1989 Illinois Turfgrass Research Report

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The front cover design is by Joan Zagorski, Graphic Designer, Office of Agricultural Communications and Education.

Foreword

This report presents the results of turfgrass research investigations conducted in Illinois during 1989. 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.

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

Jean Haley, Editor

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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

D. J. Wehner and J. E. Haley

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 ft by 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 1989 growing season the turf was fertilized with 3.0 lbs N/1000 sq ft and was on a preventative fungicide program.

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. 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.

The results from the 1989 growing season paralleled those from earlier years. Penneagle, followed by blends containing Penneagle, received the highest quality ratings of all the entries (Table 1). Plots of Penncross and blends with Penncross received slightly lower quality ratings than Penneagle.

During the course of this study, we have not observed any segregation of the cultivars. Segregation would result in patches of one cultivar developing within the plot. The segregation of grasses in a putting green would disrupt the playability of the green.

This study is being discontinued in 1990. It will be replaced by a national bentgrass cultivar evaluation.

Table 1. The evaluation of creeping bentgrass cultivars and blends mowed at 0.25 inch height of cut during the 1989 growing season.[1]

Cultivar/Blend	Quality[2] 5/16	8/01	9/22	All Dates[3]
Penneagle	5.0	7.7a	6.0	6.2a
Penneagle/Emerald	4.7	7.0ab	6.0	5.9a
Penneagle/Seaside	4.3	6.3bc	6.0	5.6ab
Penneagle/Penncross	4.7	7.3ab	6.7	6.2a
Penncross	4.0	7.0ab	6.0	5.7a
Penncross/Emerald	4.3	7.3ab	5.7	5.8a
Penncross/Seaside	4.0	7.0ab	5.7	5.6ab
Emerald	3.3	5.7c	5.0	4.7c
Seaside	3.7	5.7c	5.3	4.9bc
Emerald/Seaside	3.7	5.3c	5.3	4.8c
$LSD_{0.05}$	NS	1.1	NS	0.7

[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.

USDA National Kentucky Bluegrass Cultivar Evaluation at Carbondale

Kenneth L. Diesburg

INTRODUCTION

Kentucky bluegrass is the mainstay of turf throughout central to northern Illinois as well the rest of the upper midwest. In southern Illinois, however, this species has a tough time surviving in unmanaged situations. It persists to a limited extent and is usually dominated by tall fescue, zoysiagrass, or bermudagrass, whichever happens to be present. Kentucky bluegrass will persist and actually thrive, however, in this transition zone if it receives adequate supplemental nutrition, and timely irrigation. For this reason, the national trial of 72 cultivars has been established at Southern Illinois University. This is an excellent place to test the heat, drought, or poor soil tolerance of Kentucky bluegrass.

MATERIALS AND METHODS

The trial contains two complete sets of entries, one managed at a high level and the other at a low level. The high management bluegrass receives one pound of nitrogen (N) per month in June, July, August, September, October, and November, totalling six pounds N/1000 sq ft per year with a clipping height of 1 1/2" and irrigation to prevent drought stress. The low management bluegrass receives one pound N in September, only, with a clipping height of 2 1/4 inches and no irrigation. In 1989, Nitroform urea formaldehyde was the sole source of nitrogen for the whole trial. Betasan and Dacthal were applied separately in April and June, respectively, to prevent weed seed germination. Turflon D was applied in November to kill broadleaf weeds that managed to escape the preemergent treatments.

Ratings of turf quality are taken monthly to estimate the relative combinations of color, texture, and density among cultivars (Tables 1 and 2). The rating scale is from 1 to 9 with 9 being nearly perfect turf quality, 5 being unacceptable turf quality and 1 being dead turf. Additionally, the opportunity afforded itself to allow the rating of cultivars in their resistance to <u>Helminthosporium (Drechslera) sorokinianum</u>, Leaf Spot in April, 1989. This occurred only in the high management block (Table 1).

RESULTS

Monthly performance of cultivars is combined and presented in the Tables as average yearly performance (Avg). The cultivars are ranked in descending order, accordingly. Many cultivars did better at either high or low management, but not in both. Whereas some cultivars managed to excel in both managements. The pick of the lot for both managements in 1989 are Wabash and Blacksburg.

Table 1. Performance of Kentucky bluegrass cultivars under high management in southern Illinois.

	Ratings, 9 = most desireable									
	Turf Quality									Apr Hel-
Entry	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Avg	minth
Mystic	7.0	7.0	7.7	8.0	6.7	5.3	6.3	6.0	6.8	9.0
Blacksburg	4.0	5.7	5.7	6.7	7.7	9.0	8.3	6.0	6.6	8.3
Wabash	6.3	3.3	4.3	7.0	7.3	9.0	8.0	7.3	6.6	6.0
A-34	6.0	6.0	6.3	6.0	5.3	5.7	7.7	8.7	6.5	8.0
NE 80-88	4.3	6.0	6.0	6.7	6.3	7.3	7.7	7.0	6.4	8.0
Freedom	6.0	6.0	6.0	6.3	5.0	5.7	7.3	7.3	6.2	7.3
Eclipse	4.7	6.3	7.0	7.3	5.3	6.3	7.3	5.3	6.2	8.3
Kenblue	7.7	4.0	4.3	7.0	5.7	8.0	7.0	6.0	6.2	4.7
Trenton	4.3	6.0	6.3	6.7	5.3	5.0	7.7	8.3	6.2	8.7
Haga	5.3	6.0	6.3	6.0	6.0	5.3	7.7	7.0	6.2	7.7
S.D.Certified	7.3	4.3	4.0	6.3	6.7	7.7	7.7	5.3	6.2	5.7
Princeton 104	6.0	6.3	7.3	7.3	6.3	7.3	4.7	5.0	6.2	8.0
Challenger	4.0	5.7	6.3	7.3	5.7	6.7	7.3	5.7	6.1	8.0
Monopoly	4.7	5.7	6.7	6.7	4.3	7.0	7.3	6.0	6.1	8.0
WW Ag 496	3.3	6.0	5.7	5.7	6.0	8.0	8.0	5.7	6.1	7.3
Able I	3.0	6.0	7.0	7.3	5.7	6.0	6.7	6.7	6.1	9.0
Midnight	1.7	6.3	7.3	6.7	7.3	7.3	6.3	5.0	6.0	9.0
Huntsville	6.0	3.0	4.0	8.0	6.3	7.0	7.0	6.3	6.0	4.0
Harmony	3.7	6.0	5.7	7.0	6.0	6.0	7.0	6.3	6.0	7.3
Aspen	4.7	6.0	7.0	6.3	5.3	4.0	6.3	8.0	6.0	8.7
Somerset	5.7	5.7	6.0	8.3	4.7	4.7	6.3	6.0	5.9	8.3
Parade	4.3	5.0	5.7	6.3	5.3	4.7	7.7	8.3	5.9	7.7
K3-178	5.0	5.3	5.7	6.0	5.0	5.7	7.7	7.0	5.9	7.7
Ba 69-82	3.3	6.3	7.3	6.0	5.7	5.7	6.3	6.3	5.9	9.0
Suffolk	5.3	4.3	4.7	6.7	5.0	5.3	7.3	8.0	5.8	7.3
Annika	4.3	6.3	7.0	7.0	5.7	4.7	6.0	5.7	5.8	9.0
PST-CB1	4.7	4.7	4.7	6.3	5.0	5.7	8.0	7.7	5.8	7.0
WW Ag 495	4.0	5.7	5.7	7.3	6.7	6.0	6.0	5.0	5.8	9.0
Merion	4.7	5.7	5.7	6.7	5.7	7.0	6.7	4.0	5.7	8.3
Ba 73-540	2.7	6.0	7.0	6.0	5.3	6.0	6.7	6.3	5.7	8.3
Julia	4.0	5.7	5.0	5.3	6.7	7.0	7.3	5.0	5.7	6.3
Classic	5.3	6.3	5.7	5.7	4.3	4.0	7.0	7.3	5.7	7.7
Ba 70-242	3.7	6.0	5.7	6.3	5.7	6.7	5.7	5.7	5.7	8.0
K1-152	4.7	4.7	5.3	6.0	5.0	5.7	6.7	7.0	5.6	7.0
Ikone	3.7	5.3	5.0	5.7	6.3	8.0	6.7	4.3	5.6	7.0
Cheri	2.0	7.0	7.7	5.7	5.0	5.7	6.3	5.7	5.6	8.3
WW Ag 491	4.3	4.7	5.3	7.0	5.7	5.0	6.7	6.0	5.6	6.3
Joy	7.7	4.3	4.3	6.3	4.7	5.7	6.0	5.3	5.6	6.3
America	2.3	5.3	6.7	7.0	4.7	5.3	7.3	5.7	5.6	9.0
Georgetown	4.0	6.0	5.7	6.0	4.7	4.0	6.7	6.7	5.5	8.3
Cynthia	3.7	5.3	5.3	7.0	6.0	4.7	6.0	5.7	5.5	7.3

