06	10/13	10/20	10/27
Granular urea	44.9a	35.8a	9.5	12.1b	2.4
Granular urea w/ inhibitor	46.1a	34.9a	8.6	19.1a	3.5
Liquid applied urea	40.7a	40.7a	10.4	12.2b	3.3
Liquid applied urea w/ powdered inhibitor 5 g/M	31.8a	35.1a	10.1	13.7ab	2.8
Liquid applied urea w/ powdered inhibitor 10 g/M	45.6a	42.1a	11.3	13.6ab	3.2
Granular urea - watered in	28.9a	33.1a	8.6	12.2b	2.0
Ammonium nitrate	39.7a	32.4a	7.0	14.5ab	3.0
SCU	45.2a	37.1a	8.9	17.3ab	2.6
Check	6.6b	8.5b	3.0	5.5c	1.0
$LSD_{0.05}$	20.0	18.3	NS	6.3	NS

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weight refers to the fresh weight in grams of turfgrass clippings per 14.4 sq ft.

LAKE COUNTY FERTILIZER EVALUATION

T. B. Voigt, R. P. Schmerbauch, T. W. Fermanian, and J. E. Haley

INTRODUCTION

Professional turf managers, lawn care applicators, and home owners can choose from many turf fertilizer products and application regimes. Fertilizers of various formulations, analyses, and mineral availability exist, and application scheduling and rates can also vary greatly. A turf manager should consider these variables, along with soil and turfgrass conditions, when establishing a fertilization program. The objectives of this study were twofold: (a) to determine fertilizer effects on soil pH, and (b) to evaluate general turf quality following fertilizer application.

MATERIALS AND METHODS

This study was initiated on 25 April 1988, when nine fertilizer treatments were applied, replicated three times, to a poor quality Kentucky bluegrass turf. The four fertilizers used in this study were Vitex Lawn and Turf (8-4-5, Dynamic International, Inc.), Vitex Soil Enricher Greens (9-3-6, Dynamic International, Inc.), Urea (46-0-0, Farm Supply), and a locally formulated fertilizer (8-4-5, Farm Supply). Within each replication, four plots received three applications of 1 lb N/1000 sq ft of the above fertilizers at eight week intervals. A second set of four plots received six applications of 0.5 lb N/1000 sq ft of the above fertilizers at four week intervals. A final unfertilized plot was left as a check. Each plot measured 5 x 6 ft.

The test area received no irrigation and was heavily trafficked during a two week portion of the growing season. General turf quality was evaluated using a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality. Plots were evaluated weekly (2 May through 26 September) except during a period of extreme drought (1 July through 18 August) when the turf was dormant and no differences among treatments were noted. The soil pH in the test area was 7.4 on 4 April and ranged from 7.3 to 7.5 on 25 October.

RESULTS

There were no significant differences among treatments, except for three evaluation dates in the early growing season (Table 1). This past summer was extremely hot and dry, resulting in turf that was of poor quality throughout the growing season. A lack of supplemental irrigation, and the presence of traffic in July contributed to overall poor turf quality. Soil pH tests following the growing season indicated little, if any, difference.

This study should be repeated, and, if possible, the test site should be irrigated as necessary to maintain active turf growth. Additionally, the amount of traffic should be reduced. Repeating the study under better growing conditions may allow turf and soil response to fertility differences to become more apparent.

Table 1. The effect of four fertilizers and two application methods on the quality of a Lake County turf during the 1988 growing season.[1]

Treatment	Rate[2] lb N/M 3X	6X	Quality[3] 5/2	5/11	5/16	5/25	5/31
Vitex Lawn & Turf	1.0		5.0	5.7a	5.3ab	5.0a	4.0
Vitex Lawn & Turf		0.5	5.0	5.0ab	4.7b	4.0bc	3.7
Vitex Soil Enricher Greens	1.0		4.7	5.0ab	4.7b	4.7ab	4.0
Vitex Soil Enricher Greens		0.5	5.0	5.0ab	4.7b	4.3ab	3.3
Urea	1.0		5.0	5.0ab	5.7a	4.7ab	3.7
Urea		0.5	5.0	4.7bc	4.7b	4.3ab	3.3
Locally Formulated	1.0		5.0	5.0ab	5.7a	4.7ab	4.0
Locally Formulated		0.5	4.7	5.0ab	5.0ab	4.0bc	4.0
Check			4.3	4.0c	3.7c	3.3c	3.0
$LSD_{0.05}$			NS	0.7	0.9	0.8	NS

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]One pound rates were applied 3 times during the growing season, 25 April, 20 June and 11 August. One half pound rates were applied 6 times during the growing season, 25 April, 23 May, 20 June, 18 July, 11 August, and 12 September.

[3]Quality evaluations are made on a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality.

PREEMERGENCE CONTROL OF CRABGRASS

J. E. Haley, T. W. Fermanian and D. J. Wehner

INTRODUCTION

Preemergence herbicides for control of crabgrass have been available to turfgrass managers for many years. Periodically, new herbicides and new turf formulations of field crop herbicides are developed that need to be evaluated for crabgrass control and compared to the existing materials. The purpose of this research was to evaluate the new herbicides Mon 15151 1EC, Mon 15179 0.5G, Ronstar 50WP, Ronstar 1.05ME, Prograss 1.5EC, Prodiamine 65DG, Team 10%, Lesco R11299, Lesco R11309, Lesco R12510, Lesco R12547, Lesco R11353, Lesco R11428, and Balan 60DG for crabgrass control.

MATERIALS AND METHODS

The herbicides used as industry standards in this study were Dacthal (DCPA, Fermenta Plant Protection Co.) at 10.5 lbs ai/A; Ronstar 2G (oxadiazon, Rhone-Poulenc) at 1.0, 2.0 and 3.0 lbs ai/A; Team 2G (balan + trifluralin, Elanco) at 3.0 lbs ai/A; Betamec 4EC (bensulide, Stauffer) at 7.5 lbs ai/A; Lesco Pre-M 60DG (pendimethalin, Lesco) at 1.5 lbs ai/A and Balan (benefin, Elanco) at 2.0 + 2.0 lbs ai/A. New herbicides that were evaluated were Mon 15151 1EC (undisclosed, Monsanto Agricultural Co.) at 0.125, 0.25, 0.5 and 1.0 lb ai/A; Mon 15179 0.5G (undisclosed, Monsanto Agricultural Co.) at 0.125, 0.25, 0.5 and 1.0 lb ai/A; and Prodiamine 65DG (prodiamine, Sandoz Crop Protection) at 0.5 and 0.75 lb ai/A. Also evaluated were Prograss 1.5EC (ethofumesate, Nor-Am) at 1.5 + 1.0 lbs ai/A and new turf formulations of Ronstar 50WP and Ronstar 1.05ME at 1.0, 2.0 and 3.0 lbs ai/A; Team 10% sprayable (benefin + trifluralin, Spring Valley Turf Products) at 2.0 and 3.0 lbs ai/A; several Lesco herbicide plus fertilizer combinations (undisclosed), Lesco R11299, R11309, R12510, R12547, R11428, and R11353 at 4.0 and/or 6.0 lbs product/1000 sq ft; and Balan 60DF at 2.0 + 2.0 lb ai/A. All treatments were applied on 28 April 1988 to an improved Kentucky bluegrass turf blend. Where a second treatment was required applications were made on 10 June 1988. Liquid herbicides were applied with a small plot sprayer at a spray volume of 40 gpa. Granular materials were applied by hand. Each treatment was replicated 3 times and an untreated check was included with each replication. Plot size was 3 x 10 ft. The turf was mowed at 3/8 inches and irrigated to encourage crabgrass germination. Plots were evaluated for percent crabgrass control. Percent crabgrass control was determined by comparing percent cover with crabgrass of each treated plot and comparing it to percent cover with crabgrass in the untreated check.

RESULTS

When interpreting the results please keep in mind that the period of crabgrass germination was much longer than usual and that crabgrass pressure was not as great as in previous years (7-15% on 7/20 and 30-70% on 8/24 in the untreated check). Most herbicides provided good (80% or better) crabgrass control well into midsummer (Table 1). Crabgrass germination continued throughout the season and many herbicides were no longer active mid to late August. Products that provided less than 75% control on 24 August were Prograss at 1.5 and 1.5 + 1.0 lbs ai/A, Spring Valley Team at 2.0 and 3.0 lbs ai/A, Dacthal at 10.5 lbs ai/A, Ronstar 2G at 2.0 and 3.0 lbs ai/A, Lesco Pre-M at 1.5 lb ai/A, Lesco R11428 at 4 lbs cf/1000 sq ft, Mon 15151 at 0.125, 0.25 and 0.5 lb ai/A, and Mon 15179 at 0.125 lb ai/A.

Some phytotoxicity was noted with a few of the herbicides. This could be a result of extremely high temperatures and/or a very close mowing height and might not occur under other environmental and cultural conditions. Phytotoxicity scores of 7.0 or lower (unacceptable injury for a high quality turf) were found with Mon 15179 at 0.5 and 1.0 lb ai/A, Mon 15151 at 1.0 lb ai/A, Lesco R12547 at 6 lbs cf/1000 sq ft, Team at 3.0 lbs ai/A, and Balan 60DF at 2.0 + 2.0 lbs ai/A.

Table 1. The evaluation of herbicides for preemergence control of crabgrass in an improved Kentucky bluegrass turf blend applied 28 April 1988.[1]

Herbicide	Rate lb ai/A	% Crabgrass Control[2] 7/20 83 DAT[4]	% Crabgrass Control[2] 8/24 118 DAT	Phytotoxicity[3] 7/13 76 DAT
Mon 15151 1EC	0.125	55.7g	47.4kl	8.7ab
Mon 15151 1EC	0.25	67.5e-g	66.9e-j	9.0a
Mon 15151 1EC	0.5	74.4c-g	66.9e-j	8.3a-c
Mon 15151 1EC	1.0	96.7ab	95.9ab	6.3e
Mon 15179 0.5G	0.125	60.2fg	61.9g-k	8.3a-c
Mon 15179 0.5G	0.25	85.2a-e	93.7ab	7.3c-e
Mon 15179 0.5G	0.5	96.7ab	98.1a	6.7de
Mon 15179 0.5G	1.0	100.0a	99.5a	5.0f
Ronstar 50WP	1.0	83.0a-e	76.7b-h	9.0a
Ronstar 50WP	2.0	96.7ab	95.9ab	8.7ab
Ronstar 50WP	3.0	100.0a	97.6a	8.7ab
Ronstar 2G	1.0	69.0e-g	55.4i-l	9.0a
Ronstar 2G	2.0	62.4fg	58.9h-l	9.0a
Ronstar 2G	3.0	89.7a-d	84.7a-f	8.7ab
Ronstar 1.05ME	1.0	83.0a-e	82.8a-f	8.7ab
Ronstar 1.05ME	2.0	83.0a-e	90.8a-c	8.7ab
Ronstar 1.05ME	3.0	90.0a-d	92.6ab	8.3a-c
Prograss 1.5EC	1.5	60.2fg	42.5l	8.7ab
Prograss 1.5EC	1.5 + 1.0[*]	83.0a-e	71.6c-i	8.7ab
Prodiamine 65DG	0.5	96.7ab	99.2a	8.3a-c
Prodiamine 65DG	0.75	100.0a	99.2a	8.3a-c
Spring Valley Team 10%	2.0	59.5fg	48.4j-l	9.0a
Spring Valley Team 10%	3.0	76.7b-f	47.4kl	7.3c-e
LESCO R11299	4.0 lb cf/M	85.2a-e	83.1a-f	8.3a-c
LESCO R11309	4.0 lb cf/M	73.5d-g	86.2a-e	8.7ab
LESCO R12510	4.0 lb cf/M	87.8a-e	81.2a-g	8.7ab
LESCO R12510	6.0 lb cf/M	96.7ab	98.7a	7.3c-e
LESCO R12547	4.0 lb cf/M	96.7ab	95.8ab	7.3c-e
LESCO R12547	6.0 lb cf/M	91.9a-d	86.1a-e	6.7de
LESCO R11353	4.0 lb cf/M	96.7ab	82.3a-f	8.3a-c
LESCO R11353	6.0 lb cf/M	100.0a	94.0ab	7.7b-d
LESCO R11428	4.0 lb cf/M	89.7a-d	70.4d-i	8.3a-c

(continued)

Table 1. The evaluation of herbicides for preemergence control of crabgrass in an improved Kentucky bluegrass turf blend applied 28 April 1988 (continued).[1]

Herbicide	Rate lb ai/A	% Crabgrass Control[2] 7/20 83 DAT[4]	8/24 118 DAT	Phytotoxicity[3] 7/13 76 DAT
LESCO's Pre-M 60DG	1.5	93.0a-d	70.4d-i	8.3a-c
Team 2G	3.0	90.0a-d	82.5a-f	5.0f
Balan 60DF	2.0 + 2.0*	100.0a	93.1ab	6.7de
Balan 2.5G	2.0 + 2.0*	100.0a	95.8ab	8.3a-c
Dacthal 75WP	10.5	94.4a-c	65.5f-k	8.7ab
Betamec 4EC	7.5	96.7ab	88.8a-d	9.0a
Check	---			9.0a
$LSD_{0.05}$		20.5	19.4	1.2

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Percent crabgrass control represents percent control of the crabgrass plant in the plot when compared with the untreated check.

[3]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible injury to the turf and 1 = complete necrosis.

[4]DAT refers to days after treatment.

*The second application was made 10 June 1988.

EVALUATION OF PRODIAMINE FOR PREEMERGENCE CONTROL OF CRABGRASS

J. E. Haley and T. W. Fermanian

INTRODUCTION

Prodiamine (Sandoz Crop Protection) is a herbicide currently being evaluated at the University of Illinois as a preemergence annual grass control. Very little is known about the effect of prodiamine on turfgrass, especially over several growing seasons. Experiments have been established to evaluate the potential phytotoxicity of prodiamine applied over the long term and to examine its ability to control crabgrass.

1984 EVALUATION

MATERIALS AND METHODS

This evaluation consisted of treatments of prodiamine at 0.25, 0.38, 0.50, 0.75 and 2.0 lbs ai/A and Dacthal at 5.25, 10.5 and 21.0 lbs ai/A. Dacthal (DCPA, Fermenta Plant Protection) at the 1/2, 1 and 2 times recommended label rates was included for comparison as one industry standard for preemergence weed control. Herbicides were applied to one set of plots in the fall (6 November 1984, 3 October 1985 and 23 October 1986) and to another set of plots in the spring (20 April 1985, 18 April 1986 and 18 April 1987). Treatments were replicated 3 times and an untreated check was included in each fall and spring application. Materials were applied to 3 x 10 ft plots of common Kentucky bluegrass using a small plot sprayer in a spray volume of 40 gpa. On 1 September 1987 one half of each plot was sprayed with Roundup (glyphosate, Monsanto Agricultural Co.) at 5 qts/A. On 15 September 1987 one half of the glyphosated area was seeded with a blend of Kentucky bluegrass at 1.8 lbs/1000 sq ft. The other half of the treated area was sodded with a commercial nursery blend of Kentucky bluegrass sod.

RESULTS

In the past, crabgrass control was good to excellent with all spring applications of Dacthal and Prodiamine. Crabgrass control was also good to excellent with fall applications of Prodiamine at rates of 0.5, 0.75 and 2.0 lbs ai/A. Turf injury was visible on the turf treated in the fall with 2.0 lbs ai/A. There was no significant difference in turf density among treatments in the half of the plot not renovated (Table 1). Turf density was not affected by repeated herbicide applications 12 months after the last herbicide treatment. In the seeded plots a significant reduction in Kentucky bluegrass germination was noted where treated in the fall with prodiamine at

2.0 lbs ai/A and in spring treated plots of prodiamine at 0.38, 0.75 and 2.0 lbs ai/A and Dacthal at 5.25 and 21.0 lbs ai/A. Plant survival and development were significantly reduced with spring applications of Dachtal at 21.0 lbs ai/A and with spring and fall applications of prodiamine at 2.0 lbs ai/A.

1988 EVALUATION

MATERIAL AND METHODS

On 30 April 1988 prodiamine was applied to 2 adjacent Kentucky bluegrass turfs that had been established the previous fall. The first turf, a blend of Aspen, Trenton, Rugby and Parade, had been seeded 15 September 1987. The second turf, a blend of Parade, Rugby, Adelphi, and Glade, was established with sod also on 15 September 1987. Treatments applied on 30 April 1988 to both turfs included prodiamine at 0.5, 0.75, 1.0, 1.25, 1.5, 1.75 and 2.0 lbs ai/A. Several split applications were made with the second treatment applied on 10 June 1988. These treatments were prodiamine at 0.25 + 0.25, 0.5 + 0.25, 0.5 + 0.5, 0.75 + 0.25, and 0.75 + 0.5 lbs ai/A.