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Avg	Hel-
Asset	5.7	6.3	7.0	6.3	4.3	3.3	5.7	5.0	5.5	8.0
Compact	3.7	4.7	5.3	6.7	5.0	6.0	6.7	5.7	5.5	7.3
Merit	3.0	5.0	5.3	6.0	6.3	7.3	6.3	4.3	5.5	8.7
Destiny	4.7	5.3	5.7	6.0	4.7	5.3	6.3	5.7	5.5	8.3
WW Ag 468	2.3	6.0	6.7	6.7	6.0	6.0	5.7	4.0	5.4	8.7
Dawn	4.0	6.0	6.7	6.0	4.3	4.0	6.0	6.3	5.4	8.7
Estate	2.7	6.7	7.3	6.0	4.3	5.0	6.0	5.3	5.4	8.3
Lofts 1757	4.0	4.7	5.7	6.7	5.3	5.0	6.3	5.7	5.4	8.3
BAR VB 534	4.0	5.0	5.3	6.3	4.7	5.7	6.7	5.7	5.4	8.3
Liberty	3.7	5.7	6.3	6.3	4.3	4.3	6.0	6.3	5.4	7.7
Rugby	3.7	4.7	5.3	5.0	5.3	4.7	7.0	7.3	5.4	7.0
Nassau	5.0	5.3	5.7	5.3	4.7	4.7	6.3	5.7	5.3	9.0
Amazon	4.0	6.3	6.7	7.0	4.7	4.0	5.0	5.0	5.3	8.7
Coventry	2.3	6.3	7.3	6.0	4.0	4.7	5.7	6.0	5.3	8.7
Chateau	2.3	6.0	7.7	5.0	4.7	4.3	6.3	5.7	5.2	8.0
HV 97	4.3	5.0	6.3	6.3	5.0	4.3	6.0	4.7	5.2	7.7
Bristol	3.3	6.3	6.3	5.7	4.3	5.3	6.0	4.7	5.2	9.0
Welcome	4.7	6.0	5.7	6.3	5.0	4.0	5.0	4.3	5.1	7.3
Baron	2.3	5.7	5.3	5.3	5.7	6.0	5.7	5.0	5.1	8.0
Abbey	3.7	6.3	6.0	5.7	5.0	4.7	5.3	4.0	5.1	8.3
Sydsport	2.0	5.3	7.0	5.3	4.3	5.0	6.7	4.7	5.0	9.0
Gnome	4.0	4.7	5.7	5.7	4.7	5.0	5.7	4.7	5.0	9.0
Kelly	3.3	6.0	5.7	6.3	5.0	5.0	4.7	3.7	5.0	8.3
Aquila	5.7	4.7	4.7	6.7	4.3	4.0	4.3	5.3	5.0	6.3
Ram-1	4.7	6.3	6.7	7.0	3.3	3.0	4.3	3.7	4.9	8.0
Victa	4.3	6.0	5.3	5.7	4.3	4.3	4.3	4.0	4.8	9.0
BAR VB 577	6.3	5.3	6.0	6.0	3.0	2.3	5.0	4.0	4.8	8.3
Tendos	4.0	4.7	4.7	5.3	4.3	4.3	5.7	5.3	4.8	8.0
Conni	2.7	4.7	5.7	6.3	4.0	4.3	5.3	5.0	4.8	8.3
Glade	3.0	5.3	6.0	6.3	5.7	4.3	3.7	3.3	4.7	8.0
Barzan	3.3	5.0	5.0	5.3	4.3	4.3	6.0	4.3	4.7	7.0
LSD 0.05	1.8	1.7	1.3	1.5	1.7	2.2	1.7	1.8	.9	1.6

Table 2. Performance of Kentucky bluegrass cultivars under low management in southern Illinois.

	Turf Quality Ratings, 9 = most desireable								
Entry	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Avg
Wabash	5.7	8.0	7.3	7.0	6.7	7.3	8.0	6.0	7.0
Blacksburg	4.0	6.3	8.0	8.0	8.3	6.7	7.7	5.7	6.8
Coventry	3.0	7.7	8.3	6.7	6.3	6.3	7.7	6.3	6.5
WW Ag 496	4.3	7.0	7.3	7.3	6.7	6.3	6.7	5.0	6.3
America	5.0	6.7	6.7	8.3	4.7	5.0	7.7	5.7	6.2
Monopoly	4.7	8.0	8.3	6.7	4.7	5.3	6.7	4.7	6.1
Harmony	2.7	7.0	7.7	6.3	6.7	6.0	7.0	4.3	6.0
Rugby	4.3	6.7	7.0	6.3	5.7	5.3	6.7	5.7	6.0
Julia	3.3	6.7	6.3	6.0	5.0	7.0	7.7	5.3	6.0
HV 97	4.3	7.7	7.0	6.7	4.7	5.0	6.3	5.3	5.9
Baron	2.7	7.0	6.7	6.7	7.0	6.3	6.0	4.7	5.9
S.D.Cert.	5.7	7.7	4.7	6.0	4.7	6.0	7.3	4.7	5.8
Chateau	4.0	6.0	6.7	6.7	6.7	5.7	5.7	5.3	5.8
A-34	5.7	6.7	6.3	5.7	5.7	4.7	6.3	5.7	5.8
Mystic	7.0	7.7	7.3	6.3	6.3	3.7	4.7	3.7	5.8
Gnome	3.3	6.0	4.7	7.7	6.7	6.3	637	5.0	5.8
Kelly	4.3	6.3	6.0	7.3	7.0	5.7	5.0	4.0	5.7
Huntsville	4.0	5.7	6.0	7.3	5.0	5.3	7.0	5.0	5.7
Sydsport	4.0	7.3	7.0	6.3	5.0	4.7	5.7	5.3	5.7
Ba 70-242	4.0	6.0	6.0	7.3	7.0	5.3	5.3	4.0	5.7
Abbey	3.0	6.3	6.0	6.7	6.7	6.3	6.0	4.0	5.6
Suffolk	5.0	7.3	7.3	6.3	5.0	3.3	5.3	5.0	5.6
Ikone	3.0	6.0	6.7	5.7	5.7	6.3	6.3	5.0	5.6
Princ.104	3.3	4.7	5.7	7.3	7.7	6.0	5.3	4.3	5.5
Freedom	4.0	6.3	7.0	6.3	5.0	4.3	6.0	5.3	5.5
PST-CB1	4.0	6.3	6.7	7.0	4.3	4.7	6.0	5.0	5.5
Victa	4.3	6.7	5.7	5.3	6.7	5.3	5.3	4.7	5.5
Joy	6.7	7.0	5.0	5.3	4.0	4.7	6.7	4.3	5.5
Compact	2.3	6.7	5.0	5.7	6.0	6.0	6.3	5.7	5.5
Barzan	2.7	6.0	6.3	7.3	6.0	5.3	5.7	4.3	5.5
Midnight	2.0	6.0	6.7	7.3	8.0	4.0	5.0	4.3	5.4
Ba 73-540	3.0	7.0	7.3	7.0	5.3	4.0	5.0	4.7	5.4
WW Ag 495	4.3	5.7	6.7	7.0	6.3	4.7	4.7	4.0	5.4
Parade	5.0	6.7	7.0	7.0	4.3	3.3	5.0	4.7	5.4
Bristol	3.0	5.3	5.3	6.3	5.7	6.0	7.0	4.3	5.4
Kenblue	7.0	6.7	4.3	4.0	4.7	4.7	6.3	5.3	5.4
Estate	2.7	6.7	6.7	6.0	5.0	5.3	5.7	5.0	5.4
K1-152	5.7	5.5	6.3	5.7	4.7	4.3	6.0	5.0	5.4
Eclipse	3.7	6.0	6.3	7.3	5.7	4.3	5.0	4.3	5.3
Georgetown	4.3	6.3	7.0	6.7	5.0	4.0	5.0	4.3	5.3
Cheri	2.7	6.3	6.3	6.0	5.3	4.7	6.7	4.7	5.3
Liberty	3.7	6.7	6.3	7.0	5.0	4.0	6.0	4.0	5.3
WW Ag 468	2.7	6.0	6.3	6.3	5.3	5.0	6.7	4.3	5.3
K3-178	5.7	7.3	6.7	6.0	4.3	3.3	5.0	4.0	5.3

	Mar	Apr	Jun	Jul	Aug	Sep	Oct	Nov	Avg
Aspen	4.3	5.7	6.0	7.3	5.7	3.7	4.7	5.0	5.3
Somerset	4.0	7.0	6.7	6.3	3.7	4.3	6.0	4.3	5.3
Classic	5.0	6.7	7.0	6.3	4.7	3.3	4.3	4.7	5.2
Lofts 1757	3.7	6.3	6.3	6.7	6.0	3.7	5.0	4.3	5.2
Ba 69-82	2.7	5.7	5.7	4.7	6.0	5.7	6.3	5.0	5.2
Trenton	4.0	5.3	6.3	6.3	5.0	4.7	5.7	4.3	5.2
NE 80-88	4.7	6.3	6.7	4.0	5.7	4.0	6.0	4.3	5.2
Amazon	4.7	6.3	6.3	7.0	5.7	3.0	4.0	4.0	5.1
Conni	4.7	6.3	6.3	6.0	5.3	3.7	4.7	3.7	5.1
BAR VB 534	2.7	6.7	7.7	7.0	5.3	2.7	4.3	4.3	5.1
Cynthia	2.3	6.0	6.0	6.7	5.7	3.3	5.3	5.0	5.0
Merit	2.3	5.7	5.3	7.0	5.3	5.0	5.3	4.3	5.0
Nassau	3.3	5.3	5.3	6.0	5.7	4.3	5.3	4.7	5.0
WW Ag 491	3.7	6.3	7.7	7.3	5.0	3.0	3.7	3.3	5.0
Glade	2.7	7.0	7.3	5.7	4.0	4.3	4.7	4.3	5.0
Aquila	5.0	7.3	5.7	6.3	5.7	3.0	3.3	3.3	5.0
Able I	3.7	6.7	7.0	6.0	5.7	2.7	3.7	4.3	5.0
Challenger	3.0	6.0	6.0	5.7	4.3	3.7	5.7	4.0	4.8
Asset	5.0	5.7	7.0	6.0	4.7	2.0	4.0	3.7	4.8
Merion	3.0	5.0	5.7	6.3	5.0	3.3	5.3	3.7	4.7
Haga	3.0	5.3	5.7	6.3	4.3	3.0	5.0	4.3	4.6
BAR VB 577	4.3	6.3	5.0	7.0	3.7	2.7	4.0	4.0	4.6
Welcome	4.0	6.7	5.7	6.7	5.0	2.3	3.0	3.7	4.6
Destiny	2.3	5.0	5.7	7.7	4.3	3.3	4.7	4.3	4.6
Dawn	3.0	5.3	5.0	6.0	4.3	3.7	4.3	5.0	4.6
Annika	3.0	6.0	6.7	6.3	4.7	3.3	3.3	3.3	4.6
Tendos	2.3	5.0	5.7	7.3	3.7	3.0	4.0	3.7	4.3
Ram-1	3.3	6.3	7.0	7.0	3.0	1.7	2.7	3.0	4.2
LSD 0.05	2.0	1.8	1.7	1.9	1.9	1.9	1.9	1.6	1.0

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. During 1989 the area was fertilized with 3 lbs N/1000 sq ft and mowed at 2.0 inches. Herbicides for both pre and postemergence crabgrass control were applied. Prograss was applied to the area at 0.75 lbs ai/A on 10 October and 13 November 1989 for Poa annua control.

DISCUSSION

The average plot area covered with turf 30 days following seeding is listed in Table 1. Cultivars that provided 60% or greater plot cover are Bronco, Dawn, Glade, Julia, Liberty and Midnight. Poa annua infestation was so great during 1989 that the cultivars were not evaluated for such characteristics as density, color, quality, heat and drought tolerance. We hope that this weed will not be as great a problem in 1990 and that the cultivars can be further evaluated.

Table 1. Percent cover of plot with Kentucky bluegrass 30 days following seeding.[1]

Cultivar	% Cover[2] 10/13/88	Cultivar	% Cover[2] 10/13/88
Abbey	50.0a-g	Glade	65.0a
Abel-1	41.7e-j	Gnome	2.3rs
Adelphi	25.0k-p	Haga	36.7g-l
Alpine	40.0f-k	Huntsville	40.0f-k
Amazon	50.0a-g	H76-1034	45.0c-i
America	45.0c-i	Ikone	31.7h-n
Aspen	56.7a-e	Julia	63.3a
BA 70-242	58.3a-d	Liberty	63.3a
Baron	50.0a-f	Lofts 1757	43.3d-j
Bell 21	11.7p-s	Merit	46.7b-h
Blacksburg	28.3k-p	Midnight	61.7ab
Bristol	20.0m-q	Monopoly	58.3a-d
Bronco	60.0a-c	Mystic	1.0s
CB1	53.3a-f	Nassau	25.0l-p
Challenger	33.3h-m	Nutop	45.0c-i
Chateau	45.0c-i	Opal	56.7a-e
Cheri	16.7n-r	Ram I	30.0i-n
Classic	33.3h-m	S-21	43.3d-j
Compact	55.0a-f	Somerset	8.3q-s
Coventry	46.7b-h	Suffolk	50.0a-f
Dawn	61.7ab	Sydsport	2.3rs
Destiny	13.3o-s	Tendos	21.7l-q
Eclipse	14.3o-s	Trenton	50.0a-g
Estate	45.0c-i	Victa	53.3a-f
Freedom	23.3l-q	Wabash	55.0a-f
Fylking	35.0h-m	229	53.3a-f
Georgetown	21.7l-q	84-403	45.0c-i
$LSD_{0.05}$	15.6		15.6

[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 cover refers to the % of plot area covered with Kentucky bluegrass turf. This number would reflect the amount of seed that germinated as well as survival and growth following germination.

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 cultivars 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 ft by 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. During 1989 the turf was mowed at 2.0 inches and fertilized with 3 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. 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 (<u>Laetisaria fuciformis</u>) 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.

During the 1989 growing season quality was good to excellent in the spring and fall months for most perennial ryegrass cultivars (Table 1). Due to a high instance of dollar spot (Lanzia and Moellerodiscus spp.) turf quality deteriorated during the summer months. Perennial ryegrass cultivars that obtained quality scores of 7.7 or greater (excellent quality) on at least two rating dates were Palmer, Pick 300, Pick 600, PST-2H7, PST-2PM and Rival. Cultivars that exhibited some resistance to dollar spot (a score of 5.7 or greater) included Goalie, MON LP 763, NK 80389, Pick 300, Pick 600, PST 259, and Regency.

Table 1. The evaluation of perennial ryegrass cultivars during the 1989 growing season.[1]

Cultivar	Quality[2] 5/11	6/22	8/01	10/04	Dollar Spot[3] 8/18
Acrobat (HE 177)	6.7c-g	4.7a-d	2.0e-g	7.3a-c	3.7c-h
Allaire	7.0b-f	4.0c-f	3.3b-e	7.7ab	4.0b-g
BAR LP 410	6.3d-g	4.7a-d	2.3e-g	6.3c-f	2.3gh
BAR LP 454	7.3a-e	4.7a-d	2.0e-g	7.3a-c	4.7a-e
Barry	6.3d-f	4.7a-d	3.3b-e	6.7b-e	3.7c-h
Belle	6.7c-g	4.3b-e	2.3e-g	7.3a-c	4.3a-f
Birdie II	7.3a-e	4.0c-f	4.0a-c	7.0a-d	4.7a-e
Brenda	7.0b-f	5.7a	4.0a-c	7.0a-d	5.3a-c
Caliente	7.3a-e	4.3b-e	3.0b-f	7.0a-d	4.0b-g
Citation II	8.0a-c	4.7a-d	3.0b-f	7.3a-c	5.3a-c
Cowboy	5.7fg	4.7a-d	3.3b-e	6.7b-e	4.0b-g
DEL 946	5.7fg	4.3b-e	3.0b-f	6.3c-f	4.3a-f
Delray	5.3g	4.7a-d	3.7a-d	7.0a-d	4.7a-e
Derby	6.3d-g	4.7a-d	2.0e-g	7.0a-d	3.7c-h
Diplomat	6.7c-g	4.0c-f	3.0b-f	6.7b-e	3.7c-h
Gator	7.7a-d	4.3b-e	3.0b-f	7.0a-d	4.3a-f
Goalie	7.3a-e	5.0a-c	3.0b-f	7.0a-d	6.0a
ISI-K2	7.3a-e	4.3b-e	2.3d-g	7.3a-c	4.7a-e
ISI-851	7.0b-f	4.3b-e	2.3d-g	8.0a	5.0a-d
J207	7.3a-e	4.3b-e	3.3b-e	6.0d-f	4.3a-f
J208	6.0e-g	3.7d-f	1.7fg	5.7ef	2.3gh
KWS-A1-2	6.7c-g	3.7d-f	2.0e-g	6.3c-f	2.0h
Linn	2.0h	2.0g	1.0g	3.0g	3.0e-h
Manhattan	7.0b-f	4.3b-e	3.0b-f	6.3c-f	4.7a-e
Manhattan II	7.0b-f	5.0a-c	3.0b-f	7.3a-c	4.0b-g
MON LP 763	7.7a-d	5.3ab	2.7c-f	7.3a-c	5.7ab
NK 80389	7.0b-f	3.0fg	2.3d-g	7.0a-d	5.7ab
Omega II	7.7a-d	4.7a-d	3.7a-d	7.0a-d	4.0b-g
Ovation	8.0a-c	4.7a-d	2.3d-g	7.3a-c	4.7a-e
Palmer	8.3ab	4.7a-d	2.7c-f	7.7ab	3.7c-h

(continued)

Table 1. The evaluation of perennial ryegrass cultivars during the 1989 growing season (continued).[1]

	Quality[2]				Dollar Spot[3]
Cultivar	5/11	6/22	8/01	10/04	8/18
Patriot	7.3a-e	4.3b-e	2.7c-f	6.7b-e	3.7c-h
Pavo (WW E	6.3d-g	4.3b-e	2.7c-f	5.3f	2.7f-h
Pennant	6.3d-g	4.7a-d	4.0a-c	7.3a-c	4.3a-f
Pennfine	6.7c-g	4.3b-e	2.3d-g	7.0a-d	4.7a-e
Pick 233	6.7c-g	4.3b-e	3.0b-f	7.0a-d	3.7c-h
Pick 300	8.0a-c	4.3b-e	3.0b-f	8.0a	5.7ab
Pick 600	8.7a	3.7d-f	2.7c-f	7.7ab	6.0a
Pick 647	7.3a-e	4.0c-f	3.7a-d	7.7ab	5.0a-d
Pick 715	7.3a-e	4.0c-f	3.3b-e	7.7ab	4.3a-f
Prelude	7.3a-e	4.7a-d	3.0b-f	6.3c-f	4.0b-g
PST-M2E	6.0e-g	5.3ab	4.3ab	7.7ab	4.0b-g
PST-2DD	6.3d-g	4.7a-d	2.7d-f	6.3c-f	3.3d-h
PST-2HH	8.0a-c	4.7a-d	4.3ab	7.0a-d	4.3a-f
PST-2H7	7.7a-d	4.7a-d	3.7a-d	7.7ab	4.0b-g
PST-2PM	8.0a-c	4.0c-f	4.0a-c	7.7ab	5.3a-c
PST-250	6.3d-g	4.3b-e	3.0b-f	7.3a-c	5.3a-c
PST-259	7.3a-e	4.7a-d	5.0a	7.3a-c	6.0a
PSU-222	6.7c-g	4.3b-e	2.0e-g	6.0d-f	4.3a-f
PSU-333	7.7a-d	4.3b-e	3.0b-f	6.7b-e	3.7c-h
Ranger	6.7c-g	4.0c-f	1.7g	7.7ab	4.7a-e
Regal	5.3g	4.0c-f	3.0b-f	6.3c-f	4.3a-f
Regency	6.3d-g	4.3b-e	2.7d-f	7.3a-c	6.0a
Repell	6.0e-g	4.0c-f	2.0e-g	7.3a-c	4.3a-f
Rival (HE 178)	7.7a-d	5.3ab	2.0e-g	7.7ab	5.0a-d
Rodeo	7.3a-e	4.3b-e	2.3d-g	6.7b-e	3.0e-h
Ronja (WW E 31)	6.0e-g	3.3ef	1.7fg	6.0d-f	3.3d-h
Runaway (HE 145)	7.3a-e	4.7a-d	2.7c-f	7.3a-c	3.7c-h
Sheriff	7.0b-f	3.7d-f	1.7fg	7.0a-d	4.0b-g
SR 4000	6.7c-g	4.7a-d	4.0a-c	7.3a-c	3.7c-h
SR 4031	6.7c-g	4.3b-e	3.7a-d	7.7ab	5.0a-d