Prodiamine was applied using a small plot sprayer at a spray volume of 40 gpa. Plot size was 3 x 10 ft. Each treatment was replicated 3 times and an untreated check was included with each replication. The turf was monitored for herbicide injury.

RESULTS

No injury was observed on any of the turf established by sod. Significant phytotoxicity was visible on the turf established by seed with prodiamine rates of 1.75 and 2.0 lbs ai/A (Table 2). The suggested rate of prodiamine is projected to be 0.5 lb ai/A with a total annual rate of 1.0 lb ai/A. This would indicate that prodiamine is safe on a 7 month old turf at manufacturer's rates, however, additional evaluations are planned.

Table 1. The evaluation of Kentucky bluegrass turf treated with prodiamine in the spring and fall from November 1984 to April 1987.[1]

Herbicide	Rate lb ai/A	Time of Application[3]	Density[2] 4/04/88	Seedling Survival[4]
Dacthal	5.25	spring	8.6	1.22a-c
Dacthal	10.5	spring	9.2	1.58ab
Dacthal	21.0	spring	9.1	0.57de
Prodiamine	0.25	spring	8.1	1.25a-c
Prodiamine	0.38	spring	10.0	1.15b-d
Prodiamine	0.50	spring	10.0	1.04b-d
Prodiamine	0.75	spring	8.3	0.81cd
Prodiamine	2.0	spring	8.0	0.17e
check	---		9.4	1.56ab
Dacthal	5.25	fall	8.6	1.47ab
Dacthal	10.5	fall	8.3	1.24a-c
Dacthal	21.0	fall	6.6	1.53ab
Prodiamine	0.25	fall	8.2	1.05b-d
Prodiamine	0.38	fall	10.0	1.81a
Prodiamine	0.50	fall	7.8	1.33a-c
Prodiamine	0.75	fall	9.0	1.41a-c
Prodiamine	2.0	fall	7.2	0.17e
check	---		7.2	1.33a-c
$LSD_{0.05}$			NS	0.63

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Density refers to the average number of shoots per 1 square centimeter.

[3]Fall applications were made 6 November 1984, 3 October 1985 and 24 October 1986. Spring applications were made 20 April 1985, 18 April 1986, and 18 April 1987.

[4]Seedling survival refers to the average number of shoots per 1 square centimeter. The turf was slit seeded 15 September 1987 and seedling survival was recorded 13 April 1988.

Table 2. The evaluation of prodiamine applied on 30 April 1988 to turf established by seed on 15 September 1987.[1]

Herbicide	Rate lb ai/A	Phytotoxicity[2] 7/22/88
Prodiamine	0.5	9.0a
Prodiamine	0.75	9.0a
Prodiamine	1.0	8.7a
Prodiamine	1.25	8.3a
Prodiamine	1.5	8.7a
Prodiamine	1.75	6.7b
Prodiamine	2.0	5.3c
Prodiamine	0.25 + 0.25*	8.7a
Prodiamine	0.50 + 0.25*	8.3a
Prodiamine	0.50 + 0.50*	8.0a
Prodiamine	0.75 + 0.25*	8.3a
Prodiamine	0.75 + 0.50*	8.0a
Check	---	9.0a
$LSD_{0.05}$		1.0

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible injury to the turf and 1 = complete necrosis.

*Second applications were made 10 June 1988.

POSTEMERGENCE CONTROL OF CRABGRASS

J. E. Haley, D. J. Wehner, and T. W. Fermanian

INTRODUCTION

Crabgrass (Digitaria sp.) is one of the most frequently occurring weeds in turf. It can be controlled by application of either preemergence or postemergence herbicides. Preemergence herbicides are the preferred crabgrass control method. If preemergence herbicides fail to control crabgrass throughout the season or are applied after some weed germination has occurred then postemergence herbicides are needed. In the past, organic arsenicals were the primary herbicides used for postemergence crabgrass control. In recent years another postemergence crabgrass control herbicide, fenoxaprop (Acclaim, Hoescht Roussel Agri-Vet), has been introduced into the turf market. Acclaim is generally thought to be less phytotoxic and more efficacious with a single application than the organic arsenicals. The purpose of this research was to evaluate new herbicides along with some industry standards for postemergence control of crabgrass.

MATERIALS AND METHODS

Extreme drouth and high temperatures in central Illinois early in the growing season delayed crabgrass germination. Early applications (2 leaf - 1 tiller) were made 1 July. Treatments included Acclaim 1EC applied at 0.18 lb ai/A; Acclaim at 0.25 lb ai/A plus Ronstar 50WP (oxadiazon, Rhone-Poulenc) at 0.5, 0.75, and 1.0 lb ai/A; Daconate 6 (MSMA, Fermenta Plant Protection Co.) at 2.0 + 2.0 lbs ai/A; Daconate 6 at 2.0 lbs ai/A plus Ronstar 50WP at 0.5 and 1.0 lb ai/A; and Prograss 1.5EC (ethofumesate, Nor-Am) at 1.5 lbs ai/A. Also included in the evaluation was an experimental herbicide from Monsanto Agricultural Co., Mon 15151 1EC at 0.25, 0.5, and 0.75 lb ai/A; at 0.5 lb ai/A with Acclaim at 0.09 lb ai/A; and at 0.5 lb ai/A with Daconate 6 at 1.0 lb ai/A.

Late applications (2-5 tillers) were made 19 July. Herbicides applied at this time were Acclaim 1EC at 0.18 and 0.25 lb ai/A; and Daconate 6 at 2.0 + 2.0 lbs ai/A. Additional evaluations of Mon 15151 at 0.5, 1.0 and 1.5 lb ai/A; Mon 15151 at 0.75 lb ai/A with Acclaim at 0.18 lb ai/A; and with Daconate 6 at 1.0 lb ai/A were included. Surfactant X77 was used at 0.5% v/v with all Mon 15151 applications. Second applications of Daconate 6 were made on 19 July for the early treatment and 2 August for the late treatment. Herbicides were applied with a backpack sprayer at a spray volume of 40 gpa.

RESULTS

When treated early the best crabgrass control was found with combinations of pre and postemergence herbicides (Acclaim + Ronstar, Daconate 6 + Ronstar), with herbicides that provide both pre and postemergence control (Mon 15151) or with 2 applications of postemergence herbicides (Daconate 6) (Table 1). This is probably due to significant crabgrass germination following the application of the herbicides. Good crabgrass control was found with all herbicides applied on 19 July. Significant turf injury was observed with early and late applications of Acclaim alone and in combination with Mon 15151 or Ronstar. Some injury was visible with early and late applications of Daconate 6 + Mon 15151 and late applications of Daconate 6 alone.

Table 1. The evaluation of herbicides for postemergence control of crabgrass applied to an improved Kentucky bluegrass turf blend in 1988.[1]

Herbicide	Rate lb ai/A	% Crabgrass Control[2] 8/04 34 DAT[4]	% Crabgrass Control[2] 8/24 54 DAT	Phytotoxicity[3] 7/13 12 DAT	Phytotoxicity[3] 8/04 34 DAT
	Applied 7/1/88				
Acclaim 1EC	0.18	88.3ab	70.6bc	6.3c-e	8.0a-c
Daconate 6	2 + 2*	98.3a	87.3ab	8.7ab	7.7a-d
Mon 15151 1EC	0.25	93.3a	91.9a	8.3ab	8.0a-c
Mon 15151 1EC	0.5	95.0a	95.8a	7.7a-c	7.0c-e
Mon 15151 1EC	0.75	100.0a	96.9a	8.0ab	7.3b-e
Mon 15151 + Acclaim	0.5 + 0.09	98.3a	96.8a	7.3b-d	7.7a-d
Mon 15151 + Daconate 6	0.5 + 1.0	100.0a	93.3a	7.3b-d	8.0a-c
Prograss 1.5EC	1.5	50.0c	57.8c	8.3ab	9.0a
Ronstar 50WP + Acclaim	0.5 + 0.25	98.3a	93.3a	5.3e	8.0a-c
Ronstar 50WP + Acclaim	0.75 + 0.25	98.3a	93.6a	6.0de	8.7ab
Ronstar 50WP + Acclaim	1.0 + 0.25	96.7a	97.5a	6.3c-e	7.7a-d
Ronstar 50WP + Daconate 6	0.5 + 2.0	63.3c	56.4c	8.7ab	8.0a-c
Ronstar 50WP + Daconate 6	1.0 + 2.0	70.0bc	70.0bc	9.0a	8.7ab
	Applied 7/19/88	16 DAT	36 DAT		16 DAT
Acclaim 1EC	0.18	93.3a	96.8a		7.7a-d
Acclaim 1EC	0.25	100.0a	98.5		6.3d-f
Daconate 6	2 + 2**	100.0a	88.1ab		5.0f
Mon 15151 1EC	0.5	96.7a	100.0a		8.7ab
Mon 15151 1EC	1.0	98.3a	100.0a		8.0a-c
Mon 15151 1EC	1.5	100.0a	100.0a		6.3d-f
Mon 15151 + Acclaim	0.75 + 0.18	100.0a	100.0a		6.0ef
Mon 15151 + Daconate 6	0.75 + 1.0	100.0a	100.0a		7.0c-e
Check				9.0a	8.7ab
$LSD_{0.05}$		21.2	18.4	1.5	1.6

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Percent crabrasss control represents percent control of the crabgrass plant in the plot when compared with the untreated check.

[3]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible injury to the turf and 1 = complete necrosis.

[4]DAT refers to days after treatment.

*Second applications were made on 19 July 1988.

**Second applications were made on 2 August 1988.

ACCLAIM APPLIED TO AN IMPROVED KENTUCKY BLUEGRASS BLEND

J. E. Haley and D. J. Wehner

INTRODUCTION

The herbicide Acclaim (fenoxaprop, Hoechst Roussel Agri-Vet) has been shown to be an effective postemergence control of crabgrass. Some turf injury has been noted with applications to Kentucky bluegrass. It is believed that applications of nitrogen made with Acclaim will reduce or mask any phytotoxic effects the herbicide might have on some improved Kentucky bluegrass cultivars. Our first experiment evaluated Acclaim alone and in a tank mix with nitrogen and several herbicides.

It has also been observed that Acclaim activity is reduced when the herbicide is applied in tank mixes with phenoxy herbicides or with dicamba. A second study evaluated Acclaim 1EC in tank mixes with several postemergence broadleaf weed control herbicides.

MATERIALS AND METHODS

In the first evaluation herbicide treatments included Acclaim at 0.08 and 0.12 lb ai/A with Lesco Pre-M (pendimethalin, Lesco) at 1.5 lbs ai/A; Acclaim at 0.18 and 0.25 lb ai/A with Lesco Pre-M at 1.5 lbs ai/A and Trimec (2,4-D, MCPP and dicamba, PBI Gordon) at 3 pts product/1000 sq ft; Acclaim at 0.12 lb ai/A with Prodiamine (prodiamine, Sandoz Crop Protection) at 0.75 lb ai/A; and Acclaim at 0.12 lb ai/A. All treatments included urea (45-0-0) at 1.0 lb N/1000 sq ft. Herbicide applications were made with a backpack sprayer at a spray volume of 3.0 gallons/1000 sq ft on 30 June 1988. A TK SS 30 flood jet nozzle was used to simulate the spray guns used by the lawn care industry.

In the second evaluation treatments included Acclaim at 0.18 and 0.25 lb ai/A; Acclaim at 0.25 lb ai/A with Breakthru (chlorflurenol methyl ester, The Andersons) at 0.125 lb ai/A plus Turflon (triclopyr, Dow Chemical) at 0.125 plus Banvel 4S (dicamba, Velsicol) at 0.1 lb ai/A; this herbicide combination with Urea (45-0-0) at 0.5 lb N/1000 sq ft; Acclaim at 0.25 lb ai/A with Breakthru at 0.125 plus Turflon at 0.125 lb ai/A; Acclaim at 0.18 and 0.25 lb ai/A with Turflon Amine at 0.38 lb ai/A; Acclaim at 0.18 lb ai/A with BAS 514 (quinclorac, BASF); Acclaim at 0.25 lb ai/A with clopyralid (Dow Chemical) at 0.25 lb ai/A plus Turflon at 0.38 lb ai/A; and Acclaim at 0.25 lb ai/A with Banvel at 0.25 lb ai/A. Herbicide applications were made with a backpack sprayer at a spray volume of 3.0 gallons/1000 sq ft on 19 July 1988. Because some difficulties were encountered using the flood jet nozzle to spray small plots an even flat fan nozzle was used in this evaluation.

In both evaluations treatments were replicated 3 times and an untreated check was included with each replication. The 9 month old turf was a blend of improved Kentucky bluegrass cultivars mowed at 0.5 inches and irrigated to encourage crabgrass germination. Plots were evaluated for percent crabgrass control. Percent crabgrass control is determined by comparing percent crabgrass cover of each treated plot with percent crabgrass cover of the untreated check plot.

RESULTS

In the first evaluation there was no difference in crabgrass control among the treatments on any of the rating dates (Table 1). Although more injury was observed with some of the treatments this injury appeared to be associated with the addition of the preemergence herbicide pendimethalin rather than with Acclaim. The authors believe that some injury may have resulted from uneven pesticide/fertilizer application caused by the use of the flood jet nozzle.

In the second evaluation the addition of broadleaf weed herbicides with Acclaim did not seem to effect crabgrass control (Table 2). Some turf injury was observed with all treatments except the untreated check. In both evaluations efficacy and injury were probably influenced by high temperatures and low mowing height.

Table 1. The evaluation of Acclaim applied with urea at a spray volume 152.5 gpa to an improved Kentucky bluegrass turf blend on 30 June 1988.[1]

Herbicide + Urea[4]	Rate lb ai/A	% Crabgrass Control[2] 7/20 20 DAT[*]	8/04 35 DAT	Phytotoxicity[3] 7/13 13 DAT
Acclaim + Urea	0.12	90.0	83.9	8.0ab
Lesco's Pre-M + Urea	1.5	63.3	57.2	7.3b-e
Acclaim + Pre-M + Urea	0.08 + 1.5	86.7	86.1	7.3b-e
Acclaim + Pre-M + Urea	0.12 + 1.5	90.0	83.8	6.3e
Acclaim + Pre-M + Trimec + Urea	0.12 + 1.5 3 pt cf/M	81.9	73.9	7.7b-d
Acclaim + Pre-M + Trimec + Urea	0.18 + 1.5 3 pt cf/M	78.6	63.9	7.0c-e
Acclaim + Pre-M + Trimec + Urea	0.25 + 1.5 3 pt cf/M	86.7	84.5	6.7de
Acclaim + Prodiamine + Urea	0.12 + 0.75	96.7	83.7	8.0ab
Check				9.0a
$LSD_{0.05}$		NS	NS	1.2

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Percent crabgrass control represents percent control of the crabgrass plant in the plot when compared with the untreated check.

[3]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible injury to the turf and 1 = complete necrosis.

[4]Urea was applied at 1 lb nitrogen per 1000 sq ft.

[*]DAT refers to days after treatment.

Table 2. The evluation of Acclaim applied with broadleaf weed control herbicides to an improved Kentucky bluegrass turf blend on 19 July 1988.[1]

Herbicide	Rate lb ai/A	% Crabgrass Control[2] 8/04 16 DAT[*]	% Crabgrass Control[2] 8/24 36 DAT	Phytotoxicity[3] 8/04 16 DAT
Acclaim	0.18	93.6	98.8a	5.3de
Acclaim	0.25	96.9	98.8a	4.7e
Acclaim + Breakthru + Turflon	0.25 + 0.125 + 0.125	97.5	97.3a	6.0b-d
Acclaim + Breakthru + Tuflon + Banvel	0.25 + 0.125 + 0.125 + 0.1	90.8	96.4a	6.3b-d
Acclaim + Turflon amine	0.18 + 0.38	90.8	93.6a	6.7bc
Acclaim + Turflon amine	0.25 + 0.38	89.2	97.4a	5.7c-e
Acclaim + Breakthru + Turflon + Banvel + Urea	0.25 + 0.125 + 0.125 + 0.1 + 0.5 lb N/M	99.2	97.1a	6.3b-d
Acclaim + BAS 514	0.18 + 0.5	84.7	76.3b	7.0b
Acclaim + clopyralid + triclpyr	0.25 + 0.25 + 0.38	98.3	98.5a	7.0b
Acclaim + Banvel	0.25 + 0.25	95.3	96.7a	6.7bc
Check				9.0a
$LSD_{0.05}$		NS	12.5	1.1

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Percent crabgrass control represents percent control of the crabgrass plant in the plot when compared with the untreated check.