(continued)

Table 1. The evaluation of perennial ryegrass cultivars during the 1989 growing season (continued).[1]

	Quality[2]				Dollar Spot[3]
Cultivar	5/11	6/22	8/01	10/04	8/18
SR 4100	7.3a-e	4.3b-e	3.7a-d	7.3a-c	4.7a-e
Sunrye (246)	6.7c-g	4.0c-f	4.3ab	8.0a	5.0a-c
Tara	7.7a-d	5.0a-c	2.3d-g	7.0a-d	3.7c-h
Vintage-2DF	5.7fg	4.0c-f	3.0b-f	7.0a-d	4.7a-e
Yorktown II	6.0e-g	5.0a-c	2.7c-f	6.7b-e	3.3d-h
$LSD_{0.05}$	1.4	1.1	1.4	1.2	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]Quality evaluations are made on a 1-9 scale where 9 = excellent turfgrass quality and 1 = very poor turfgrass quality.

[3]Dollar spot 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 Perennial Ryegrass Cultivar Evaluation at Carbondale

Kenneth L. Diesburg

INTRODUCTION

Perennial ryegrass has come a long way since 1961 when NK-100 was released as the first cultivar meant specifically for turf. The USDA initiated a national evaluation program of 47 entries in 1982. During the ensuing four years, there were enough releases of new cultivars to warrant the testing of this new set containing 65 entries in 1986. Perennial ryegrass does not persist well in the transition zone, but it is used extensively in species mixes as a nurse species for the slower establishing tall fescue and zoysia. It is also used as a pure stand in golf course tees, and collars or in any higher management situation where a high-quality cover is needed quickly.

MATERIALS AND METHODS

Since its establishment in 1987, the trial has received 3 to 4 lb N/1000 sq ft per year. In 1989, Nitroform urea formaldehyde was the sole source of nitrogen. Clipping height was at 2 1/4 inches. Weeds were controlled with two applications of preemergent herbicide in April and June, Betasan and Dacthal, respectively, plus a single application of a broadleaf herbicide in November, Turflon D. Weekly irrigation or precipitation is necessary to assure persistence of the trial through June, July, August, and September. The ratings presented in the table are subjective, based upon color, texture, and density.

There are two complete sets of entries. In 1990, therefore, the trial will be divided into high and moderate management blocks. The high management will be a 1 1/2 inch clip with ample nutrient and water supply, while the moderate management will be a 2 1/4 inch clip with somewhat limited nutrient and water supply.

RESULTS

There was a severe and fairly uniform infestation of masked chafer grub in this trial in 1989. Differences among cultivars in resistance to this pest were evident during August and September. The somewhat unusual ranking could be a result of resistance to this pest in some cultivars from either multigenic traits or presence of endophyte in the plant tissues.

Table 1. Turf quality ratings of perennial ryegrass from summer through autumn in southern Illinois.

	Turf Quality Ratings, 9 = best					
Entry	July	August	September	October	November	Average
SR 4100	6.2	6.7	7.3	7.5	7.8	7.10
Dasher II	5.8	6.7	8.0	6.8	8.0	7.07
Pennant	5.5	7.2	8.0	6.3	8.2	7.03
Riviera	6.0	7.0	7.7	6.5	8.0	7.03
SR 4000	5.5	6.7	7.7	7.0	7.8	6.93
Commander	6.5	6.2	7.7	6.0	8.0	6.87
Birdie II	6.0	6.7	7.0	6.5	8.0	6.83
Goalie	5.2	7.2	7.5	6.5	7.8	6.83
Charger	6.0	6.7	7.2	6.5	7.5	6.77
Repell	5.3	7.2	7.0	6.0	8.0	6.70
Caliente	5.2	6.7	6.8	6.8	7.7	6.63
Pennfine	5.7	5.7	7.2	6.5	7.7	6.53
Cowboy	5.7	6.0	6.5	6.5	7.8	6.50
Prelude	5.5	6.2	6.8	6.2	7.8	6.50
Saturn	4.8	6.7	7.3	6.0	7.7	6.50
Citation II	5.0	6.0	7.3	6.2	8.0	6.50
SR 4031	5.7	6.2	7.2	5.8	7.5	6.47
PST 2DD	5.3	6.0	6.8	6.7	7.5	6.47
Del 946	5.2	6.2	6.3	6.0	8.0	6.33
Regal	5.5	5.7	6.8	6.0	7.7	6.33
PSU 222	4.8	5.5	7.2	6.3	7.7	6.30
Yorktown II	5.2	5.8	6.8	6.3	7.3	6.30
Patriot	5.0	5.3	7.3	6.2	7.7	6.30
BAR Lp 410	4.8	6.2	6.2	6.7	7.5	6.27
PSU 333	5.2	5.7	6.8	6.2	7.3	6.23
Pick 715	6.0	5.3	6.7	6.2	6.8	6.20
Lindsay	5.0	5.5	7.2	6.0	7.2	6.17
PST-2H7	5.0	5.7	7.0	5.8	7.3	6.17
Blazer II	5.7	5.2	6.7	6.0	7.3	6.17
Omega II	4.8	5.5	7.0	6.0	7.5	6.17
Manhattan II	4.7	5.5	6.8	6.0	7.5	6.10
246	5.5	5.5	6.5	5.7	7.3	6.10
Vintage	4.7	5.7	6.3	6.0	7.7	6.07
PST-M2E	4.7	5.3	7.0	6.0	7.2	6.03
Belle	4.3	6.2	7.0	5.0	7.7	6.03
Derby	4.8	5.7	6.7	5.5	7.3	6.00
Competitor	4.7	5.7	6.7	5.5	7.5	6.00
Fiesta II	5.3	5.3	6.8	5.3	7.0	5.97
Ronja	4.7	5.3	6.7	5.3	7.5	5.90
Dillon	4.3	6.0	6.2	5.3	7.5	5.87
Palmer	4.5	5.0	6.5	6.2	7.2	5.87
Ranger	4.0	5.7	7.0	5.2	7.5	5.87
Rival	5.2	5.5	5.5	5.7	7.0	5.77
Tara	4.3	5.2	5.7	6.7	7.0	5.77
Gator	4.7	5.3	6.5	4.8	7.5	5.77
Delray	4.3	4.8	6.2	6.0	7.5	5.77
NK 80389	5.0	4.8	6.0	5.7	7.2	5.73

Table 1. Turf quality ratings of perennial ryegrass from summer through autumn in southern Illinois.

	Turf Quality Ratings, 9 = best					
Entry	July	August	September	October	November	Average
Regency	4.7	5.2	6.0	6.0	6.8	5.73
Runaway	4.3	4.8	6.0	5.8	7.3	5.67
Brenda	4.3	5.3	6.0	5.7	6.7	5.60
Barry	4.5	4.7	6.2	6.2	6.5	5.60
Aquarius	4.2	4.7	6.7	5.3	7.2	5.60
Diplomat	4.5	5.2	5.3	5.7	7.2	5.57
Allaire	4.5	4.3	6.3	5.5	6.8	5.50
Sheriff	4.7	5.3	5.3	5.2	6.8	5.47
Pavo	5.0	4.5	5.2	5.8	6.8	5.47
Mom LP 763	3.7	5.3	5.8	5.2	7.3	5.47
Manhattan	3.8	5.0	6.2	5.0	7.2	5.43
J207	3.8	5.0	5.5	5.5	7.2	5.40
Linn	4.2	5.2	5.2	5.5	6.8	5.37
J208	4.3	4.7	5.2	5.0	7.2	5.27
BAR LP 454	3.8	4.7	5.8	5.0	7.0	5.27
Rodeo	4.0	4.0	6.2	5.3	6.8	5.27
Acrobat	4.3	4.7	5.2	4.7	6.7	5.10
Ovation	4.0	4.8	4.8	5.0	6.7	5.07
LSD 0.05	1.3	1.5	1.3	1.3	0.9	0.96

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 ft by 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 1989 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 2.0 inches height of cut and irrigated as needed.

RESULTS

Turf quality is rated on a scale of 1-9, where 9 = excellent turf quality and 1 = very poor turf quality. During 1988, early June quality was fair to good for most cultivars. 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.

Trends in cultivar quality during the 1989 growing season were similar to the previous year. Observed quality for most cultivars during May and June was good to fair (Table 1). No siginificant difference among cultivars was noted in August and in general quality ratings were low. Cultivars that consistantly exhibited excellent quality (scores above 7.7 for two or more dates) were Bonanza, Hubbard 87, JB-2, KWS-DUR, Mesa, Normarc 25, Normarc 77, PE-7, PE-7E, Pick DDF, Pick TF9, Pick 127, Pick 845PN, PST 5AG, PST-5AP, PST-5HF, PST-5MW, Rebel II, Thoroughbred, Trailblazer and Wrangler. Cultivars that had scores of 6.3 or lower (poor to fair quality) on at least 3 of the rating dates were Fatima, Ky-31 and Pick SLD.