[3]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible injury to the turf and 1 = complete necrosis.

[*]DAT refers to days after treatment.

EVALUATION OF HERBICIDES FOR BROADLEAF WEED CONTROL IN TURF

D. J. Wehner and J. E. Haley

INTRODUCTION

The purpose of this research was to evaluate several herbicides for postemergence control of broadleaf plantain (Plantago major L.), buckhorn plantain (Plantago lanceolata L.), and dandelion (Taraxacumofficinale Weber) in a mixed Kentucky bluegrass - tall fescue turf. Two separate studies were conducted, one at 40 gallons spray volume per acre and one at 152 gallons of spray volume per acre.

MATERIALS AND METHODS

Herbicides listed in Table 1 were applied on 14 June 1988 using a CO_2 powered sprayer in either 40 (Table 2) or 152 (Table 3) gallons of water per acre. Plot size was 3 x 10 ft and each treatment, along with an untreated check, was replicated three times. Weed control evaluations were made on 28 July 1988 using a scale of 1 to 9 with 9 = a large, healthy weed population and 1 = no weeds present.

RESULTS AND DISCUSSION

The hot dry weather during the test period slowed the activity of the herbicides compared to other years. No irrigation was available on the site, however, a small amount of water was provided with a tank truck. The materials applied at the 40 gallon per acre rate (Table 2) all provided excellent control of dandelion with the exception of EH 946 at the low rate. Although not as effective as the other treatments, EH 946 still reduced the weed population below that of the check. There was more variation in control of plantain. Treatments ranged in effectiveness from complete control with EH 937 to EH 946 and the combination of GR007 + GR008 + Turflon amine which provided the least control.

In general, less weed control was observed with the herbicides that were applied in 152 gallons of water per acre. The dilution of the herbicides along with the unfavorable growing conditions probably magnified the difficulties associated with controlling the weeds. The best dandelion control was observed with Turflon D while the best plantain control was observed with Turflon II amine (Table 3).

Table 1. Herbicides evaluated for postemergence control of dandelions and broadleaf and buckhorn plantain during the 1988 growing season.

Herbicide	Active Ingredients	Manufacturer
Banvel	dicamba	Velsicol
Turflon Amine	triclopyr	Dow Chemical USA
Turflon II Amine	2,4-D amine, triclopyr amine	Dow Chemical USA
Turflon D	triclopyr, 2,4-D	Dow Chemical USA
XRM-5085	triclopyr amine, clopyralid amine	Dow Chemical USA
XRM-4993	triclopyr amine, clopyralid amine	Dow Chemical USA
Trimec	2,4-D, MCPP, dicamba	Dow Chemical USA
EH937	2,4-DP, 2,4-D, dicamba	PBI-Gordon Corporation
EH680	2,4-DP, 2,4-D, dicamba	PBI-Gordon Corporation
EH946	MCPA, MCPP, dicamba	PBI-Gordon Corporation
Riverdale Weedestroy Tri-Ester II	MCPA, MCPP, 2,4-D	Riverdale Chemical Co.
GR007	undisclosed	
GR008	undisclosed	

Table 2. Postemergence control of dandelion and plantain 44 days following herbicide application on 14 June 1988.[1]

Herbicide	Rate oz ai/A	Weed Control[2] Plantain 7/28	Dandelion 7/28
GR007	0.75	1.3gh	1.0c
GR007	1.5	1.7f-h	1.0c
GR007 + GR008	0.75 + 0.25	2.3e-h	1.0c
GR007 + GR008	0.50 + 0.50	2.0e-h	1.0c
GR007 + Banvel	0.75 + 0.125 lb ai/A	1.7f-h	1.0c
GR007 + Turflon Amine	0.25 + 0.125 lb ai/A	4.7bc	1.0c
GR007 + Turflon Amine	0.50 + 0.25 lb ai/A	3.0d-f	1.0c
GR007 + GR008 + Banvel	0.50 + 0.25 + 0.125 lb ai/A	2.0e-h	1.0c
GR007 + GR008 + Turflon Amine	0.25 + 0.125 + 0.125 lb ai/A	5.0b	1.3c
GR007 + GR008 + Turflon Amine	0.50 + 0.25 + 0.25 lb ai/A	4.0b-d	1.0c
Trimec	3.0 pt cf/A	2.0e-h	1.7c
EH 937	2.0 pt cf/A	2.7d-g	1.0c
EH 937	3.0 pt cf/A	1.0h	1.0c
EH 680	2.0 pt cf/A	1.3gh	1.0c
EH 946	2.0 pt cf/A	5.0b	3.0b
EH 946	3.0 pt cf/A	3.3c-e	1.0c
Riverdale Weedestroy Triester II	2.0 pt cf/A	1.7f-h	1.3c
check		9.0a	9.0a
$LSD_{0.05}$		1.6	0.9

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weed evaluations are made on a scale of 1-9, where 9 = no control of the weed species and 1 = no weeds present.

Table 3. The evaluation of postemergence broadleaf weed control herbicides applied at 152.5 gpa on 14 June 1988.[1]

		Weed Control[2]	
	Rate	Plantain	Dandelion
Herbicide	pt cf/A	44 DAT[*]	44 DAT
XRM-5085	1.0	4.0bc	4.0bc
XRM-5085	1.5	4.3b	3.7b-d
XRM-5085	2.0	4.7b	3.0b-d
XRM-4993	1.0	5.7b	4.7b
Turflon II Amine	2.5	1.7c	3.3b-d
Turflon D	2.5	3.7bc	2.0d
Trimec	3.0	5.7b	2.3cd
check		9.0a	9.0a
$LSD_{0.05}$		2.5	1.9

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Weed evaluations are made on a scale of 1-9, where 9 = no control of the weed species and 1 = no weeds present.

[*]DAT refers to days after treatment.

CONTROL OF BUCKHORN PLANTAIN

T. W. Fermanian, T. B. Voigt, R. Kane and J. E. Haley

INTRODUCTION

Buckhorn plantain (Plantago lanceolata L.) is a common pest of Illinois turfs. It is most easily controlled with the use of 2,4-D or similar herbicides, moderate fertilization, and moderate irrigation. In some turfs, however, buckhorn plantain can be a persistent, hard to control weed. Chicago Golf Club in Wheaton, IL has had continuing problems controlling buckhorn plantain on the course roughs and in general areas. The course is maintained as a links-style course with long, unmowed roughs grown under low fertility. Cultural controls for managing weed populations are quite limited. This research is a continuation of an initial study at the Chicago Golf Club begun in 1987. The continuing objectives of this research are to evaluate the ability of common herbicides or their combinations and to evaluate the timing of their application to control buckhorn plantain at this particular location.

MATERIALS AND METHODS

A field study was established near the 14th fairway on 15 September 1988. Broadleaf weed herbicides were applied alone or in combination (Table 1). Early treatments were made on 15 September with repeat applications made on 13 October. Late treatments were initially applied on 29 September and retreated on 27 October. Each phenoxy based herbicide or combination was applied with and without urea (1 lb N/1000 sq ft). Urea was added to the spray mixture to promote herbicide uptake. The highest rate for each material was within the current label rate range. All herbicides selected are commercially available and labeled for use on some type of turf. At the time of application, buckhorn plantain was present on the plots in populations which covered 5 to 60% of the plots. All treatments were applied at 65 gpa with a small plot sprayer at 20 psi. Treatments were arranged as a randomized complete block design with four replications. Plot size was 3 X 10 ft.

RESULTS

Materials were applied during the fall of 1988 and will be evaluated in late Spring, 1989. A final report of this project will be presented in the 1989 Turfgrass Research Report.

Table 1. Herbicide treatments, rates and application timings to control buckhorn plantain at the Chicago Golf Club during the 1988 growing season.

	Rates[1]			
	Early Treatments		Late Treatments	
	1st	2nd	1st	2nd
Herbicide[2]	9/15	10/13	9/29	10/27
2,4-D Ester[a]	2.0	2.0	2.0	2.0
2,4-D Ester	2.0 +	2.0	2.0	2.0
+ Urea	1.0 lb N/M	1.0 lb N/M	1.0 lb N/M	1.0 lb N/M
Trimec[b]	2.0	2.0	2.0	2.0
Trimec	2.0 +	2.0	2.0	2.0
+ Urea	1.0 lb N/M	1.0 lb N/M	1.0 lb N/M	1.0 lb N/M
Super Trimec[c]	1.5	1.5	1.5	1.5
Super Trimec	1.5 +	1.5	1.5	1.5
+ Urea	1.0 lb N/M	1.0 lb N/M	1.0 lb N/M	1.0 lb N/M
Escort 60WDG[d]	0.25 oz cf/A		0.25 oz cf/A	
Escort 60WDG	0.5 oz cf/A		0.5 oz cf/A	
Telar 75WDG[e]	1.0 oz cf/A		1.0 oz cf/A	
Untreated				

[1]All rates are quarts of commercial formulation per acre except where noted.

[2]All herbicide and herbicide/urea treatments were applied in a 0.75% solution of X77 surfactant and a 0.3% solution of colorant.

[a]2,4-D Ester consists of 3.8 lbs/gal of 2,4-D.

[b]Trimec consists of 2.03 lbs/gal of 2,4-D, 1.08 lbs/gal of MCPP, and 0.21 lbs/gal of dicamba.

[c]Super Trimec consists of 2.0 lbs/gal of 2,4-D, 2.0 lbs/gal of 2,4-DP, and 0.5 lbs/gal of dicamba.

[d]Escort 60WDG consists of 60% metsulfuron methyl.

[e]Telar 75WDG consists of 75% chlorsulfuron.

TURFGRASS RENOVATION AND OVERSEEDING METHODS

T. B. Voigt, J. E. Haley, and D. J. Wehner

INTRODUCTION

Turf conversions from one grass species or cultivar to another to improve turf playability, pest resistance, environmental tolerance, or appearance is commonplace on golf courses and home lawns. Often, old turf areas are chemically killed prior to mechanically planting the desired turf species. Different mechanical planting methods used by turf managers include core aerification, vertical mowing, spiking or slicing followed by broadcast seeding. Slit seeders are also used as a single step operation. This study examines mechanical methods regularly employed for overseeding following chemical killing by glyphosate.

MATERIALS AND METHODS

A perennial ryegrass area was treated with glyphosate (Roundup, Monsanto Agricultural Co.) at a 2 qts/A rate on 23 August 1988. On 6 September 3 x 10 ft plots were planted with tall fescue or Kentucky bluegrass using five different methods. The tall fescue blend planted at 6 lbs/1000 sq ft was Triathalawn Tall Fescue Mixture (Northrup King), a combination of Bonanza, Olympia, and Apache tall fescues. Germination was 90% PLS. The Kentucky bluegrass seed planted at 2 lbs/1000 sq ft was a blend of the cultivars Adelphi, Mystic, Rugby and Parade. Planting methods were as follows:

1) slit seeded (Ryan Mataway Overseeder);
2) core aerified (Ryan Greensaire, one pass, 1/2" tines), seed broadcast;
3) core aerified (Ryan Greensaire, one pass, 1/2" tines), one-half seed broadcast, slit seeded remainder;
4) disturbed with a vertical mower 0.3" deep, seed broadcast;
5) rototilled, seed broadcast.

All broadcast seed was raked in lightly. Each method was replicated 3 times for each turf species.

Following planting, the area was fertilized with 1 lb N/1000 sq ft using a 25-5-15 fertilizer with 10% sulfur. The plots were irrigated as necessary to insure germination. On 17 October 1988, five 2 x 2 inch randomly selected plugs were removed from each plot. A count of live shoots was made to determine density.

RESULTS

No significant differences in seedling density were noted among planting methods in either tall fescue or Kentucky bluegrass planted plots

(Table 1). Additionally, there were no differences among methods when density was averaged over both species (Table 1).

During the early portion of the 1989 growing season a second shoot count will be made to determine differences in density and winter survival among treatments.

Table 1. The density per 4 square inches of tall fescue and Kentucky bluegrass seedlings planted by 5 different methods on 6 September 1988.[1]

Treatment	Density[2] Tall Fescue	Kentucky Bluegrass	Over Both Species[3]
Slit seed	38.3	31.1	34.7
Core aerify, Broadcast seed	36.4	28.7	32.5
Core aerify, Broadcast seed/slit seed	37.9	31.9	34.9
Vertical mow, Broadcast seed	32.4	30.6	31.5
Rototill, Broadcast seed	43.3	30.7	37.0
$LSD_{0.05}$	NS	NS	NS

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference test.

[2]Density is reported as turfgrass shoots per 4 square inches.

[3]Values represent the mean of 6 scores obtained from 3 replications and 2 turf species.

CANOPY TEMPERATURE BASED STRESS DETECTION OF COOL SEASON TURFGRASSES

D. L. Martin and D. J. Wehner

INTRODUCTION

Nearly all aspects of turfgrass management are aimed at eliminating or controlling the degree of environmental stress to which turf is exposed. A technique for rapid and accurate assessment of turfgrass stress would be a welcome tool to any turfgrass manager. Canopy temperature based stress detection techniques appear to be the tools needed by turfgrass managers. In work performed on agronomic crops, such techniques have been useful in water stress detection and irrigation scheduling. Early detection of plant damage due to pathogen or insect attack has also been realized. The limited body of canopy temperature work performed on turf suggests the same benefits can be realized by turfgrass managers. A brief review of background information on the infrared thermometer and stress detection will be provided before discussing our research in this area.

An infrared thermometer is used to measure the overall temperature of the plant canopy in each of the several canopy temperature based stress detection techniques thus far devised. The infrared thermometer is used to provide a rapid and accurate measure of the surface temperature of the plant canopy(by measuring long wave or infrared radiation emitted by the plants). The underlying principle behind canopy temperature based stress detection methods is that when plants transpire, the temperature of the leaves are lowered. When transpiration is reduced the leaves are not cooled to as great of a degree. Factors such as reduced available soil moisture and injury to roots or shoots act to lower transpiration, raising the temperature of affected plants relative to well watered unaffected plants.

One of the most versatile of the canopy temperature based methods is the crop water stress index (CWSI) method. The CWSI value, a measure of the degree of stress being suffered by the plant, is calculated by determining the temperature difference between the plant canopy and the surrounding air. This difference is then corrected for the environmental conditions prevailing at the time of the canopy temperature measurement such as relative humidity, solar radiation and wind speed. The most simple models correct only for the humidity of the air, while more complex models correct for additional environmental variables.

The CWSI scale (range) will vary depending upon the specific methods used to calculate the CWSI values; most scales range from 0 to 1, with 0 being no stress and values approaching 1 being severe stress. The stress index method cannot tell the user the cause of the stress, rather simply alert him/her to the degree of stress being suffered by the plant. A key understanding of cultural and environmental factors acting on the plant is still required in order to pinpoint the cause of the stress and to take proper corrective actions. A typical scenario in deducing the cause of the stress on the plant would first involve reviewing the irrigation history of the site (amount, frequency, proper sprinkler pattern, etc.) before looking to soil related problems or suspecting damage to foliage or roots from insects or pathogens.

To date the CWSI method of stress detection has found its greatest utility in irrigation scheduling of agronomic crops. Irrigation is performed when the plants under consideration reach a predetermined CWSI value depending upon the species present, the intensity of management, and the targeted yields.

A very limited body of canopy temperature research specific to turf exists, and only recently has commercial equipment targeted at turfgrass managers been introduced to the market. Several questions exist regarding stress detection and the scheduling of irrigation using the CWSI method. These questions include i) is a single stress detection model applicable across all turfgrass species and management regimes, ii) how complex of a model is needed to accurately determine the stress to which turf is being exposed, iii) what time of day is best for accurately determining the stress to which turf is exposed, iv) at what CWSI value should irrigation be undertaken for bluegrasses or bentgrasses to achieve a desired level of quality? Our research is aimed at finding answers to these questions.

MATERIALS AND METHODS

STUDY ONE

The objective of this study is to determine whether a single model is appropriate for predicting the canopy-air temperature difference of well watered turfgrasses (essential in constructing a CWSI model) as well as to determine the number of environmental variables necessary to accurately predict the value of that difference. The Kentucky bluegrasses used in this study were maintained under regular mowing at 1 7/8 inch and fertilization at 4 lbs of N/1000 sq ft/yr while the creeping bentgrass was maintained at 3/8 inch and fertilized with 6 lbs N/1000 sq ft/yr. All turf was maintained under moist conditions. Canopy temperature, air temperature, relative humidity, net radiation and wind speed were measured on/over 17 x 17 ft nonreplicated plots of Penncross creeping bentgrass; South Dakota Common, America, Kenblue, and Bristol Kentucky bluegrass; and a blend of Adelphi, Glade, Parade and Rugby Kentucky bluegrass. The measurements were taken on 17 dates between 6 June and 14 Oct 1988. Each plot was monitored for four one minute periods, with samples taken every 5 seconds and then averaged to provide a mean for each of the four one minute sampling periods. Sampling was performed between 12 and 3 pm. Various linear additive models were fitted to the canopy-air temperature difference found on the sampling dates for each plot. Additional data will be taken in 1989 to further refine the predictive models generated in 1988.

STUDY TWO

The objective of this study is to determine the optimum time of day for taking readings of the CWSI on turfgrass. The environmental variables discussed under Study One were sampled from nonreplicated well watered and drought stressed plots of the Kentucky bluegrass blend (cultural practices were as previously discussed). Sampling was performed on seven dates between 28 June and 7 Oct 1988. One one minute sampling period (sampling every 5 secs) was performed every thirty minutes from approximately 8 am to 6 pm on the turf under the two moisture regimes. At the time of publication, analysis of the results of this study were not complete. Additional sampling dates are planned for the 1989 growing season.

STUDY THREE

In 1989 several of the CWSI models developed during the 1988 growing season will be used to schedule irrigation on Penncross creeping bentgrass and the Kentucky bluegrass blend. Irrigation will take place at several preselected CWSI values and the quality response of turf under each irrigation regime recorded. This information will aid in determining CWSI values at which turfgrass managers should irrigate in order to achieve a desired level of turfgrass quality.

RESULTS AND DISCUSSION

STUDY ONE

Models developed from 1988 data for predicting the canopy-air temperature difference of well watered turf utilized i) the vapor pressure deficit (VPD); ii) VPD and net radiation load and iii) VPD, net radiation load and wind speed as variables for predicting the canopy-air temperature difference. As expected the percentage of variability in the canopy-air temperature difference accounted for by the models increased with the number of variables in the model. The single variable equations utilizing only the VPD accounted for less variability than those published for other crops. However, it should be noted that data in this study was taken under both clear and overcast skies (unlike the conditions under which models for other crops have been generated). In order for the stress index model to be useful to turfgrass managers in the midwest it must be useful under a variety of meteorological conditions. Based on the inability of the single variable model to account for a majority of the variation in canopy-air temperature differences, it seems likely that vapor pressure deficit as well as some measure of light level will be necessary if the stress index model is to be useful under conditions when cloud cover prevails. Additional data from the 1989 growing season as well as testing the models on independent data sets will be necessary before we can confidently determine if a single predictive equation can be utilized across both Kentucky bluegrass and creeping bentgrass.

ABILITY OF TRAINED AND UNTRAINED INDIVIDUALS TO IDENTIFY MORPHOLOGICAL CHARACTERS OF IMMATURE GRASSES

T. W. Fermanian, M. Barkworth and H. Liu

INTRODUCTION

In the maintenance of fine turf, controlling weeds is a major operation. The initial step in any control program is the correct identification of weed species and an assessment of their abundance. Grass weeds are particularly difficult to identify because of their similarity to turf species. In addition, frequent mowing removes the reproductive structures on which identification is usually based. Identifications of juvenile grasses have to be based on the characteristics of vegetative structures which is especially difficult because their characteristics are greatly affected by growing conditions.

Several keys have been constructed for the identification of mature grasses through their vegetative characters. These are helpful, but are designed primarily for plant taxonomists and are difficult for untrained individuals to use. During the last fifteen years, several computer-based identification keys have been developed. These are an improvement over written keys because they permit the user to select a character (e.g. size, shape, color, etc.) overriding the computer program's order of selection. None of these early programs, however, employed a formal procedure for evaluating the relative effectiveness of individual characters for supporting a correct identification.

Recently, expert systems technology (computer software) has been used to build identification systems that provide an alternative to traditional written identification keys. One of the primary objectives of these programs is to develop identification tools for use by non-specialists.

WEEDER, a grass identification system based on expert systems technology, has a similar objective. In an initial study, it was not determined whether the potential performance level of WEEDER had been realized. WEEDER was, however, found to be a more effective at identifying examined species than a written identification key.

One problem which affected both WEEDER and the written identification key was the inability of users to select the correct alternative state for describing some of the characters. Interestingly, untrained individuals were found to have only a slightly more difficult time than trained individuals. Two possible basis for the problem are i) the characters involved are more variable than recognized in the design of WEEDER or ii) the distinctions between the alternative states of a character are too fine for practical purposes. Adjustment of the relative weight, a measure of the importance a character state has in identifying the species, of each character-state pair in WEEDER improved its performance rating. It seemed appropriate, therefore, to determine the consistency with which the correct state of a particular character could be identified by both trained and untrained individuals. This information could then be used to modify the relative weights attached to the states of each of the characters. With this in mind, the following objectives were set for this study: i) to determine, for each selected character, whether untrained individuals could identify the correct state as often as trained individuals, ii) to determine, for selected characters, which of the alternative states was most frequently correctly identified, and iii) to determine if combining alternative states would change the abilities of trained and untrained individuals to recognize the correct alternative for each of selected characters.

METHODS AND MATERIALS

Seeds or young seedlings of 18 grass species (Table 1) commonly found in turfs of the United States were either collected locally or purchased (Valley Seed Service, Fresno, CA). Seeds were sown in 5 x 5 cm plastic plots in a standard greenhouse mix and placed under mist for germination and development in a greenhouse. There was some variation in the growth rate between species, but all were allowed to develop until the shortest species attained a height of 12-15 cm. Interfering debris and contaminant species were removed prior to the experiments.

Each participant was provided with an instruction booklet and a score sheet. The instruction booklet included line drawings illustrating the vegetative morphology of a grass plant plus, for each vegetative character that was to be studied, illustrations of possible alternative states. The score sheet resembled a multiple choice examination, with individual characters corresponding to the questions and alternative states to the choices. For each character, participants were asked to circle the alternative state they considered most accurately represented what they observed on the plant they were examining. If they were unable to decide, to select the alternative 'Do not know'.

The first set of observations involved individuals with little or no knowledge of grasses (untrained participant group.) The participants were 40 students enrolled in an introductory horticulture course on the campus of the University of Illinois at Urbana-Champaign and four volunteers at Utah State University. A the beginning of a session, participants were instructed in the use of the booklet, the general area to look on plant specimens for the required characters, and the use of the supplementary materials (e.g. hand lens, dissecting microscopes, etc.) Grass specimens were then presented to participants randomly. Throughout the session, individuals were available to answer questions of a general nature. Participants were instructed to continue to select as many new grass specimens for examination as possible within the time allowed (approximately one hour). This led to some variation in the total number of specimens examined (Table 1).

Observations from trained participants were obtained from sessions held at various locations. In these sessions, participants were faculty members in turfgrass science and graduate students with field experience in grass identification at six midwestern universities and experienced graduate students at Utah State University. At each location, the procedures followed were the same as those used with the untrained participants. The number of trained participants that examined each species is summarized in Table 1.

Each alternate state chosen was considered correct if it matched the state(s) provided in the rules of WEEDER. The frequency of correct and incorrect (including 'Do Not Know') responses for each character was tabulated by group. For each character, a Chi square test was used to test the independence of correct response frequency and participant group.

RESULTS

Forty-four untrained participants completed 204 evaluations of 18 species whereas 24 trained participants completed 130 evaluations of the same group of species. The frequency with which a correct alternative was selected for each character among all specimens examined within a group is shown in Table 2. Blade width, vernation, auricle, and pubescence were the only characters of the nine examined which were chosen correctly more than 65% of the time by either group.

Considered over all characters, the trained participants selected the correct alternative 59% of the time, the untrained participants 53%. There was no significant association between participant group and selection ability for ligule size, sheath, blade width, collar, and pubescence when all species were considered jointly. The ability to identify the correct kind of vernation was significantly related to group membership, but the relationship between identification ability and participant group was even stronger for ligule type, growth habit, and auricle (Table 2).

Blade width and ligule size were the only quantitative characters among the nine studied and were determined by comparing the character with a scale provided in the instruction booklet. It seems likely that 'incorrect' values reported for this character reflect variation in the specimens rather than the inability of the students to make accurate measurements.

The high frequency of correct responses to the auricle character reflects, in part, the large number of species which had no auricles (15) and the ease with which this determination was made. An analysis of the frequency of each correctly selected alternative state for auricle within a group (Table 3) indicated a highly significant dependence on the state for both trained and untrained individuals.

For three characters, ligule type, ligule size, and growth habit, the correct values were selected less than 50% of the time by either group (Table 2). In each case, the trained participants did better than the untrained participants, significantly so in the case of ligule type and growth habit. Growth habit was the most difficult of all characters for the untrained group. This was probably attributable to the immaturity of the specimens being used, all of which were less than 6 weeks old.

DISCUSSION

It is evident from this study that the alternative states of some characters (e.g., sheath, blade width, vernation, and auricle) were easier to identify than those of other characters. Unfortunately, these characters are not particularly useful for identifying individual species because they are not sufficiently variable between species. For instance, most grasses have a compressed leaf sheath; most grasses lack auricles; most temperate grasses have rolled vernation. Consequently, although these characters are helpful in identifying the relatively few species exhibiting the uncommon state, they provide little assistance in most instances.

Ligule type and ligule size present the opposite problem. They are, theoretically, very useful for discriminating between the 18 species but, because of the difficulty participants found in identifying the state in a given plant, their effective reliability is low. In such instances, it is advisable to determine whether the effective reliability can be increased by combining or redefining the alternative states in a way that makes it easier for users to identify the correct state. While participants from either group correctly identified the states of round and acute for ligule type in all specimens examined, they were less then 50% accurate in recognizing the states of truncate and acuminate (Table 3). The frequency a ligule type state was correctly selected was reanalyzed after selected rules in WEEDER were modified to consider the states of truncate or round and acute or acuminate as correct when either state in one of the pairs was originally considered correct. After modification, the percent frequency of correctly identified states of ligule type increased from 47 to 62% and 31 to 49% for the trained and untrained groups, respectively.

Alternatively, it may be that the species examined are more variable than suggested by the original rules developed to determine a correct state. If examination of a number of specimens proved this to be the case, the rules should be further modified. Such an examination, which should include specimens derived from a number of different sources, was beyond the scope of this study.

For all but two characters (sheath and pubescence) trained individuals were more successful in selecting the correct character state for a given plant. It is worth noting, however, that the difference was not significant for five of the variables. This supports the idea that an expert system for grass identification could be a functional tool for untrained individuals. For both trained and untrained participant groups, the ability to identify the correct state of a character was approximately 10% higher than the ability of each group to identify the species to which a plant specimen belonged in an earlier study.

On the basis of this study, we would recommend that anyone attempting to construct an identification tool examine both the ability of each character used to discriminate among the included species and the ability of expected users to correctly select among the alternative states or conditions of each character. Both factors must be considered in determining the levels of uncertainties in the system.

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Table 1. Number of participants in each group examining specimens of 18 grass species.

Common Name	Scientific Name	Number Selected[1] Untrained	Trained	Total
Redtop	Agrostis alba L.	10	5	15
Creeping bentgrass	Agrostis palustris Huds.	13	3	16
Bermudagrass	Cynodon dactylon (L.) Pers.	14	4	18
Large crabgrass	Digitaria sanquinalis (L.) Scop.	18	10	28
Barnyardgrass	Echinochloa crusgalli (L.) Beauv.	7	3	10
Quackgrass	Elytrigia repens Desv. ex Jacobs. [=Agropyron repens]	6	4	10
Tall fescue	Festuca arundinacea Schreb.	6	10	16
Red fescue	Festuca rubra L.	14	6	20
Velvetgrass	Holcus lanatus L.	14	9	23
Italian ryegrass	Lolium multiflorum Lam.	12	5	17
Perennial ryegrass	Lolium perenne L.	9	5	14
Dallisgrass	Paspalum dilatatum Poir.	7	8	15
Bahiagrass	Paspalum notatum Flugge.	21	11	32
Timothy	Phleum pratense L.	7	5	12
Kentucky bluegrass	Poa pratensis L.	4	6	10
Yellow foxtail	Setaria glauca (L.) Beauv.	14	9	23
Johnsongrass	Sorghum halepense (L.) Pers.	16	12	28
Zoysiagrass	Zoysia japonica Steud.	12	15	27
Total specimens selected		204	130	334

[1]Total number of specimens selected by participants within a group.

Table 2. Percent frequency with which trained and untrained participants identified the correct alternative for each character for all 18 grass species examined.

Test Group	Percent Correctly Identified								
	Ligule Type	Ligule Size	Sheath	Blade width	Vernation	Collar	Growth habit	Auricle	Pubescence
Trained[a]	47	48	60	78	89	60	38	92	66
Untrained[b]	31	43	62	77	80	52	20	76	69
	**	NS	NS	NS	*	NS	**	**	NS

[a]Test group consisting of Turfgrass Science faculty and graduate students at six Midwestern universities and faculty and graduate students at Utah State University.

[b]Group of students from an introductory Horticulture class and students at Utah State University.

*,**Significant at the 0.05 and 0.01 levels, respectively. NS = not significant at the 0.05 level.

Table 3. Percent frequency with which trained and untrained participants identified correctly an alternative state for three characters examined in 18 grass species.

Alternative states Character	Alternative States							
	Percent Correctly Indentified							
	absent	toothed	ciliate	truncate	acuminate	round	acute	
Ligule type								
Trained[a]	0	15	76	46	33	100	100	**
Untrained[b]	0	0	44	21	4	100	100	**
	folded	rolled						
Vernation								
Trained	100	95	**					
Untrained	100	84	**					
	absent	short	clawlike					
Auricle								
Trained	94	100	33	**				
Untrained	96	100	25	**				

[a]Test group consisting of Turfgrass Science faculty and graduate students at six Midwestern universities and faculty and graduate students at Utah State University.

**Significant at the 0.01 levels.

[b]Group of students from an introductory Horticulture class and students at Utah State University.

AN EXPERT SYSTEM FOR PLANNING THE ESTABLISHMENT OF TURFS IN ILLINOIS

T. W. Fermanian and H. Liu

INTRODUCTION

Establishing a new turf or renovating an old one is a routine practice in the management of turfgrasses, however, advice from turf experts on the design of the new turf is not always readily available. The initial task in the establishment of a turf is the development of an establishment design which considers the intended use of the turf. Knowledge-based advisory systems, commonly referred to as expert systems, have shown great potential for planning tasks. While TURFPLAN, an expert planning system, was constructed principally for turf managers, it may be used by anyone in related areas (e.g. Extension staff, educators, contractors, etc.). The major design tasks of TURFPLAN are the selection of turfgrass species and their cultivars, establishment procedures, and maintenance procedures during the post-planting period.

Turf establishment typically includes four stages. The initial stage is the development of a design for the intended turf. Design decisions are necessary to determine the intended use of the turf, the available annual maintenance budget, resources available during the establishment procedure (i.e. funds, equipment, labor, etc.) and the timing of establishment procedures. Site preparation, planting, and post-planting care are the final three stages, respectively. The success of an establishment is equally dependent on the success of each stage. The initial design stage is the most knowledge intensive and is best suited to utilize computer technology for assistance.

Expert systems are sophisticated computer programs that are able to solve problems within a narrowly defined area or domain. Most of these systems were designed to provide advice for the general task of diagnosis or goal selection. Since the design stage of turf establishment requires planning, the objectives of this study were: i) to investigate the application of expert system methodology to a planning task in turfgrass management; ii) to develop an expert system for planning for the establishment of turfs in Illinois.

MATERIALS AND METHODS

Development of TURFPLAN

TURFPLAN was designed for turfs in the North Central United States, particularly Illinois. The major tasks of TURFPLAN are the selection of turfgrass species and their cultivars, establishment procedures, and maintenance procedures during the post-planting period. A goal-driven paradigm was chosen for selecting the best potential design from those included in TURFPLAN. The establishment knowledge domain, therefore, was divided into four main concepts: i) intended use of turf and its projected annual maintenance budget; ii) selection of turfgrass species and cultivars; iii) environmental conditions and constraints and the establishment process; iv) Post-plant maintenance (Fig. 1).