Table 1. The evaluation of tall fescue cultivars during the 1989 growing season.[1]

	Quality[2]			
Cultivar	5/11	6/22	8/01	10/04
Adventure	7.7a-c	7.3b-d	6.3	7.0c-e
Apache	7.3b-d	7.7a-c	5.3	7.3b-d
Arid	7.0c-e	7.0c-e	6.3	7.0c-e
Aztec	7.0c-e	7.7a-c	6.3	7.7bc
BAR FA 7851	7.7a-c	7.0c-e	5.7	7.7bc
Bel 86-1	7.3b-d	7.3b-d	6.7	7.3b-d
Bel 86-2	7.0c-e	7.3b-d	6.3	7.7bc
Bonanza	8.0ab	8.0ab	6.3	7.0c-e
Carefree	7.3b-d	7.3b-d	7.0	7.0c-e
Chieftan	7.3b-d	7.7a-c	6.7	7.3b-d
Cimmaron	7.0c-e	7.7a-c	6.7	7.0c-e
Falcon	7.0c-e	7.3b-d	5.7	7.0c-e
Fatima	6.3ef	6.3ef	5.7	6.0f
Finelawn I	7.0c-e	7.0c-e	5.3	6.7d-f
Finelawn 5GL	7.7a-c	7.3b-d	4.7	6.0f
Hubbard 87	8.0ab	8.0ab	6.3	8.0b
Jaguar	7.7a-c	7.0c-e	7.0	7.3b-d
Jaguar II	6.7d-f	7.3b-d	6.3	7.7bc
JB-2	7.7a-c	8.0ab	6.3	7.0c-e
KWS-BG-6	6.7d-f	7.0c-e	5.0	6.7d-f
KWS-DUR	7.7a-c	7.7a-c	7.0	7.3b-d
Ky-31	5.3g	6.0f	5.7	6.0f
Legend	7.0c-e	7.3b-d	4.7	7.3b-d
Mesa	8.0ab	7.7a-c	7.0	8.0b
Monarch	7.3b-d	7.0c-e	6.0	7.3b-d
Normarc 25	8.0ab	8.0ab	7.0	7.3b-d
Normarc 77	7.7a-c	8.0ab	7.3	7.3b-d
Normarc 99	6.7d-f	7.3b-d	6.3	7.0c-e
Olympic	7.0c-e	7.7a-c	6.0	7.0c-e
Pacer	6.0fg	6.7d-f	6.3	7.0c-e

(continued)

Table 1. The evaluation of tall fescue cultivars during the 1989 growing season (continued).[1]

Cultivar	Quality[2] 5/11	6/22	8/01	10/04
PE-7	8.3a	8.0ab	6.7	7.7bc
PE-7E	7.7a-c	8.0ab	6.7	9.0a
Pick DDF	7.0c-e	7.7a-c	5.3	7.7bc
Pick DM	7.0c-e	7.3b-d	6.0	7.7bc
Pick GH6	7.3b-d	7.3b-d	6.7	7.0c-e
Pick SLD	6.3ef	7.0c-e	4.3	6.3ef
Pick TF9	7.7a-c	7.7a-c	6.0	7.7bc
Pick 127	8.0ab	8.0ab	7.3	7.3b-d
Pick 845PN	7.3b-d	8.0ab	6.7	7.7bc
PST-DBC	7.0c-e	7.3b-d	6.3	7.3b-d
PST-5AG	7.7a-c	8.0ab	6.3	8.0b
PST-5AP	7.3b-d	7.7a-c	7.0	7.7bc
PST-5BL	7.0c-e	7.7a-c	5.7	7.3b-d
PST-5DL	7.3b-d	8.0ab	6.0	7.0c-e
PST-5DM	6.7d-f	7.7a-c	6.3	7.0c-e
PST-5D7	7.3b-d	7.3b-d	5.7	7.3b-d
PST-5EN	7.0c-e	7.3b-d	6.0	7.3b-d
PST-5F2	7.3b-d	7.3b-d	6.0	7.7bc
PST-5HF	7.0c-e	8.3a	7.0	8.0b
PST-5MW	7.7a-c	8.0ab	6.3	8.0b
PST-5OL	6.7d-f	6.7d-f	6.3	7.0c-e
Rebel	7.0c-e	7.0c-e	5.3	7.0c-e
Rebel II	7.7a-c	7.7a-c	6.0	7.3b-d
Richmond	6.7d-f	6.7d-f	5.7	7.0c-e
Sundance	8.0ab	7.3b-d	6.0	7.0c-e
Syn Ga	6.7d-f	7.0c-e	5.7	6.3ef
Taurus	6.7d-f	7.0c-e	6.3	6.3ef
Thoroughbred	7.3b-d	7.7a-c	6.3	8.0b
Tip	6.7d-f	6.3ef	6.3	6.7d-f
Titan	7.0c-e	7.0c-e	6.7	6.7d-f

(continued)

Table 1. The evaluation of tall fescue cultivars during the 1989 growing season (continued).[1]

	Quality[2]			
Cultivar	5/11	6/22	8/01	10/04
Trailblazer	8.0ab	7.7a-c	5.3	7.3b-d
Tribute	7.0c-e	7.3b-d	7.0	7.0c-e
Trident	7.0c-e	7.3b-d	6.3	7.3b-d
Willamette	6.7d-f	7.0c-e	6.0	6.7d-f
Wrangler	8.0ab	8.0ab	6.0	7.7bc
$LSD_{0.05}$	1.0	0.9	NS	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.

Establishment of the National Testing Program Bermudagrass Trial at Southern Illinois University

Kenneth L. Diesburg

INTRODUCTION

Cultivars identical to those being established at Carbondale are being tested at many other locations throughout the southern United States. This program is organized by the USDA, Beltsville, Maryland.

Bermudagrass is not usually considered for turfgrass in Illinois. There are situations, however, in southern Illinois where it is the species of choice. These are areas where play is so intense that the superior stoloniferous growth rate of bermudagrass allows rapid recovery as long as seasonal temperatures are in the 60s or higher. Specifically, athletic fields and golf course tees are the sites for using bermudagrass. There is a rule-of-thumb that the bermudagrass will be winter-killed one year out of five, but the turfgrass manager considers that a lesser loss than losing the turf of some other species every summer from intensive traffic.

MATERIALS, METHODS, AND RESULTS

Two-inch plugs of the vegetative cultivars were planted July 24 and the seeded cultivars were planted July 25 into a randomized complete block design with three replications. Among the seeded cultivars, CD-32 germinated four days sooner than the others (Table 1). Establishment rate of the plugs was estimated by averaging two, perpendicular, diameter measurements from stolon tip to stolon tip in each of four plugs per plot. There were large differences in stoloniferous growth. The more vigorous cultivars had completely filled in their plots by the end of summer, while the less vigorous ones had barely filled half their plots.

Ability to hold color into autumn was estimated by subjective rating (Table 1). There were large differences among cultivars for this trait, as well.

DISCUSSION

The degree of success in maintaining a bermudagrass cover on intensively used turf in southern Illinois could depend largely upon the cultivar used. It would seem that the faster growing cultivars would be more useful. This idea remains to be tested.

Table 1. Establishment characteristics of burmudagrass cultivars in Southern Illinois.

Cultivar	Days to Germination	Stoloniferous Growth(cm)	Color Rating 10/10,9=best
Vegetative			
U-3		81.0	5.3
E-29		65.0	8.0
FB-119		64.3	7.0
A-29		60.0	5.7
Tiffine		59.7	3.7
RS-1		58.3	6.3
NM-471		54.7	3.7
C-53		51.7	6.0
A-22		49.7	6.7
NM-507		48.0	6.7
MSB-30		45.7	6.0
Vamont		45.3	8.0
MSB-20		43.7	4.3
Tufcote		43.3	5.3
Texturf		42.3	6.7
Tifgreen		41.4	4.3
NM-72		41.0	4.3
NM-43		41.0	4.3
CT-23		33.0	7.3
Westwood		32.5	7.7
Midiron		31.0	7.0
NM-375		28.3	7.0
419		27.3	5.3
Tifway		23.0	7.0
MSB-10		22.3	7.0
Tifway II		19.7	6.3
328			4.3
Audobon			8.3
Seeded			
NMCT	10		9.0
NMC-1	10		8.0
NMC-2	10		8.0
Cheyenne	11		8.7
Sahara	10		5.3
NMS-2	10		2.3
NMS-3	12		5.0
NMS-4	11		5.3
NMS-5	10		
NMPx5	10		3.0
Arizona Common	12		4.7
Guymon	10		5.0
CD 6.67	10		4.0
CD 5.08	11		5.7
CD-32	8		5.0
$LSD_{0.05}$	1	17.1	2.6

1989 NCR-10 REGIONAL ALTERNATIVE TURFGRASS SPECIES EVALUATION

T. B. Voigt and J. E. Haley

INTRODUCTION

Many acres of roadsides, industrial settings, airports, and little-used park areas receive little maintenance and require turfgrasses suitable for less-than-optimal environmental conditions. Interest in tough, tolerant grasses has increased in light of recent hot, dry weather conditions and turf watering restrictions imposed by several Illinois communities. Budgetary constraints have also contributed to interest in these grasses.

A USDA-sponsored group of turf researchers from Midwestern universities, the NCR-10 research committee, has agreed to evaluate sixteen turfgrasses that are not often 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. They are maintained at three heights in an attempt to define appropriate mowing regimes.

MATERIALS AND METHODS

Sixteen turfgrasses (Table 1) were planted into a firm, Flanagan silt loam seed bed 7 September 1988. Planting rates for the 3' x 10' plots, each replicated three times, are listed in Table 1. One pound of N/1000 sq ft was applied 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 plot areas.