Relationships within each of the four main concepts were considered as the primary elements of TURFPLAN. All the included knowledge was classified into one of these four elements. Information on the intended use of the turf and an estimated budget is queried from the user. A projected level of maintenance is then determined by the system and control of the dialog is passed to the element for site preparation and planting methods. Control is chained to further elements as necessary for the intended maintenance level.

The expert system development environment, Expert System Environment (ESE, International Business Machines Corporation, Endicott, NY), was selected as the tool for the development of TURFPLAN. ESE was operating on an IBM 3081GX computer under the CMS (Release 4.0) operating system. It is a rule-based expert system building tool (International Business Machines Corporation, 1986) with two subenvironments, Expert System Development Environment (ESDE) and Expert System Consultation Environment (ESCE). Four megabytes of RAM are necessary for running TURFPLAN.

A portion of the rules for the selection of turfgrass cultivars were developed from examples through inductive learning (AURORA, International Intelligent Systems, Inc., Fairfax, VA) Inductive learning was used to construct rules for the selection of Kentucky bluegrass cultivars. Data from the national Kentucky bluegrass evaluation trial were examined to construct examples of cultivar performance over 21 locations. Three performance groups (high, medium, low) were develop for each location by partitioning cultivars by statistical mean grouping (LSD.) Cultivar names along with site and maintenance data listed in the report were entered into AURORA as example input for inductive learning. Rules produced through learning, which represented the surface level associations between cultivar performance and site parameters, were then added to the appropriate cultivar selection element of TURFPLAN.

Evaluation Study

An evaluation of TURFPLAN's performance was conducted by comparing a set of its establishment designs to a comparable set developed by turf experts. The study was carried out in two steps with turfgrass establishment designs being collected from a group of turfgrass scientists first. These designs along with the those suggested by TURFPLAN were then submitted to a second group of nationally recognized turf experts (30 turfgrass scientists who were members of the Crop Science Society of America, C-5 division) for their evaluation of the suitability of each design for its intended use.

The human experts, along with TURFPLAN, were asked to designed turf establishments for five different proposed sites. Eight turfgrass science professors designed turf establishments for i) a highway right of way turf in central Illinois; ii) a homelawn in northern Illinois; iii) a golf course green in northern Illinois; iv) a football field in southern Illinois; v) a golf course fairway in northern Illinois. Designs from four of the eight experts were randomly selected for the evaluation. For each proposed site there were five designs, one from TURFPLAN and four from human designers, one from each of the four selected experts.

The human designers were asked to select an appropriate value from a list of values for 12 possible design elements for each design (Table 1). Designs were developed in TURFPLAN after the authors replied to questions on the same design elements.

The second group of turf experts were asked to rank the five designs for each site in the order of best to worse design for the proposed situation. Ties were permitted. The sources of the designs were not available to them. Each evaluator ranked these five designs from 1 to 5 with 1 representing the best design. Analyses of variance were developed for the mean rank among designers and between the mean rank of the TURFPLAN design and the mean rank of all the human designers for each proposed site.

RESULTS AND DISCUSSION

Twenty-two evaluations were returned from the second group of turf experts. An analysis of variance of rank, assigned by the evaluators. for the five turf designs for each situations showed significant differences in the mean rank (Table 2). For the proposed highway right of way turf, designs from experts 2 and 3 were ranked higher than the TURFPLAN design. No significant differences in mean rank were found among TURFPLAN, expert 1 and expert 4 designs. A comparison of the mean rank of the TURFPLAN design to the mean of the four expert designs indicated TURFPLAN provided a lower ranked design than the experts (Table 3).

An analysis of the expert ranking of designs for establishing a homelawn showed that TURFPLAN provided a significantly higher ranked design than any of the experts alone (Table 2) or their combined mean rank (Table 3.) The opposite was found in the analysis of ranking means of golf course green establishment designs. The TURFPLAN design was ranked significantly lower than three of the four human designs when compared alone (Table 2) and when compared to the mean rank of all human experts (Table 3.) Designs for a football field and a golf fairway showed no significant difference in the mean rank of designs between TURFPLAN and the experts either alone or together.

TURFPLAN was perceived to produce poor establishment designs for low maintenance turfs (i.e. highway rights of way) and high maintenance turfs (i.e. golf course greens). The knowledge base currently does not have an adequate quantity of knowledge about either low or very high maintenance level turf establishment. However, for medium maintenance turfs, TURFPLAN was perceived to match or exceed the experts in providing advice.

The evaluators were asked for additional comments along with their ranking of the designs. Many evaluators indicated they had difficulty in assigning a rank to a design. Some of the reasons offered: i) there were too many decisions involved, it would be better to rank each variable for each proposed turf; ii) many differences in design selections were arbitrary or insignificant; iii) insufficient number of design elements used; iv) not familiar with Illinois conditions. Due to these concerns and the perceived limitations of the TURFPLAN knowledge base, it has not been released for general use.

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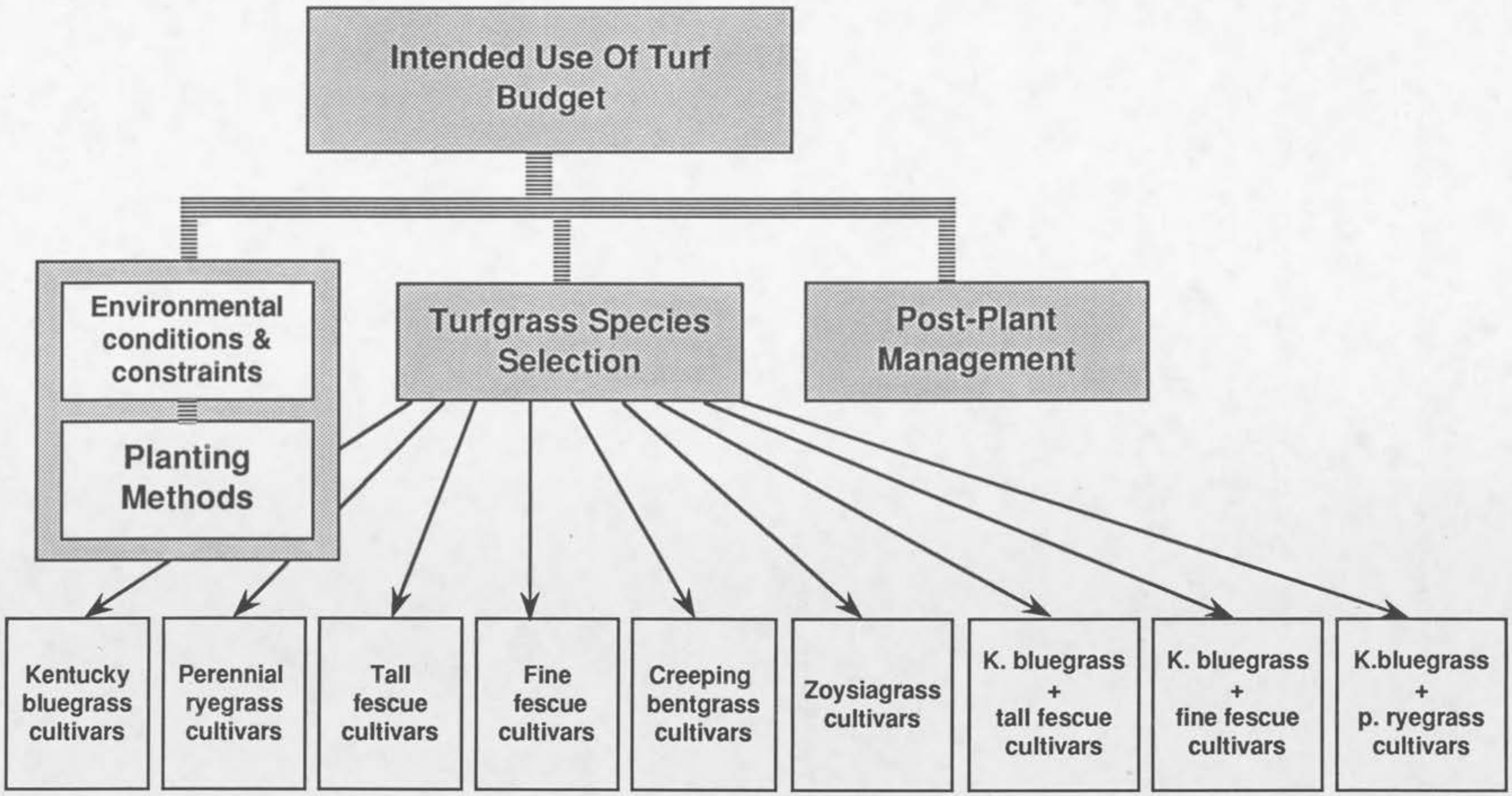

Figure 1. Organization Of Major Establishment Concepts In Turfplan

Table 1. Elements used for constructing designs to establish turf for five proposed sites.

Design Element	Values[1]
Turfgrass species	*Poa pratensis* L., *Agrostis palustris* Huds., *Festuca arundinacea* Schreb., *Festuca rubra* L., *Lolium perenne* L., *Zoysia japonica* Steud.
Soil preparation-tillage	plowing, rototilling, harrowing, disking, chisel, none[2]
Basic fertilizer	quantity of P_2O_5, K_2O, or N to add[2]
Soil modification	quantity of texture amendment, sulfer, or limestone to add[2]
Drainage	surface, surface and subsurface, none
Planting method	seeding, sodding, broadcast stolonizing, plugging, sprigging
Seeding method	broadcast seeding, slit seeding, hydroseeding
Planting time	spring, summer, fall
Mulch	required, not required
Irrigation	scheduled, not scheduled but available, none
Mowing (first year)	<2 times/season, <2 times/month, <1 time/week, 1 time/week,2 times/week, 3 times/week, 1 time/day
Weed control	preemergence annual grass herbicide, postemergence selective broadleaf herbicide, nonselective preplant herbicide, none

[1]Primary values. The complete set of values is listed in Liu, 1988.

[2]May choose more than one value. Only applicable if seeding is selected for "Planting method".

Table 2. Mean design suitability rank among five turf establishment designs for five proposed turfs.

Design source	Proposed Turf: Highway right of way	Homelawn	Golf course green	Football field	Golf course fairway
TURFPLAN	3.7c[1]	1.8a	4.0c	2.7a	2.9ab
Expert 1	2.9c	2.8bc	2.4a	3.8b	3 6b
Expert 2	1.8a	2.8b	3.7bc	3.3ab	3.4b
Expert 3	2.2ab	3.7cd	2.2a	2.5a	2.4a
Expert 4	4.4c	4.1d	2.8ab	2.8ab	2.3a
$LSD_{0.05}$	0.8	0.9	1.0	1.0	1.0
CV	41	44	47	49	47

Table 3. Mean design suitability rank between the mean of four human turf establishment designs and a TURFPLAN design for five proposed turfs.

Design source	Proposed Turf: Highway right of way	Homelawn	Golf course green	Football field	Golf course fairway
TURFPLAN	3.7b[1]	1.8a	4.0b	2.7a	2.9a
Experts	2.8a	3.3b	2.8a	3.1a	2.9a
$LSD_{0.05}$	0.8	0.8	0.8	0.8	0.8
CV	50	48	51	52	51

[1]Means with the same letter are not significantly different at the 0.05 level as determined by Least Significant Difference test.

Preliminary Surveys of Nematode Populations on Putting Greens in the Chicago Area

R.T. Kane and H.T. Wilkinson

Introduction

Interest in possible nematode injury on highly maintained putting green turf has increased in recent years. "Heat stress" is no longer an acceptible diagnosis for loss of Poa annua and Agrostis palustris (creeping bentgrass) on putting greens. Closer attention is being paid to soils, rooting, and root parasites, including nematodes. A survey was begun in the Chicago area in April 1987 to determine the prevalence of different genera of parasitic nematodes, and to attempt to relate these populations to turf injury. This report will briefly summarize the results of these surveys, and will include a small study of the effects of Nemacur (phenamiphos) on nematode populations and turf injury.

Methods

Soil samples were taken from a total of 23 putting greens from eight different golf courses in north eastern Illinois. Greens were sampled five times through the growing season (Apr-Oct) in 1987 and 1988. Soil samples consisted of 3/4 inch cores taken randomly from each green, approximately 6 to 8 cores per green. Soil cores from each green were processed by removing thatch and foliage, breaking the cores, and mixing in plastic bags. Nematodes were extracted using the sugar flotation/centrifugation technique.

In 1987, a green with high nematode populations was identified in April, and was treated with Nemacur the first week of June. Nematode populations following treatment were then monitored for the remainder of 1987 and all of 1988. Also, two more greens with high populations were identified in April 1988, and each green was treated with Nemacur on May 2, but only the front half of each green was treated. Therefore, the effects of Nemacur treatment could be observed and compared to untreated areas on the same green.

Results

Nematode counts from greens in the Chicago area were variable, with some instances of very high populations noted. The most frequently encountered genera of plant parasitic nematodes were Tylenchorhynchus (stunt), Helicotylenchus (spiral), and Criconemoides (ring). Average counts for each nematode genus over all sampling dates appear in Table 1. In general, nematode populations appear to increase through the season into autumn.

Certain individual greens had very high counts of one or more genus. Stunt populations greater than 1000 per 100cc soil were not uncommon, and populations of spiral nematode greater than 800 were also observed. Table 2 shows average counts for selected greens that tended to have abnormally high populations.

Nemacur treatments at recommended label rates were found to reduce nematode populations within a few weeks. The Spring '87 treatment appeared to affect populations through most of 1988 (Table 3), which indicates that a fairly long period of time may be needed for populations to recover to pre-treatment levels.

Nemacur treatments on sections of greens with high populations of the stunt nematode proved to be quite effective in 1988. Not only were populations reduced by nearly ten-fold (Table 4), but also better rooting and resistance to effects of high temperature stress were observed on treated portions of greens in mid-August. Poa annua in treated areas of greens remained healthy throughout the heat of the summer of 1988.

Table 1. Averages of All Greens Sampled (count per 100 cc soil)

	1987			1988		
	stunt	spiral	ring	stunt	spiral	ring
Apr.	160	62	91	339	110	86
May	148	132	111	323	134	105
June	210	183	252	332	85	129
Aug.	325	208	143	474	202	155
Sept.	515	301	328	582	372	194

Table 2. Averages of High Trending Greens (count per 100 cc soil)

	1987			1988		
	stunt	spiral	ring	stunt	spiral	ring
Apr.	333	167	141	895	170	121
May	270	248	172	670	239	156
June	517	303	421	688	129	208
Aug.	809	345	207	945	344	233
Sept.	975	575	454	944	653	288

Table 3. Effect of Nemacur Treatment on Nematode Populations (count per 100 cc soil)

	1987+			1988		
	stunt	spiral	ring	stunt	spiral	ring
Apr.	180	320	30	85	25	10
May	300	910	96	52	10	42
June	150	510	90	172	15	15
Aug.	125	375	100	180	100	60
Sept.	30	304	90	340	60	50

+ one treatment applied following second sampling in 1987; no treatments applied 1988.

Table 4. Nemacur Treated vs Untreated Areas (count per 100 cc soil)+

	Untreated			Treated		
	stunt	spiral	ring	stunt	spiral	ring
Apr.	975	200	30	-	-	-
May	721	85	104	414	110	158
June	825	100	220	113	95	200
Aug.	1150	107	179	112	17	114
Sept.	1160	655	225	172	8	47

+ counts are average of 2 greens sampled, half of each green treated w/nemacur at the May sampling date

THE RELATEDNESS OF PATCH CAUSING FUNGI IN THE MIDWEST

H. T. Wilkinson and R. T. Kane

Summer patch, poa patch, zoysia patch and take-all patch, appear to be caused by at least two different genera, three species, and several biotypes. Diseased turf samples were collected from eight Midwest states and isolation of ecototrophs was done. Cultural characteristics, pathogenicity on six grass species, anatomosis groups, temperature optima, isoenzymes, and DNA:DNA hybridization were used to characterize the isolates and determine relatedness. Isolates collected from _P. pratensis_ and _P. annua_ appear to be genetically related and belong to the genus _Magnaporthe_. Both mating types were isolated from either species of bluegrass, but biotypes from _P. annua_ differed in pathogenicity and temperature optima. Not all isolates from _Poa_ species were of the genus _Magnaporthe_, nor were they all pathogens. The pathogens from _Agrostis palustris_ was a _Geaumannomyces_ sp. The species from _Z. japonica_ display characteristics different than either this genus or _Magnaporthe_.

ETIOLOGY AND EPIDEMIOLOGY OF ZOYSIA PATCH IN *Zoysia japonica*

H. T. Wilkinson

A highly destructive disease of *Z. japonica* was observed in turfs in the climatic-transitional zone of the United States. Zoysia patch has not been reported in other regions. Zoysia patch is perennial and disease severity is difficult to predict. Symptoms may appear in the spring and/or fall when soil temperatures are 15-20 C. Ectotrophic root colonization is followed by root destruction, premature death of lower leaves and finally the entire shoot. Rhizomes appear more resistant, but are colonized. Penetration of the root is direct and colonization is mainly in the cortical region, with occasional penetration of the stele. Root colonization and disease severity are enhanced by periodic wetting and draining of the root zone. The fungus is capable of colonizing turf 1 m radially in nine months and forms abundant phialospores on infected turf and in culture. A teliomorphic state has not been observed. The anamorphic state is morphologically similar to the summer patch pathogen.

1988 FIELD FUNGICIDE EFFICACY TRIALS: FINAL RESULTS AND INTERPRETATIONS

H. T. Wilkinson

INTRODUCTION

Research on the efficacy of numerous fungicides to control dollar spot and brown patch diseases on bentgrass were conducted at the University of Illinois Ornamental Horticulture Research Center, Urbana, IL. The details of the tests and interpretations of those results are described below.

MATERIALS AND METHODS

Field test site consisted of bentgrass (Agrostis palustris) cv. Penncross, established about 10 years ago on a soil-sand base. The management of the bentgrass included about 4 lbs/1000 sq ft nitrogen, watered to maintain growth, mowed at 3/16 inch, topdressed 2-3 times with an 8-1-1 sand-soil-peat mixture. Broadleaf herbicide and preventative crabgrass controls were applied. No fungicides were applied other than the treatments. The treatment plot area was 4 x 5 ft, all treatments were replicated 3 times, and a completely randomized block design of treatments was used. All chemicals were applied in 5 gal water/1000 sq ft and were prepared and applied within 24 hr. Treatments were generally applied in the morning during calm conditions using a CO_2 backpack spray rig (35 psi, nozzle 101E, single boom-nozzle construction). The system was rinsed between each treatment to prevent contamination. Plastic beverage containers were used and each was washed between applications. The same container was used throughout the treatment period. All treatments were applied following the development of dollar spot and brown patch symptoms in the turf. Initially, dollar spot symptoms were observed on about 20% of the turf, and 84% of the turf showed brown patch symptoms. Dollar spot severity was rated by estimating the percent of turf/treatment plot covered with symptoms. A Duncan's test was used to determine the significance of different treatments at the 5% level of confidence. Brown patch severity was recorded using a disease severity rating system as follows: 0 = no symptoms; 1 = apparent, but not active disease; 2 = active disease. Each plot was evaluated, and the percentage of disease control was calculated. Replications were then compared statistically using a Duncan's test at the 5% level of significance. Data presented at each date are the percentage improvement compared to the previously listed date. The results were reviewed and visual evaluations that had been recorded at the time of data collection were combinded to allow a final assessment of each treatments efficacy.

RESULTS

The results of the field evaluations can be found in Tables 1, 2, and 3.

Dollar Spot

Thirteen different treatments produced 90% or better control of this disease over a 60 day period starting with about 25-30% disease. This indicates that these treatments provided good therapeutic and continued control. The 90% control level was arbitrarily selected based on what I felt was acceptable control. There were several other treatments that provided control in the 80 percentile, and these may be more effective in different environments or under different turf managemnet conditions. It is also important to realize that while treatments 3, 10 and 11 were effective in controlling dollar spot, they were also phytotoxic. It can be said that generally those treatments resulting in control of 95% or greater were the most superior treatments in terms of disease control and the resulting quality of the turf. It is also noteworthy that the disease pressure this season was great and the extreme heat inhibited the rapid recovery of damged turf. This can explain in part why some treatments, such as 15, 23 and 24, appeared to effectively control dollar spot after 14 days, and then lost some of this efficacy after 28 and 56 days. Other interpretations are left to the reader.

Brown Patch

The control of brown patch was in general poor. Disease pressure in the turf was very high this year, and conditions for damaged turf recovery were poor due to the extreme heat. Of the treatments reported, only 4 were effective in suppressing brown patch by 40% or greater (3, 12, 23, and 24), and only treatments 23 and 24 did so without also resulting in phytotoxicity. Brown patch is caused by Rhizoctonia solani, an effective soil inhibitor and pathogen of the crown and lower leaves, which makes it inherently difficult to control in one season. The population of R. solani presented in my research turf is indigenous, which makes it that much more diffuclut to control compared to an inoculated isolate.

Fungicide Efficacy Trials - 1989

Trials will be conducted this year. New this year will be the addition of an inoculated field trial for brown patch. A new method has been developed that effectively establishes the pathogen in existing turfgrass, and this will be used in our research.

TABLE 1. Fungicide Efficiency Trials for Dollar Spot and Brown Patch on *Agrostis palustrosis*.*

TRT No.	Chem Co.	Fungicide	Application Rate	Interval (Days)
1	MAAG	Ro 14-3169	1.0 oz Ai	14
2	MAAG	Ro 14-3169	3.0 oz Ai	28
3	MAAG	Ro 15-1297	0.3 oz Ai	14
4	MAAG	Ro 15-1297	1.0 oz Ai	28
5	Rhone-Poulenc	LS 84.606 + 26019	0.0125 + 0.25 oz Ai	28
6	Rhone-Poulenc	LS 84.606 + 26019	0.25 + 0.50 oz Ai	28
7	Rhone-Poulenc	LS 84.606 + 26019	0.5 + 1.0 oz Ai	28
8	Rhone-Poulenc	26019	1.0 oz Ai	28
9	Rhone-Poulenc	LS 84.606	0.0.25 oz Ai	28
10	ICI	CA0523	3.0 gm F	14
11	ICI	CA0523	6.0 gm F	14
12	ICI	CA0523	8.0 gm F	14
13	Rohm/Haas	RH3866	0.25 oz Ai	14
14	Rohm/Haas	RH3486	0.75 oz Ai	14
15	Rohm/Haas	RH3486	1.0 oz Ai	14
16	Rohm/Haas	RH3486	1.5 oz Ai	14
17	ELANCO	Rubigan	0.75 oz F	14
18	ELANCO	Rubigan	0.75 oz F	28
19	ELANCO	Rubigan	1.5 oz F	14
20	ELANCO	Rubigan	1.5 oz F	28
21	CIBA-GEIGY	Banner 1.1E	1.0 oz F	21
22	CIBA-GEIGY	Banner 1.1E	1.0 oz F	28
23	CIBA-GEIGY	Banner 1.1E	2.0 oz F	14
24	CIBA-GEIGY	Banner 1.1E	2.0 oz F	28
25	CIBA-GEIGY	Banner 1.1E	4.0 oz F	56
26	CHECK			
27	MOBAY	HWG 1608	0.25 oz Ai	28
28	MOBAY	HWG 1608	0.5 oz Ai	28
29	Fermenta	DAL 2787 500F	3.0 oz F	7
30	Fermenta	DAL 2787 500F	6.0 oz F	21
31	Fermenta	DAL 90 DG	1.75 oz F	7
32	Fermenta		3.5 oz F	21
33	Fermenta	DAL 2787 + SDS66533	6.0 + 2.0 oz F	21
34	Fermenta	DAL 2787 + SDS66533	6.0 + 4.0 oz F	28
35	Fermenta	DAL 2787 + SDS66533	1.5 + 0.5 oz F	7
36	Fermenta	SDS-66534	2.1 oz F	14
37	Fermenta	SDS-66534	4.3 oz F	21
38	Fermenta	SDS-66608	3.7 oz F	1X
39	Fermenta	SDS-66608	7.4 oz F	1X
40	Fermenta	SDS-66608	11.2 oz F	1X
41	Sandoz	SAN-619F	1 gm Ai	21
42	Sandoz	SAN-619F	1.5 gm Ai	21
43	Sandoz	SAN-619F	1.5 gm Ai	28
44	Sandoz	SAN-619F	2.0 gm Ai	28
45	Sandoz	SAN-832F	31 gm Ai	21
46	Sandoz	SAN-832F	46.5 gm Ai	28
47	CHECK			

*See legend for explanation.

TABLE 2. Percentage Disease control for fungicides applied to bentgrass with Dollar Spot.

Treatment No.	Days After First Application			60 Day Mean
	14	28	56	
1	83	75	40	66
2	87	93	73	85
3	100	98	95	98
4	95	97	95	96
5	90	83	71	81
6	92	83	82	86
7	90	91	97	93
8	54	42	0	32
9	87	97	66	84
10	99	98	88	95
11	92	95	88	92
12	95	91	82	89
13	95	89	95	93
14	97	85	80	87
15	100	83	84	88
16	97	95	82	91
17	66	55	48	56
18	68	59	40	55
19	92	81	66	80
20	61	38	37	45
21	92	53	71	71
22	97	79	93	89
23	100	97	91	96
24	87	89	86	88
25	83	91	84	86
26	8	12	0	7
27	71	75	68	72
28	97	98	98	98
29	10	12	0	8
30	18	-12	-26	-7
31	-3	-12	-55	-23
32	80	22	11	36
33	97	95	95	96
34	100	95	97	97
35	80	95	95	91
36	85	61	17	54
37	87	53	66	68
38	15	4	-4	5
39	75	42	37	51
40	71	48	33	50
41	87	81	71	80
42	92	95	98	95
43	92	89	73	85
44	90	91	84	88
45	18	22	22	21
46	8	-2	-28	-7
47	-8	-12	0	-6

TABLE 3. Disease control percentage for fungicides applied to bentgrass with Brown Patch.

Treatment No.	Days From First Application 14	28	56
1	25	14	-20
2	0	-34	10
3	0	-19	43
4	19	10	31
5	25	-42	25
6	0	0	0
7	40	-0	-0
8	19	-10	35
9	-67	-25	30
10	50	10	30
11	0	0	0
12	0	0	40
13	0	0	25
14	-24	10	31
15	-34	-14	18
16	25	14	10
17	19	10	31
18	25	14	10
19	0	-24	31
20	19	-10	35
21	40	-49	13
22	25	-14	18
23	19	-32	40
24	33	-19	43
25	19	10	31
26	0	-67	-18
27	0	0	0
28	25	-14	18
29	19	33	25
30	0	-67	18
31	0	-34	10
32	25	-42	25
33	40	-0	25
34	0	0	0
35	25	-14	18
36	0	0	0
37	25	-14	18
38	19	-10	35
39	0	-24	31
40	-34	-14	18
41	19	10	31
42	40	25	18
43	-24	10	31
44	25	14	10
45	0	-24	31
46	19	-10	14
47	16	-8	-47

CHAMPAIGN, ILLINOIS RESEARCH CENTER | LOCAL CLIMATOLOGICAL DATA ILLINOIS STATE WATER SURVEY | MARCH 1988 MONTHLY SUMMARY

DATE	TEMPERATURE (F) MAX	MIN	MEAN	PRECIPITATION (IN) AMOUNT	SNOW	DEPTH	WEATHER TYPES	WIND DIR	SPEED	SKY COVER	DEGREE DAYS HEAT	COOL
1	57	25	41	0.00	0.0	0		S	7.3	CLR	24	0
2	45	32	39	0.06	0.0	0	R,L	N	6.3	CLDY	26	0
3	32	25	29	0.48	*5.4*	6	S,BS	N	14.8	CLDY	36	0
4	36	20	28	0.04	0.4	6	S,BS	N	9.8	PC	37	0
5	37	*14*	26	0.00	0.0	6		SE	1.5	CLR	39	0
6	42	20	31	0.00	0.0	4		S	4.4	PC	34	0
7	52	26	39	0.00	0.0	0		SE	3.4	CLDY	26	0
8	57	32	45	0.00	0.0	0		SE	8.1	CLDY	20	0
9	45	33	39	0.10	0.0	0	R	W	6.4	CLDY	26	0
10	52	32	42	0.00	0.0	0		E	4.5	CLR	23	0
11	62	30	46	0.00	0.0	0		SE	10.9	CLR	19	0
12	54	31	43	0.12	0.0	0	R	W	17.1	CLDY	22	0
13	31	24	28	T	T	T	S-	W	13.6	CLDY	37	0
14	28	16	22	T	T	T	SW	W	10.1	CLDY	*43*	0
15	30	21	26	T	T	0	SW	W	7.2	CLDY	39	0
16	34	26	30	0.00	0.0	0		W	4.8	CLDY	35	0
17	45	21	33	0.04	0.4	0	S	W	3.6	PC	32	0
18	44	28	36	0.02	0.2	1	S	W	6.9	CLDY	29	0
19	46	23	35	0.00	0.0	0		W	9.0	CLR	30	0
20	48	30	39	0.00	0.0	0		NE	7.7	PC	26	0
21	48	25	37	0.00	0.0	0		NE	7.4	CLR	28	0
22	72	30	51	0.00	0.0	0		E	11.2	CLR	14	0
23	73	53	63	T	0.0	0	TRW-	S	11.3	CLDY	2	0
24	*75*	53	64	0.10	0.0	0	TRW	S	16.5	CLDY	1	0
25	64	38	51	0.18	0.0	0	TRW	SW	8.2	PC	14	0
26	50	29	40	0.04	0.0	0	R,L	W	11.0	PC	25	0
27	56	24	40	0.00	0.0	0		SE	5.4	CLR	25	0
28	72	38	55	0.28	0.0	0	TRW	SE	11.0	PC	10	0
29	56	34	45	*1.02*	0.0	0	R,RW,L	N	8.4	CLDY	20	0
30	52	30	41	0.00	0.0	0		NE	5.3	CLR	24	0
31	53	37	45	0.03	0.0	0	L	NE	6.1	CLDY	20	0
TOTAL				2.51	6.4						786	0
AVG.	49.9	29.0	39.5					W	8.4			
DEP. FROM NORMAL	+2.1	-1.4	+0.4	-0.81	+1.4		(NORMAL)	S	-0.2		-17	0

NUMBER OF DAYS AND DEPARTURE

	MAX ≥90	TEMP ≤32	MIN ≤32	TEMP ≤0	PRECIPITATION ≤T	≥.01	≥.10	≥.50	≥1.00	SNOW ≥1	SKY COVER CLR	PCLDY	CLDY
TOTAL	0	4	24	0	17	13	7	1	1	1	9	7	15
DEP.	0	+1	+5	+0	-	+1	+1	-1	0	-1	+2	-2	0

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEAT DEG DAYS	SEASONAL COOL DEG DAYS	JAN-MAR PRECIP
TOTAL	0	4	0	0	9	4	7	0	0	0	2	5405	0	5.96
DEP.	-4	+1	-	-1	-	-	-	-1	-	-	-	+201	0	-1.21

WEATHER TYPES: F=Fog;T=Thunderstorm;IP=Ice Pellets;A=Hail;R=Rain;S=Snow;Z=Glaze;D=Dust; H=Haze; BS=Blowing Snow; RW=Rain Showers; SW=Snow Showers; L=Drizzle.Intensities: +heavy - light; absence of symbol indicates moderate. Degree day base 65 F. T=trace.
Averages: 1951-80 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data midnt-midnt
Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters.
REMARKS: Peak gust was 42 mph from the south on the 24th