Since April, 1989, cultural activities, other than mowing and one handweeding, were withheld. A mowing trial was initiated in April; each plot is split into three mowing heights stripped across each replication. Mowing heights are two inches, four inches, and unmowed. Overall turf quality data will be collected monthly (May-Oct.) during the growing season for a minimum of three years. Turf quality is based on a 1-9 scale where 1=tan turf, bare soil, lowest overall quality, 6=minimal turfgrass quality, and 9=darkest green, very dense, highest overall quality.

RESULTS

Ruff crested wheatgrass did not germinate and received quality ratings of 1 throughout the evaluation period. Both buffalograss selections were planted using plugs which resulted in low ratings (2-3) due to limited plot coverage. There were significant quality differences among turfgrass mowing heights during all rating dates except September. Generally, the two and four inch mowing heights received higher evaluations than the unmowed plots. There were also significant quality differences among species on each monthly evaluation (Table 1). Finally, seasonal mean ratings of the four most highly evaluated turfgrasses, Exeter Colonial Bentgrass; Sheep Fescue; Reton Red Top; and Reubens Canada Bluegrass, mowed at two inches and four inches are shown in Figures 1 and 2. Note that none of these alternative species provides turf of consistently high quality.

It is important to note that these results represent only one year's data collection. This study will be continued for a minimum of two more years. When considering one of these species, consult future Turfgrass Research Reports for evaluations based several year's data.

Table 1. The alternative turfgrasses, planting rates, and mean quality ratings for May, July and September, 1989.

Species	Planting Rate[1]	Mean Quality Rating[2] 5/89	7/89	9/89
Fairway Crested Wheatgrass *Agropyron cristatum*	4.3	4.2de	4.4bc	3.3cd
Emphraim Crested Wheatgrass *Agropyron desertorum* 'Emphraim'	4.2	3.4f	3.2d	2.3e
Ruff Crested Wheatgrass *Agropyron desertorum* 'Ruff'	6.2	1.0h	1.0f	1.0f
Sodar Streambank Wheatgrass *Agropyron riparium* 'Sodar'	4.2	3.6ef	3.7cd	4.0bc
Reton Red Top *Agrostis alba* 'Reton'	4.0	5.4ab	5.7a	5.2a
Exeter Colonial Bentgrass *Agrostis tenuis* 'Exeter'	3.8	5.8a	5.8a	5.0a
NE 84-315 Buffalograss *Buchloe dactyloides* 'NE 84-315'	1 plug tray	2.2g	2.3e	2.0e
Texoka Buffalograss *Buchloe dactyloides* 'Texoka'	1 plug tray	2.2g	2.3e	2.0e
Alta Tall Fescue *Festuca arundinacea* 'Alta'	4.5	4.6cd	4.8b	4.2b
Durar Hard Fescue *Festuca ovina* var. *duriuscula* 'Durar'	4.2	3.9ef	4.4bc	4.2b
Sheep Fescue *Festuca ovina*	4.2	5.1bc	5.9a	5.0a
Covar Sheep Fescue *Festuca ovina* 'Covar'	4.5	3.8ef	4.3bc	4.6ab
Alpine Bluegrass *Poa alpina*	4.0	3.8ef	3.2d	2.0e
Bulbous Bluegrass *Poa bulbosa*	4.2	1.9g	1.0f	1.0f
Reubens Canada Bluegrass *Poa compressa* 'Reubens'	4.3	5.1bc	5.7a	5.0a
Colt Rough-stalked Bluegrass *Poa trivialis* 'Colt'	4.0	5.6ab	4.1bc	3.2d
$LSD_{0.05}$		0.6	0.8	0.7

[1] Planting rate is in pounds of seed per 1,000 square feet except for the two buffalorgrass selections which were planted at a rate of 278 plugs per 1,000 square feet.

[2] Mean quality rating is the mean of three 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.

Fig. 1. QUALITY RATING FOR FOUR ALTERNATIVE TURFGRASSES—2" MOWING HEIGHT

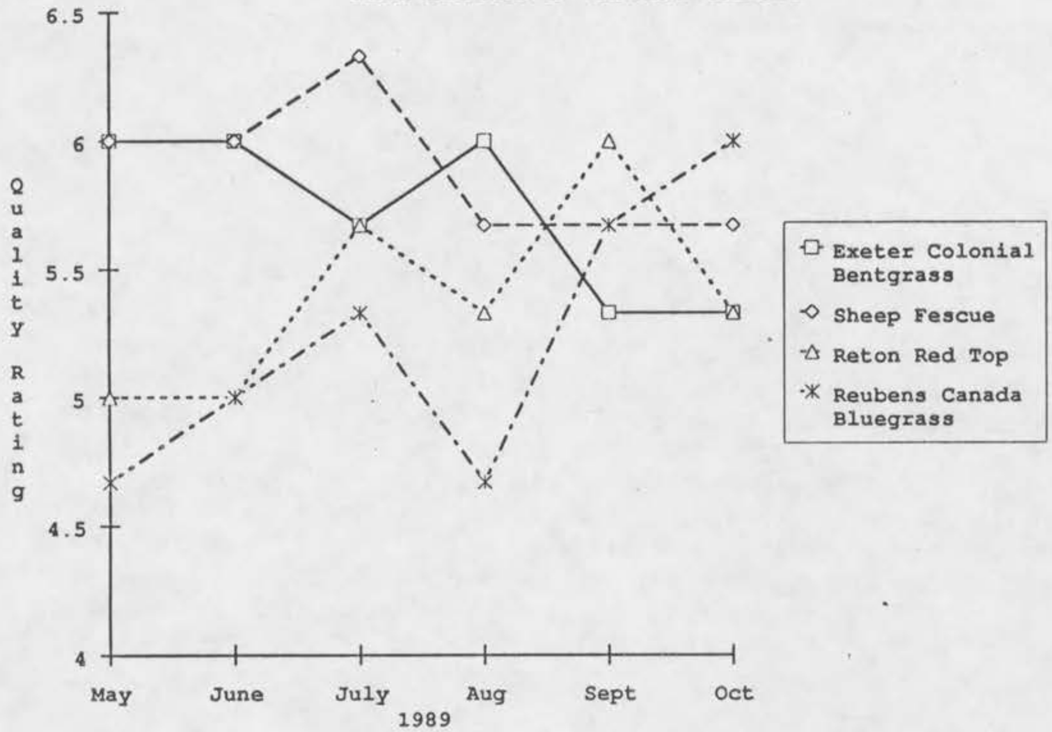
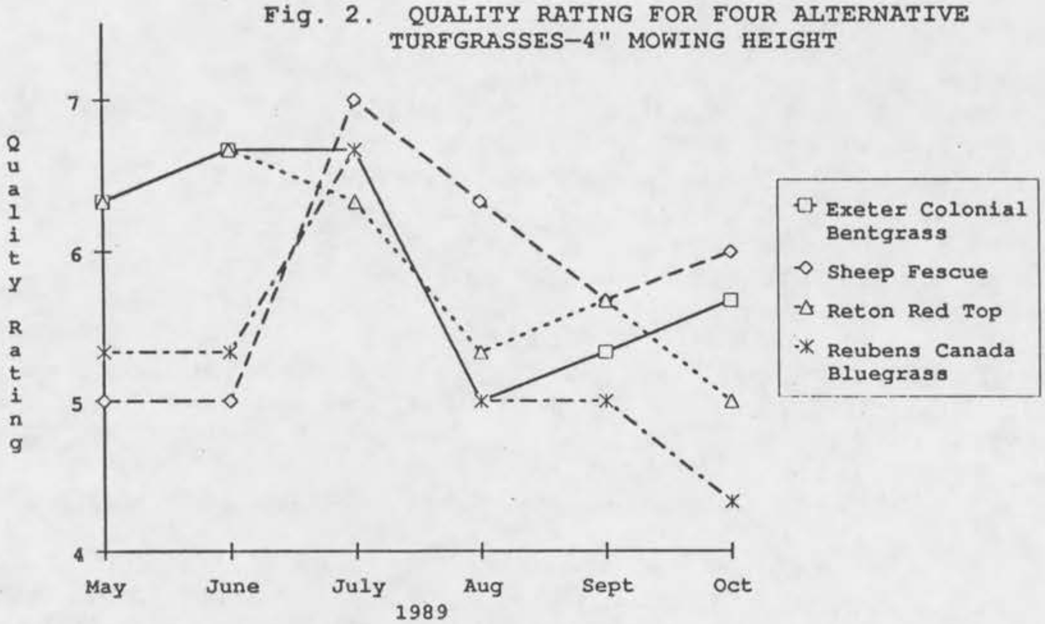


Fig. 2. QUALITY RATING FOR FOUR ALTERNATIVE TURFGRASSES—4" MOWING HEIGHT



North Central Region Evaluation of Alternative Species for Low Management Turf at Southern Illinois University, Carbondale

Kenneth L. Diesburg

INTRODUCTION

The species of popular use for turf in the temperate zone of the United States are Kentucky bluegrass, perennial ryegrass, tall fescue, bentgrass and the fine fescues. There are, however, many other perennial grass species that persist in the same area, some of them native to North America. For well-managed turf, there is no question that these popular species cannot be matched, but for low management turf there has always been the question that perhaps there are other, tougher species that might to better. This project, coordinated over ten upper midwest states, was therefore conceived to pursue that question. Seed and propagules were distributed and planted in 1988. This is the first year of data regarding establishment and early performance.

MATERIALS AND METHODS

The entries were planted on open ground, September 28. The seedlings and plugs, therefore, had the full autumn and spring seasons for establishment. Fertilizer was limited to one pound of nitrogen per thousand square feet per year with no supplemental irrigation.

RESULTS

The persistence of these cultivars was well tested during the summer, 1989, when no rain was received for over two months. Establishment went well with the fescues, most of the poas, and the bentgrass (Table 1). The wheatgrasses and Poa alpina, however, established poorly while the buffalograsses failed completely. Since buffalograss is one of the better known low management grasses, establishment will be retried in 1990. Texture and color characteristic to each species are described in Table 2. The fine fescues and bentgrass have the finest texture, while the best color can be obtained from bentgrass, sheep fescue, and Canada bluegrass. The best overall performance throughout 1989 came from sheep fescue and colonial bentgrass (Table 1). This is not expected because bentgrass is usually associated with ultra-high management greens while the fine fescues are usually recommended for shaded situations.

Within each replication there are three clipping heights; 2 inch, 4 inch, and no clip, of which the data is not presented in table form for this report. Generally, the 4-inch clipping height was favored by most of the entries. Fairway crested wheatgrass, Ephraim crested wheatgrass, and Canada bluegrass did best with no clipping, while Covar sheep fescue, bulbous bluegrass, and Poa alpina did best at the 2-inch clip.

Table 1. Establishment and performance of species.

Entry	Ratings (9 = best) Establishment	Performance
Sheep Fescue	5.8	9.0
Exeter Colonial Bentgrass	5.7	8.3
Alta Tall Fescue	5.2	9.0
Reton Redtop	4.5	8.7
Durar Hard Fescue	4.2	8.0
Reubens Canada Bluegrass	4.1	8.3
Covar Sheep Fescue	3.6	7.0
Colt *Poa trivialis*	2.9	8.2
Fairway Crested Wheatgrass	2.7	7.0
Sodar Streambank Wheatgrass	2.2	6.7
Bulbous Bluegrass	1.7	7.0
Ephraim Crested Wheatgrass	1.6	5.3
Poa alpina	1.4	1.0
Ruff Crested Wheatgrass	1.4	2.3
Texoka Buffalograss	1.0	
NE 84-315 Buffalograss	1.0	
$LSD_{0.05}$	0.9	0.4

Table 2. Characteristics of species.

Entry	Ratings(9 = best) Color	Texture	January Comments
Exeter Colonial Bentgrass	8.3	9.0	tan, dense, uniform
Sheep Fescue	7.7	9.0	green, uniform
Reubens Canada Bluegrass	7.7	8.7	green under, brown top
Reton Redtop	6.7	3.3	buff, stiff, coarse
Covar Sheep Fescue	5.7	9.0	green, clumpy, short
Fairway Crested Wheatgrass	5.6	7.3	gone
Durar Hard Fescue	4.7	9.0	green, clumpy
Alta Tall Fescue	4.7	6.0	green under, coarse
Colt *Poa trivialis*	4.6	8.8	gone
Sodar Streambank Wheatgrass	3.7	6.7	sparse, dusty blue
Ephraim Crested Wheatgrass	3.7	6.3	sparse, green
Bulbous Bluegrass	3.3	7.0	very green, very short
$LSD_{0.05}$	1.0	1.0	

IDENTIFYING APPROPRIATE TURFGRASS SPECIES: A FINAL REPORT

T. W. Fermanian and D. J. Wehner

INTRODUCTION

Approximately 10 to 25 students enrolled in Hort 236 (Turfgrass Management) each Fall explore the world of managing fine turfs for the first time. For many this experience will represent their only formal training in the area. A very important task of this course, therefore, is to provide students with the opportunity to learn how to select appropriate turf species whose growth characteristics best match the requirements of a proposed newly established or renovated turf. This approach of closely matching the genetic potential of a plant to its intended environment is considered the most environmentally "safe" method of managing turfs. Turfgrasses which are best adapted usually require minimal fertilization and reduce the need for using pesticides.

Presently turf species and their major characteristics are introduced through data sheets. This format presents one page (text only) per species with various fields on each sheet describing a state or range of states for each character. Other media (35mm slides, textbooks, etc.) are used to show pictorial representations of important visual characters. Students can see the differences and similarities among the species due to the consistency of the format of the data sheets. Many of the major associations between plant characteristics and environmental requirements are presented during lectures. One laboratory period is designed to introduce students to grass morphology and to begin to relate form to function. Time, however, does not permit students to explore all of the possible combinations of turf species and potential environments. Additional independent study time is required to explore further combinations. Some form of a self guided browser with predefined links between plant character and environmental adaptation fields is required. HyperCard from Apple represents an excellent medium to build such a browser.

PROJECT GOALS

The goals of this project were:

1. Develop a HyperCard stack of turfgrass species and cultivars which visually relates plant characteristics (e.g. growth habit, stress tolerance, etc.) to their optimum environment.

2. Determine an efficient methodology for achieving the first goal so it may be used in other horticulture courses with similar requirements (e.g. Hort 201 & 202 Identification and Use of Woody Ornamental Plants, Hort 230 Herbaceous Perennials, etc.) This methodology will be developed in a general form so it may be transferable to other biologically related courses.

3. To explore the potential for adapting the knowledge base of WEEDER (Fermanian and Michalski, 1989), an expert system for identifying grasses to a HyperCard stack.

PROJECT PROCESS

Work on the proposed project was initiated in June, 1989. An initial outline of the project and preliminary development of some of the main screens of the program were pursued over the following several months. TURF SPECIES, a HyperCard™ stack, was developed to provide instructional support for the teaching of grass species most often used in the development of fine turfs. TURF SPECIES provides an initial environment for the exploration of the characteristics of the selected grasses. TURF SPECIES has approximately 150 cards or individual screens. The initial screen is shown in Fig. 1.

TURF SPECIES has three major components. The first component is a tour of the included grass species, grouped into four categories. The Tour menu screen is shown in Fig. 2. Students can view turf species by their site of optimum adaptation, adaptation to different management programs and local site microenvironment, or the intended use of the established turf. Additionally, the species may be listed in alphabetical order of either common or scientific name. When the method of grouping is selected, subsequent menus are presented to help narrow the list of species.

A second portion of the stack includes a mechanism for understanding which groups of species are best adapted to selected environments and potential uses (Fig. 3.) The student can click on any number of the qualities listed on the tour map which are required for a proposed establishment. After clicking on the "Match it!" button, a list of species is presented which matches all of the selected requirements. As with all the cards, a "Help" button is available for additional information.

Finally, a third portion of the stack is a self running quiz or examination which provides feedback support to students after they have completed the first two components (Fig. 4.) Figure 4. is an example of a "fill-in-the-blank" question. Clicking on any of the blank boxes will present a list of possible answers to choose from. Four additional question types were also used. A score is tallied for each screen and is presented in the upper right corner. A final cumlative score is presented on a summary screen.

The intended use of TURF SPECIES is as a support tutorial system for use in the Hort 236, Turfgrass Management Course. After an initial introduction of the grass species by the instructor, each student will receive a diskette containing the TURF SPECIES stack. They will be instructed to complete the examination included in TURF SPECIES after browsing through the two sections of the tutorial. The diskette will be returned to the instructor for review.

While this is a final report, TURF SPECIES is not complete. We consider TURF SPECIES as one program in an extensive, flexible computer based instructional system. More programs or stacks are planned for the future. Additional topics to address might be fertilization, mowing, and pest control.

An effort is currently underway to address the third objective of this project. The grass identification rules of WEEDER[1] are the basis for a new knowledge base identification tool to be added to the TURF SPECIES stack. It is hoped that this ID tool can be accessed from the initial menu of TURF SPECIES.

I thank Apple Computers, the Educational Technologies Board, the University of Illinois College of Agriculture, and the Illinois Turfgrass Foundation for the support necessary for completing this project. While the stack has not been thoroughly tested, it is projected to be used in the fall 1990 Hort 236 course. Initial evaluation of TURF SPECIES will be conducted in an advance turf course offered this spring semester.

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[1] Fermanian, T. W. and R. S. Michalski. 1989. WEEDER: An Advisory System for the Identification of Grasses in Turf. Agron. J. 81:312-316.