CHAMPAIGN, ILLINOIS
RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA
ILLINOIS STATE WATER SURVEY

APRIL 1988
MONTHLY SUMMARY

	TEMPERATURE (F)			PRECIPITATION (IN)			WEATHER	WIND		SKY	DEGREE DAYS	
DATE	MAX	MIN	MEAN	AMOUNT	SNOW	DEPTH	TYPES	DIR.	SPEED	COVER	HEAT	COOL
1	52	42	47	0.10	0.0	0	R-,L	NE	5.9	CLDY	18	0
2	69	52	61	0.04	0.0	0	RW-	E	10.5	PC	4	0
3	60	42	51	0.16	0.0	0	TRW+,R	SW	9.5	CLDY	14	0
4	72	37	55	0.00	0.0	0		S	6.6	PC	10	0
5	*84*	52	68	0.22	0.0	0	TRW+,R,L	S	11.3	CLR	0	*3*
6	60	42	51	0.34	0.0	0	R,RW,L	NW	16.3	CLDY	14	0
7	62	38	50	0.00	0.0	0		N	9.8	CLR	15	0
8	68	39	54	0.00	0.0	0		E	2.9	CLR	11	0
9	70	42	56	0.00	0.0	0		E	3.5	CLR	9	0
10	62	47	55	0.00	0.0	0		N	11.2	CLDY	10	0
11	65	39	52	0.00	0.0	0		N	17.5	PC	13	0
12	65	42	54	0.00	0.0	0		N	11.9	CLR	11	0
13	70	36	53	0.00	0.0	0		W	4.9	CLR	12	0
14	57	38	48	0.00	0.0	0		W	10.2	CLR	17	0
15	53	33	43	0.00	0.0	0		W	8.9	CLR	*22*	0
16	62	30	46	0.00	0.0	0		W	5.1	CLR	19	0
17	72	36	54	*0.37*	0.0	0	TRW+	S	16.0	CLR	11	0
18	52	34	43	0.00	0.0	0		N	11.1	PC	*22*	0
19	54	32	43	0.00	0.0	0		NW	9.3	CLR	*22*	0
20	70	*29*	50	T	0.0	0	L	S	11.8	CLDY	15	0
21	58	38	48	0.20	0.0	0	TRW,R	NE	8.0	PC	17	0
22	65	42	54	0.00	0.0	0		NE	11.1	CLDY	11	0
23	64	44	54	0.00	0.0	0		W	14.3	PC	11	0
24	59	39	49	0.00	0.0	0		NW	5.4	PC	16	0
25	67	36	52	0.00	0.0	0		E	5.5	PC	13	0
26	73	39	56	0.07	0.0	0	R,L	S	9.4	CLR	9	0
27	50	40	45	T	0.0	0	L	W	18.1	CLDY	20	0
28	63	34	51	0.00	0.0	0		W	9.2	CLR	16	0
29	68	38	53	0.00	0.0	0		N	7.6	CLR	12	0
30	74	37	56	0.00	0.0	0		N	4.6	CLR	9	0
TOTAL				1.50	0.0						403	3
AVG.	64.0	39.0	51.5					W	9.6			
DEP. FROM NORMAL	+1.4	-2.9	-0.8	-2.34	-0.6		(NORMAL)	S	+1.1		+22	+3

NUMBER OF DAYS AND DEPARTURE

	MAX	TEMP	MIN	TEMP	PRECIPITATION					SNOW	SKY COVER		
	≥90	≤32	≤32	≤0	≤T	≥.01	≥.10	≥.50	≥1.00	≥1	CLR	PCLDY	CLDY
TOTAL	0	0	3	0	10	8	6	0	0	0	15	8	7
DEP.	0	0	-1	+0	-	-4	-1	-2	-1	0	+8	-2	-6

	WEATHER TYPES											SEASONAL HEAT	SEASONAL COOL	1988
	F	T	IP	A	R	L	S	Z	D	H	BS	DEG DAYS	DEG DAYS	PRECIP
TOTAL	1	4	0	0	8	5	0	0	0	0	0	5808	3	7.46
DEP.	-1	-1	-	-1	-	-	-	0	-	-	-	+223	+3	-3.55

WEATHER TYPES: F=Fog;T=Thunderstorm;IP=Ice Pellets;A=Hail;R=Rain;S=Snow;Z=Glaze;D=Dust; H=Haze;BS=Blowing Snow;RW=Rain Showers;SW=Snow Showers;L=Drizzle.Intensities: +heavy; - light; absence of symbol indicates moderate. Degree day base 65 F. T=trace.
Averages: 1951-80 data.Snow depth at 7AM LST.Sky 7AM-7PM LST.Other data mdnt-mdnt.
Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters.
REMARKS: 84F on the 5th was a new record maximum (old record was 80F in 1929). Driest April since 1977 (6th driest ever) when 0.78 inch was recorded. Peak gust was 46mph from the NW on the 6th.

:HAMPAIGN, ILLINOIS LOCAL CLIMATOLOGICAL DATA MAY 1988
/ATER SURVEY RESEARCH CENTER ILLINOIS STATE WATER SURVEY MONTHLY SUMMARY

	TEMPERATURE (F)			PRECIPITATION (IN)			WEATHER	WIND		SKY	DEGREE DAYS	
)ATE	MAX	MIN	MEAN	AMOUNT	SNOW	DEPTH	TYPES	DIR	SPEED	COVER	HEAT	COOL
1	75	40	58	0.00	0.0	0		N	6.3	CLR	7	0
2	78	44	61	0.00	0.0	0		E	4.3	CLR	4	0
3	76	46	61	0.00	0.0	0		E	6.0	PC	4	0
4	68	46	57	0.00	0.0	0		N	9.9	CLR	8	0
5	74	43	59	0.00	0.0	0		N	7.1	CLR	6	0
6	81	54	68	0.00	0.0	0		N	6.6	CLR	0	3
7	85	45	65	0.00	0.0	0		S	8.5	PC	0	0
8	84	56	70	0.53	0.0	0	TRW+,R	SE	17.6	CLDY	0	5
9	67	54	61	0.00	0.0	0		SW	14.2	CLDY	4	0
10	72	49	61	0.00	0.0	0		W	6.2	PC	4	0
11	79	46	63	0.00	0.0	0	F	SE	2.7	CLR	2	0
12	87	52	70	0.01	0.0	0	TRW-,R-	S	6.9	PC	0	5
13	77	52	65	T	0.0	0	R-	NE	9.3	CLDY	0	0
14	88	48	68	0.00	0.0	0		SE	4.2	CLR	0	3
15	87	64	75	0.00	0.0	0		SW	9.9	PC	0	10
16	75	48	62	0.07	0.0	0	RW-	NW	8.0	CLR	3	0
17	75	44	60	0.00	0.0	0		N	9.3	CLR	5	0
18	80	45	63	0.00	0.0	0		NE	5.8	CLR	2	0
19	82	50	66	0.00	0.0	0		NE	3.7	CLR	0	1
20	85	56	71	0.00	0.0	0		NE	1.5	CLR	0	6
21	90	55	73	0.00	0.0	0		S	1.9	CLR	0	8
22	85	60	73	*0.68*	0.0	0	TRW	E	4.0	CLDY	0	8
23	76	57	67	0.22	0.0	0	TRW	SE	MSG	CLDY	0	2
24	71	48	60	0.03	0.0	0	RW-,R-,L	N	11.7	CLDY	5	0
25	69	40	55	0.00	0.0	0		N	6.5	CLR	*10*	0
26	79	*39*	59	0.00	0.0	0		S	4.0	CLR	6	0
27	83	49	66	0.00	0.0	0		S	7.5	PC	0	1
28	89	55	72	0.01	0.0	0	RW-	S	6.1	CLR	0	7
29	90	60	75	0.00	0.0	0		S	6.7	CLR	0	10
30	92	58	75	0.00	0.0	0	F	S	5.4	CLR	0	10
31	*93*	59	76	0.00	0.0	0	H	S	2.3	CLR	0	*11*
TOTAL				1.55	0.0			N	6.8		70	90
AVG.	80.4	50.4	65.4									
DEP. FROM	+6.9	-1.6	+2.6	-2.04	0.0		(NORMAL)	S	-0.2		-85	+3

NUMBER OF DAYS AND DEPARTURE

	MAX TEMP	MIN TEMP	MIN TEMP	MAX TEMP	PRECIPITATION					SNOW	SKY COVER		
	≥90	≤32	≤32	≤0	T	≥.01	≥.10	≥.50	≥1.00	≥1	CLEAR	PCLDY	CLDY
TOTAL	4	0	0	0	8	7	3	2	0	0	19	6	6
DEP.	+3	0	0	0	-	-3	-4	-1	-1	0	+10	-6	-4

	WEATHER TYPES											SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-MAY PRECIPITATION
	F	T	IP	A	R	L	S	Z	D	H	BS			
TOTAL	2	4	0	0	8	1	0	0	0	1	0	5878	93	9.01
DEP.	-1	-2	0	-1	-	-	-	0	0	-	-	+138	+6	-5.59

WEATHER TYPES: F-Fog, T-Thunderstorm; IP-Ice Pellets; A-Hail; R-Rain; S-Snow; Z-Glaze; D-Dust; H-Haze; BS-Blowing Snow; RW-Rain Showers; SW-Snow Showers, L-Drizzle. Intensities: +heavy; - light; absence of symbol indicates moderate. Degree day base = 65°F. T-Trace. Normals 1951-1980 data. Snow depth at 7 AM LST. Sky 7 AM-7 PM LST. Other data midnight-midnight. Metric Conversions: C=5/9x(F-32). 1 inch = 2.43 centimeters = 25.4 millimeters.
REMARKS: Fourth highest mean maximum temperature for May. (Record 82.4, 1977). Funnel clouds sighted near Champaign-Urbana on the 23rd. Peak gust was 52 mph from the SE on the 8th.

CHAMPAIGN, ILLINOIS
RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA
ILLINOIS STATE WATER SURVEY

JUNE 1988
MONTHLY SUMMARY

	TEMPERATURE (F)			PRECIPITATION (IN)			WEATHER	WIND		SKY	DEGREE DAYS	
DATE	MAX	MIN	MEAN	AMOUNT	SNOW	DEPTH	TYPES	DIR.	SPEED	COVER	HEAT	COOL
1	94	60	77	0.00	0.0	0	F,H	W	2.1	CLR	0	12
2	94	60	77	0.00	0.0	0	H	W	5.6	CLDY	0	12
3	75	54	65	0.00	0.0	0		NE	9.0	CLR	0	0
4	80	50	65	0.00	0.0	0		NE	3.9	CLR	0	0
5	86	50	68	0.00	0.0	0		W	3.2	CLR	0	3
6	90	58	74	0.00	0.0	0		W	3.3	CLR	0	9
7	93	58	75	0.00	0.0	0		W	3.8	CLR	0	11
8	89	59	74	*0.32*	0.0	0	TRW,R	N	6.4	PC	0	9
9	73	51	62	0.00	0.0	0		N	11.3	CLR	3	0
10	75	46	61	0.00	0.0	0		N	4.5	CLR	*4*	0
11	84	*45*	65	0.00	0.0	0		W	3.5	CLR	0	0
12	88	50	69	0.00	0.0	0		S	4.9	CLR	0	4
13	93	55	74	0.00	0.0	0		S	5.5	CLR	0	9
14	95	63	79	0.00	0.0	0	H	S	5.4	CLR	0	14
15	94	64	79	0.00	0.0	0		W	5.7	PC	0	14
16	85	59	72	0.00	0.0	0		N	4.2	CLDY	0	7
17	88	55	72	0.00	0.0	0		NW	2.7	CLR	0	7
18	91	57	74	0.00	0.0	0		S	3.7	CLR	0	9
19	94	57	76	0.00	0.0	0		S	4.4	CLR	0	11
20	99	64	82	T	0.0	0	TRW-,H	SW	5.8	CLR	0	17
21	99	72	86	0.00	0.0	0	H	SW	6.3	CLR	0	21
22	95	71	83	0.00	0.0	0	H	SW	7.8	PC	0	18
23	90	69	80	0.00	0.0	0		NE	9.3	PC	0	15
24	96	62	79	0.00	0.0	0		E	2.3	PC	0	14
25	*103*	76	90	0.00	0.0	0		W	7.8	CLR	0	*25*
26	81	61	71	0.00	0.0	0		N	12.3	PC	0	6
27	84	55	70	0.00	0.0	0		N	6.4	CLR	0	5
28	90	52	71	0.00	0.0	0		SW	2.8	CLR	0	6
29	74	60	67	T	0.0	0	L-	NE	8.3	CLDY	0	2
30	82	54	68	0.00	0.0	0		N	9.3	CLR	0	3
TOTAL				0.32	0.0						7	263
AVG.	88.5	58.2	73.4					N	5.7			
DEP. FROM NORMAL	+5.7	-2.7	+1.5	-3.60	+0		(NORMAL)	SSW	-0.3		-11	+83

NUMBER OF DAYS AND DEPARTURE

	MAX	TEMP	MIN	TEMP	PRECIPITATION					SNOW	SKY COVER		
	≥90	≤32	≤32	≤0	≤T	≥.01	≥.10	≥.50	≥1.00	≥1	CLEAR	PCLDY	CLDY
TOTAL	16	0	0	0	3	1	1	0	0	0	21	6	3
DEP.	+10	0	0	+0	-	-9	-5	-3	-1	0	+12	-7	-5

	WEATHER TYPES											SEASONAL HEAT	SEASONAL COOL	JAN-JUN
	F	T	IP	A	R	L	S	Z	D	H	BS	DEG DAYS	DEG DAYS	PRECIP
TOTAL	1	2	0	0	1	2	0	0	0	6	0	5885	356	9.33
DEP.	0	-5	0	-1	-	-	-	0	-	-	-	+127	+44	-9.19

WEATHER TYPES: F=Fog; T=Thunderstorm; IP= Ice Pellets; A=Hail; R=Rain; S=Snow; Z=Glaze; D=Dust
H=Haze; BS=Blowing Snow; RW=Rain Showers; SW=Snow Showers; L=Drizzle. Intensities: +heavy,
- light; absence of symbol indicates moderate. Degree day base 65 F. T=trace.
Averages: 1951-80 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data midnt-midnt.
Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters.
REMARKS: 5th highest ave.max temp for June (rec.90.9,1933). Tied for 4th highest number of 90F or greater days (rec 21,1933). Rec. driest June,old rec. 0.47,1936. Two rec.max temps:99 [illegible] (old rec.98,1933) and 103 on 25th (old rec.99,1954). 103F also ties highest temp ever in June.

CHAMPAIGN, ILLINOIS RESEARCH CENTER — LOCAL CLIMATOLOGICAL DATA, ILLINOIS STATE WATER SURVEY — JULY 1988 MONTHLY SUMMARY

DATE	TEMPERATURE (F) MAX	MIN	MEAN	PRECIPITATION (IN) AMOUNT	SNOW	DEPTH	WETHR TYPES	WIND DIR.	SPEED	SKY COVER	DEGREE DAYS HEAT	COOL
1	81	*53*	67	0.00	0.0	0		NE	5.7	PC	0	2
2	85	55	70	T	0.0	0	L-	NE	2.9	CLR	0	5
3	90	58	74	0.00	0.0	0		NE	3.1	CLR	0	9
4	96	63	80	0.00	0.0	0		E	3.1	CLR	0	15
5	99	66	83	0.00	0.0	0	H	SE	2.1	CLR	0	18
6	96	66	81	0.00	0.0	0	H	S	2.1	PC	0	16
7	98	72	85	0.00	0.0	0	H	W	3.8	PC	0	20
8	99	70	85	0.00	0.0	0	H	SW	2.5	CLDY	0	20
9	98	70	84	0.00	0.0	0	H	SW	3.0	CLDY	0	19
10	91	68	80	0.02	0.0	0	TRW-,H	W	5.6	CLDY	0	15
11	90	67	79	T	0.0	0	T,L-,F	SE	2.9	CLDY	0	14
12	91	67	79	0.03	0.0	0	TRW-	E	3.7	CLDY	0	14
13	92	68	80	0.00	0.0	0	F	S	4.7	CLDY	0	15
14	97	71	84	0.35	0.0	0	TRW+	SW	5.8	CLDY	0	19
15	*101*	70	86	0.00	0.0	0	F	S	MSG	CLDY	0	*21*
16	98	70	84	0.00	0.0	0	F	W	MSG	PC	0	19
17	98	72	85	0.00	0.0	0		E	MSG	PC	0	20
18	84	71	78	0.92	0.0	0	TRW,RW+	SW	2.2	CLDY	0	13
19	89	68	79	0.00	0.0	0	F	N	3.8	PC	0	14
20	83	65	74	0.20	0.0	0	R,R-,L	NE	3.9	CLDY	0	9
21	82	60	71	0.00	0.0	0	F	W	4.1	PC	0	6
22	84	62	73	0.00	0.0	0		N	4.7	CLR	0	8
23	87	62	75	0.00	0.0	0	F	N	3.0	CLR	0	10
24	91	60	76	0.00	0.0	0		W	4.0	CLR	0	11
25	78	62	70	*2.12*	0.0	0	TRW+,R+,A	SW	3.2	CLDY	0	5
26	85	62	74	0.00	0.0	0	F	N	MSG	CLR	0	9
27	89	61	75	0.00	0.0	0		SW	1.5	CLR	0	10
28	90	65	78	0.00	0.0	0		SW	2.3	CLR	0	13
29	89	64	77	0.00	0.0	0	F	S	5.1	CLR	0	12
30	88	72	80	0.00	0.0	0	F	SW	6.6	CLDY	0	15
31	93	70	82	0.00	0.0	0	T	S	MSG	PC	0	17
TOTAL				3.64	0.0						0	413
AVG.	90.7	65.5	78.1					S	3.7			
DEP. FROM NORMAL	+5.2	+0.7	+2.9	-0.71	+0		(NORMAL)	SW	-1.3		0	+97

NUMBER OF DAYS AND DEPARTURE

	MAX ≥90	TEMP ≤32	MIN ≤32	TEMP ≤0	PRECIPITATION ≤T	≥.01	≥.10	≥.50	≥1.00	SNOW ≥1	SKY COVER CLR	PCLDY	CLDY
TOTAL	18	0	0	0	8	6	4	2	1	0	11	8	12
DEP.	+10	0	0	+0	-	-3	-2	-1	0	0	+1	-6	+5

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEAT DEG DAYS	SEASONAL COOL DEG DAYS	JAN-JUL PRECIP
TOTAL	10	7	0	1	8	3	0	0	0	6	0	0	769	12.97
DEP.	+8	0	0	+1	-	-	-	0	-	-	-	0	+141	-9.90

WEATHER TYPES: F=Fog;T=Thunderstorm;IP=Ice Pellets;A=Hail;R=Rain;S=Snow;Z=Glaze; D=Dust; H=Haze; BS=Blowing Snow; RW=Rain Showers; SW=Snow Showers; L=Drizzle.Intensities: +heavy; - light; absence of symbol indicates moderate. Degree day base 65 F. T=trace.
Averages: 1951-80 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data mdnit-mdnit.
Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters.
REMARKS:8th highest mon max temp(rec. 95.9,1936),7th highest number of 90F or greater days (rec 25,1921).3rd lowest total precip. first 7 months (rec.12.10,1925).Jun 9-Jul 9,31 days no meas precip,ties for 1st for dry periods during growing season,ties for 3rd for dry periods during entire year.

CHAMPAIGN, ILLINOIS
RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA
ILLINOIS STATE WATER SURVEY

AUGUST 1988
MONTHLY SUMMARY

	TEMPERATURE (F)			PRECIPITATION (IN)			WEATHER	WIND		SKY		
DATE	MAX	MIN	MEAN	AMOUNT	SNOW	DEPTH	TYPES	DIR.	SPEED	COVER	HEAT	COOL
1	95	68	82	0.00	0.0	0	F	S	3.0	CLR	0	17
2	93	72	83	0.00	0.0	0	H,F	S	3.2	CLR	0	18
3	94	70	82	0.00	0.0	0	H,F	S	2.1	CLR	0	17
4	93	71	82	0.00	0.0	0	H,F	S	4.4	PC	0	17
5	88	69	79	0.15	0.0	0	TRW,F	SW	5.5	PC	0	14
6	88	61	75	0.00	0.0	0		SE	1.8	PC	0	10
7	90	56	73	0.00	0.0	0	H	SE	2.8	PC	0	8
8	95	68	82	0.00	0.0	0	F	S	5.0	PC	0	17
9	93	73	83	*0.38*	0.0	0	TRW+,H,F	S	2.2	CLDY	0	18
10	89	74	82	0.00	0.0	0	F	NE	3.5	CLDY	0	17
11	93	70	82	0.00	0.0	0	F	SW	1.4	PC	0	17
12	94	69	82	0.00	0.0	0	F	S	2.1	CLR	0	17
13	93	72	83	0.07	0.0	0	TRW+	S	5.6	CLR	0	18
14	93	75	84	0.00	0.0	0	T	S	4.5	PC	0	19
15	99	74	87	0.00	0.0	0	F	W	2.9	CLR	0	*22*
16	101	70	86	0.00	0.0	0	F	SE	1.6	CLR	0	21
17	*102*	69	86	0.00	0.0	0	F	SW	3.2	CLR	0	21
18	101	72	87	0.26	0.0	0	TRW,H	SW	4.3	CLR	0	*22*
19	89	69	79	0.04	0.0	0	TRW,F	NE	3.8	PC	0	14
20	84	66	75	0.00	0.0	0		NE	3.6	PC	0	10
21	85	65	75	0.00	0.0	0	H	NE	4.0	CLR	0	10
22	83	60	72	0.16	0.0	0	TRW,F	E	5.5	CLDY	0	7
23	88	66	77	0.17	0.0	0	RW,R-,L	W	5.7	CLDY	0	12
24	86	58	72	0.00	0.0	0		W	4.8	CLR	0	7
25	91	53	72	0.00	0.0	0		SW	5.9	CLR	0	7
26	82	56	69	0.00	0.0	0		NW	1.9	CLR	0	4
27	74	57	66	0.05	0.0	0	RW	S	2.9	CLDY	0	1
28	75	54	65	0.00	0.0	0		N	2.9	PC	0	0
29	78	45	62	0.00	0.0	0		N	3.0	CLR	*3*	0
30	81	*44*	63	0.00	0.0	0		E	1.7	PC	2	0
31	85	51	68	0.00	0.0	0		SE	3.5	CLR	0	3
TOTAL				1.28	0.0						5	385
AVG.	89.5	64.4	77.0					S	3.5			
DEP. FROM NORMAL	+5.9	+1.6	+3.8	-2.38	+0		(NORMAL)	SW	-1.3		+5	+128

------------------------------ NUMBER OF DAYS AND DEPARTURE ------------------------

	MAX	TEMP	MIN	TEMP-------		PRECIPITATION	--------	SNOW---			----SKY COVER----		
	≥90	≤32	≤32	≤0	≤T	≥.01	≥.10	≥.50	≥1.00	≥1	CLR	PCLDY	CLDY
TOTAL	16	0	0	0	8	8	5	0	0	0	15	11	5
DEP.	+11	0	0	+0	-	0	-1	-3	-1	0	+5	-3	-2

	----------------				WEATHER TYPES				--------------			SEASONAL HEAT DEG DAYS	SEASONAL COOL DEG DAYS	JAN-AUG PRECIP
	F	T	IP	A	R	L	S	Z	D	H	BS			
TOTAL	14	7	0	0	8	1	0	0	0	7	0	5	1154	14.25
DEP.	+10	0	0	0	-	-	-	0	-	-	-	+5	+269	-12.28

WEATHER TYPES: F=Fog; T=Thunderstorm; IP=Ice Pellets; A=Hail; R=Rain; S=Snow; Z=Glaze; D=Dust; H=Haze; BS=Blowing Snow; RW=Rain Showers; SW=Snow Showers; L=Drizzle. Intensities: +heavy; - light; absence of symbol indicates moderate. Degree day base 65 F. T=trace. Averages: 1951-80 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data midnt-midnt. Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters. **REMARKS:** ***For summer (JJA)*** 3rd highest ave max temp of 89.6 (rec.90.6,1936), 7th highest ave temp of 76.2 (rec.78.0,1936). 5 days of 100F or greater, 50 days of 90F or greater, (new record). 7th driest summer with 5.20 inches (rec.2.20,1893).

CHAMPAIGN, ILLINOIS	LOCAL CLIMATOLOGICAL DATA	SEPTEMBER 1988
RESEARCH CENTER	ILLINOIS STATE WATER SURVEY	MONTHLY SUMMARY

	TEMPERATURE (F)			PRECIPITATION (IN)			WEATHER	WIND		SKY	DEGREE DAYS	
DATE	MAX	MIN	MEAN	AMOUNT	SNOW	DEPTH	TYPES	DIR.	SPEED	COVER	HEAT	COOL
1	88	50	69	0.00	0.0	0		SE	2.9	CLR	0	4
2	85	65	75	0.28	0.0	0	TRW-	S	4.5	CLDY	0	10
3	85	60	73	0.27	0.0	0	TRW	S	4.3	CLDY	0	8
4	66	56	61	0.15	0.0	0	TRW-	W	5.3	CLDY	4	0
5	69	50	60	0.00	0.0	0		MSG	MSG	CLR	5	0
6	71	41	56	0.00	0.0	0		NE	1.8	CLR	*9*	0
7	76	*40*	58	0.00	0.0	0		SE	5.2	CLR	7	0
8	83	45	64	0.00	0.0	0		S	7.9	CLR	1	0
9	85	56	71	0.00	0.0	0	F	N	3.7	PC	0	6
10	89	53	71	0.00	0.0	0		E	3.7	PC	0	6
11	87	60	74	0.00	0.0	0	H	E	6.2	CLDY	0	9
12	78	70	74	0.17	0.0	0	R,L,F	S	5.2	CLDY	0	9
13	76	60	68	0.00	0.0	0	H,F	N	3.4	PC	0	3
14	84	51	68	0.00	0.0	0		N	2.4	CLR	0	3
15	82	54	68	0.00	0.0	0		NE	4.1	PC	0	3
16	85	57	71	0.31	0.0	0	TRW+	E	6.2	CLDY	0	6
17	*92*	67	80	0.00	0.0	0		S	6.0	PC	0	*15*
18	82	68	75	0.13	0.0	0	R-,RW-,L	SE	6.1	CLDY	0	10
19	78	59	69	*2.00*	0.0	0	TRW,RW+,R,L	E	9.3	CLDY	0	4
20	73	52	63	0.00	0.0	0		W	7.8	CLR	2	0
21	79	48	64	0.00	0.0	0	F	E	2.4	CLR	1	0
22	91	52	72	0.02	0.0	0	L	S	8.7	PC	0	7
23	74	55	65	0.00	0.0	0		N	5.8	PC	0	0
24	68	53	61	0.00	0.0	0		N	4.2	CLDY	4	0
25	77	43	60	0.00	0.0	0		N	1.6	PC	5	0
26	83	47	65	0.00	0.0	0		E	2.8	CLR	0	0
27	83	48	66	0.00	0.0	0	F	S	3.0	PC	0	1
28	84	52	68	0.00	0.0	0	F	E	3.5	PC	0	3
29	82	59	71	0.00	0.0	0		E	3.6	PC	0	6
30	76.	61	69	0.00	0.0	0	F	SE	3.7	CLDY	0	4
TOTAL				3.33	0.0						38	117
AVG.	80.3	54.4	67.4					E	4.7			
DEP. FROM NORMAL	+2.0	-1.1	+0.5	+0.31	+0		(NORMAL)	SSW	-0.5		-19	+3

NUMBER OF DAYS AND DEPARTURE

	MAX	TEMP	MIN	TEMP	PRECIPITATION					SNOW	SKY COVER		
	>90	≤32	≤32	≤0	≤T	≥.01	≥.10	≥.50	≥1.00	≥1	CLR	PCLDY	CLDY
TOTAL	2	0	0	0	8	8	7	1	1	0	9	11	10
DEP.	-1	0	0	+0	-	-1	+2	-1	0	0	-2	+1	+1

	WEATHER TYPES											SEASONAL HEAT	SEASONAL COOL	JAN-SEP
	F	T	IP	A	R	L	S	Z	D	H	BS	DEG DAYS	DEG DAYS	PRECIP
TOTAL	7	5	0	0	7	4	0	0	0	2	0	43	1271	17.58
DEP.	+4	+1	0	0	-	-	-	0	-	-	-	-14	+272	-11.97

WEATHER TYPES:F=Fog;T=Thunderstorm;IP=Ice Pellets;A=Hail;R=Rain;S=Snow;Z=Glaze; D=Dust;
H=Haze;BS=Blowing Snow;RW=Rain Showers;SW=Snow Showers;L=Drizzle.Intensities: +heavy;
- light; absence of symbol indicates moderate. Degree day base 65 F. T=trace.
Averages: 1951-80 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data mdnit-mdnit
Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters.
REMARKS:Two rec low temps: 6th with 41F (old rec 43 in 1924),and 7th with 40F(old rec 44 in 1956). Two 90F+ days in Sep ties 1988 with rec high # days with 90F or greater temps for the year. Record number of days for one year is 56 set in 1936 and tied in 1954. Peak gust was 34 mph from SE on the 19th.

CHAMPAIGN, ILLINOIS RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA ILLINOIS STATE WATER SURVEY

OCTOBER 1988 MONTHLY SUMMARY

DATE	TEMPERATURE (F) MAX	MIN	MEAN	PRECIPITATION (IN) AMOUNT	SNOW	DEPTH	WEATHER TYPES	WIND DIR	SPEED	SKY COVER	DEGREE DAYS HEAT	COOL
1	69	59	64	0.62	0.0	0	R,RW,L	SW	3.9	CLDY	1	0
2	65	49	57	0.00	0.0	0		N	4.7	CLDY	8	0
3	65	42	54	0.00	0.0	0		NW	3.1	PC	11	0
4	57	40	49	0.00	0.0	0		W	7.3	PC	16	0
5	57	37	47	0.00	0.0	0		NW	4.8	CLR	18	0
6	58	31	45	0.00	0.0	0		N	2.0	CLR	20	0
7	62	34	48	0.00	0.0	0		W	1.8	CLR	17	0
8	64	30	47	0.00	0.0	0		SW	2.5	PC	18	0
9	65	44	55	0.00	0.0	0		W	3.6	CLDY	10	0
10	71	42	57	0.00	0.0	0		W	7.6	PC	8	0
11	59	33	46	0.00	0.0	0		NW	5.1	CLR	19	0
12	53	29	41	0.00	0.0	0		N	4.5	CLR	24	0
13	58	24	41	0.00	0.0	0		SE	3.4	CLR	24	0
14	76	37	57	0.00	0.0	0		S	8.6	CLR	8	0
15	*78*	52	65	0.49	0.0	0	TRW,RW,R-	SE	9.2	PC	0	0
16	75	54	65	0.10	0.0	0	RW	S	7.5	PC	0	0
17	71	57	64	*0.97*	0.0	0	TRW,RW	SE	8.5	CLDY	1	0
18	57	37	47	0.00	0.0	0		W	5.8	CLDY	18	0
19	54	38	46	0.00	0.0	0		W	4.3	PC	19	0
20	53	36	45	0.08	0.0	0	R-,L	SE	2.9	CLDY	20	0
21	57	43	50	0.17	0.0	0	R-,L	W	7.2	CLDY	15	0
22	55	36	46	0.00	0.0	0		W	4.6	CLR	19	0
23	55	42	49	0.65	0.0	0	RW,R	W	10.7	CLDY	16	0
24	48	30	39	0.00	0.0	0		W	8.8	PC	26	0
25	51	30	41	0.00	0.0	0		W	5.8	PC	24	0
26	50	25	38	0.00	0.0	0		W	4.6	CLR	27	0
27	60	31	46	0.10	0.0	0	R-,L	SE	9.8	PC	19	0
28	46	29	38	0.00	0.0	0		W	8.8	CLR	27	0
29	46	26	36	0.00	0.0	0		N	4.2	PC	*29*	0
30	47	27	37	0.00	0.0	0		E	3.8	CLR	28	0
31	56	*22*	39	0.00	0.0	0		S	5.3	CLR	26	0
TOTAL				3.18	0.0						516	0
AVG.	59.3	37.0	48.2					W	5.6			
DEP. FROM NORMAL	-6.9	-7.4	-7.1	+0.67	+0		(NORMAL)	SW	-0.7		+196	-20

NUMBER OF DAYS AND DEPARTURE

	MAX ≥90	TEMP ≤32	MIN ≤32	TEMP ≤0	PRECIPITATION ≤T	≥.01	≥.10	>.50	≥1.00	SNOW ≥1	SKY COVER CLR	PCLDY	CLDY
TOTAL	0	0	12	0	8	8	7	3	0	0	12	11	8
DEP.	0	0	+9	+0	-	0	+2	+2	-1	0	0	+2	-2

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEAT DEG DAYS	SEASONAL COOL DEG DAYS	JAN-OCT PRECIP
TOTAL	1	2	0	0	8	4	0	0	0	0	0	559	1271	20.76
DEP.	-2	0	0	0	-	-	-	0	-	-	-	+182	+252	-11.30

WEATHER TYPES: F=Fog;T=Thunderstorm;IP=Ice Pellets;A=Hail;R=Rain;S=Snow;Z=Glaze;D=Dust; H=Haze;BS=Blowing Snow;RW=Rain Showers;SW=Snow Showers;L=Drizzle.Intensities: +heavy; - light; absence of symbol indicates moderate. Degree day base 65 F. T=trace.
Averages: 1951-80 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data midnt-midnt.
Metric Conversions: C=5/9x(F-32). 1 inch= 2.54 centimeters = 25.4 millimeters.
REMARKS: 5th lowest avg monthly max temp,4th lowest avg monthly min temp,6th lowest avg monthly mean temp for Oct. First recorded frost for 1988 was on the 6th.Peak gust was 30 mph from the SE on the 17th and 27th.

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