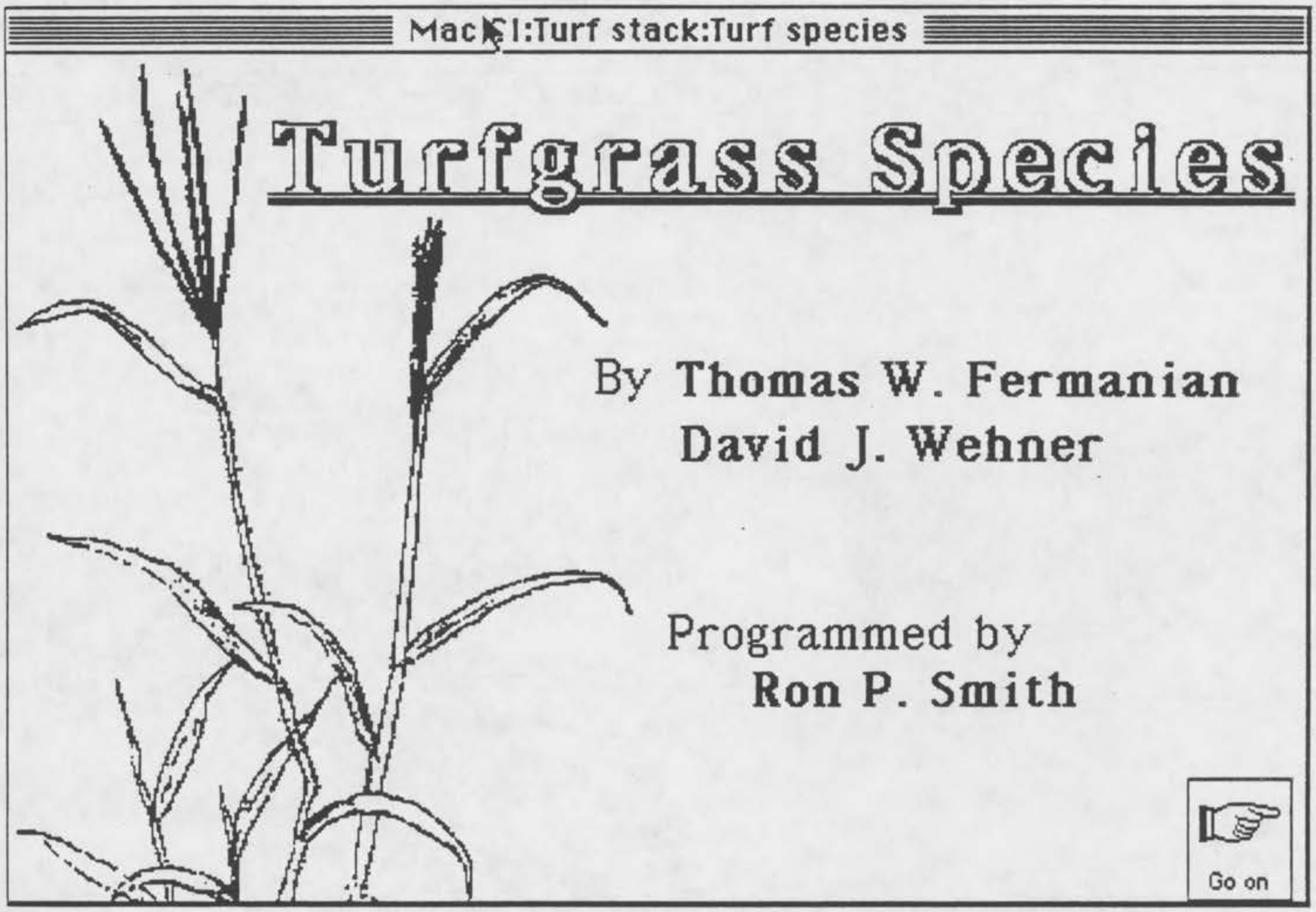


Fig. 1. TURF SPECIES Initial Screen

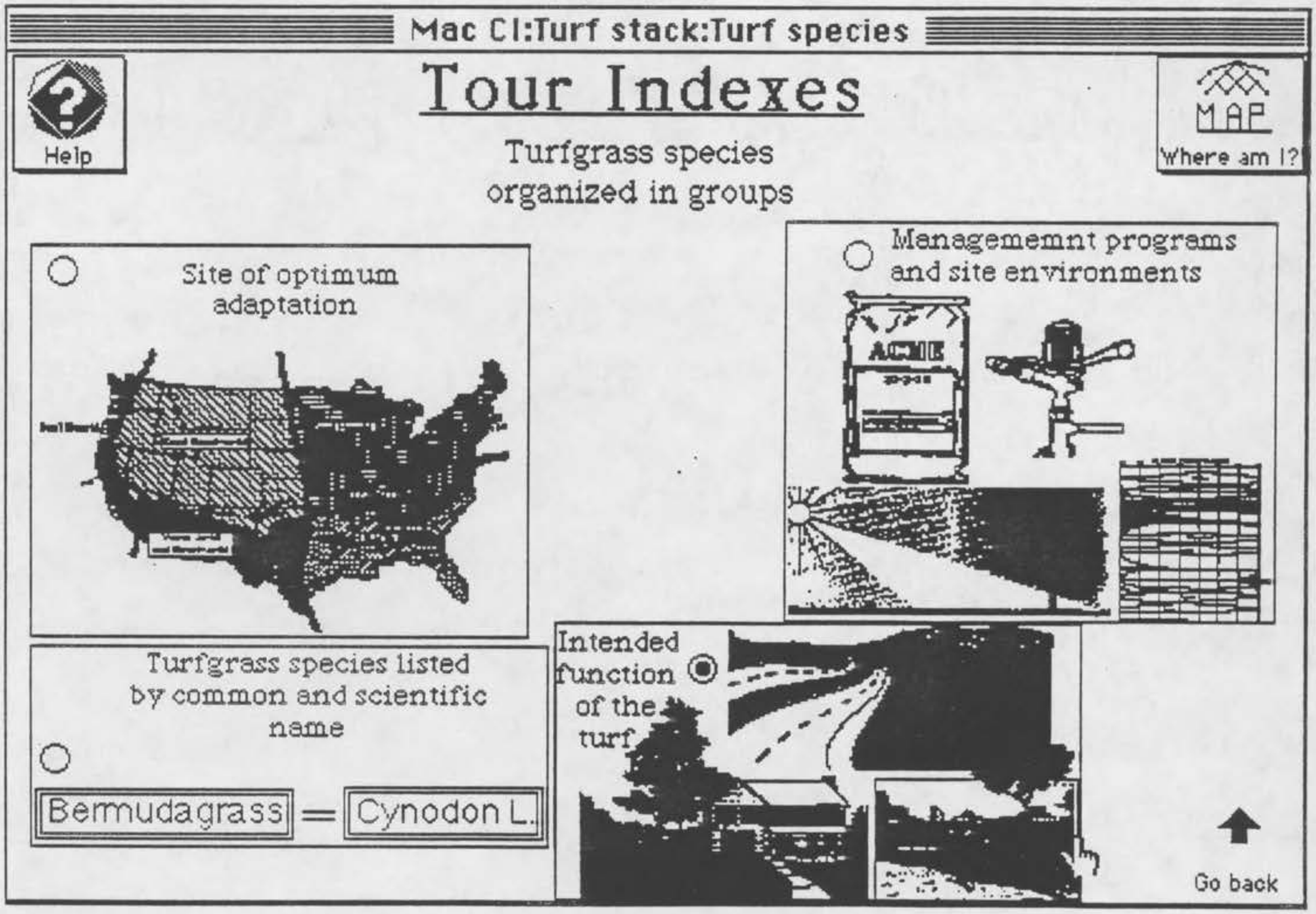


Fig. 2. Tour Menu Screen

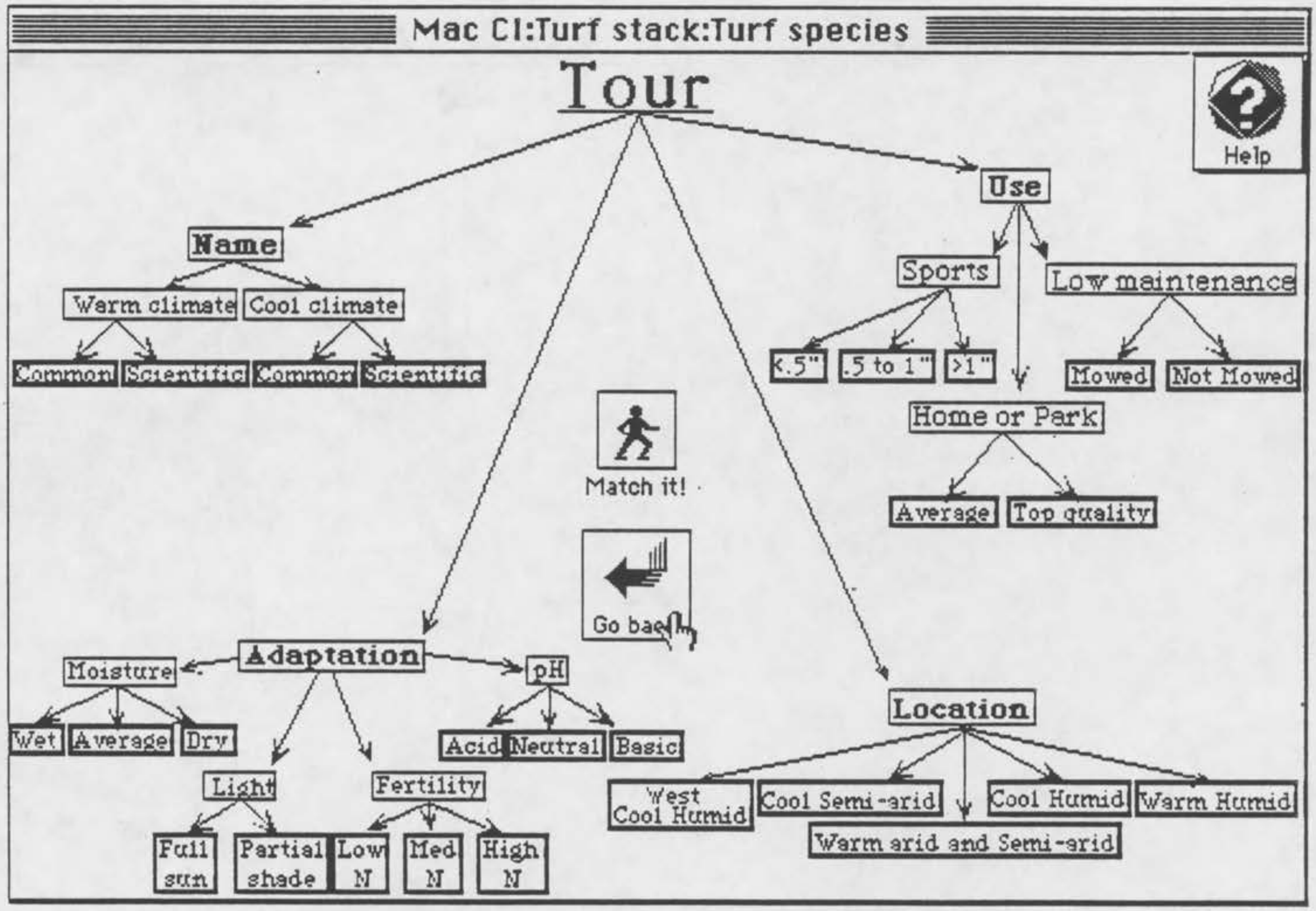


Fig. 3. Establishment Design Screen

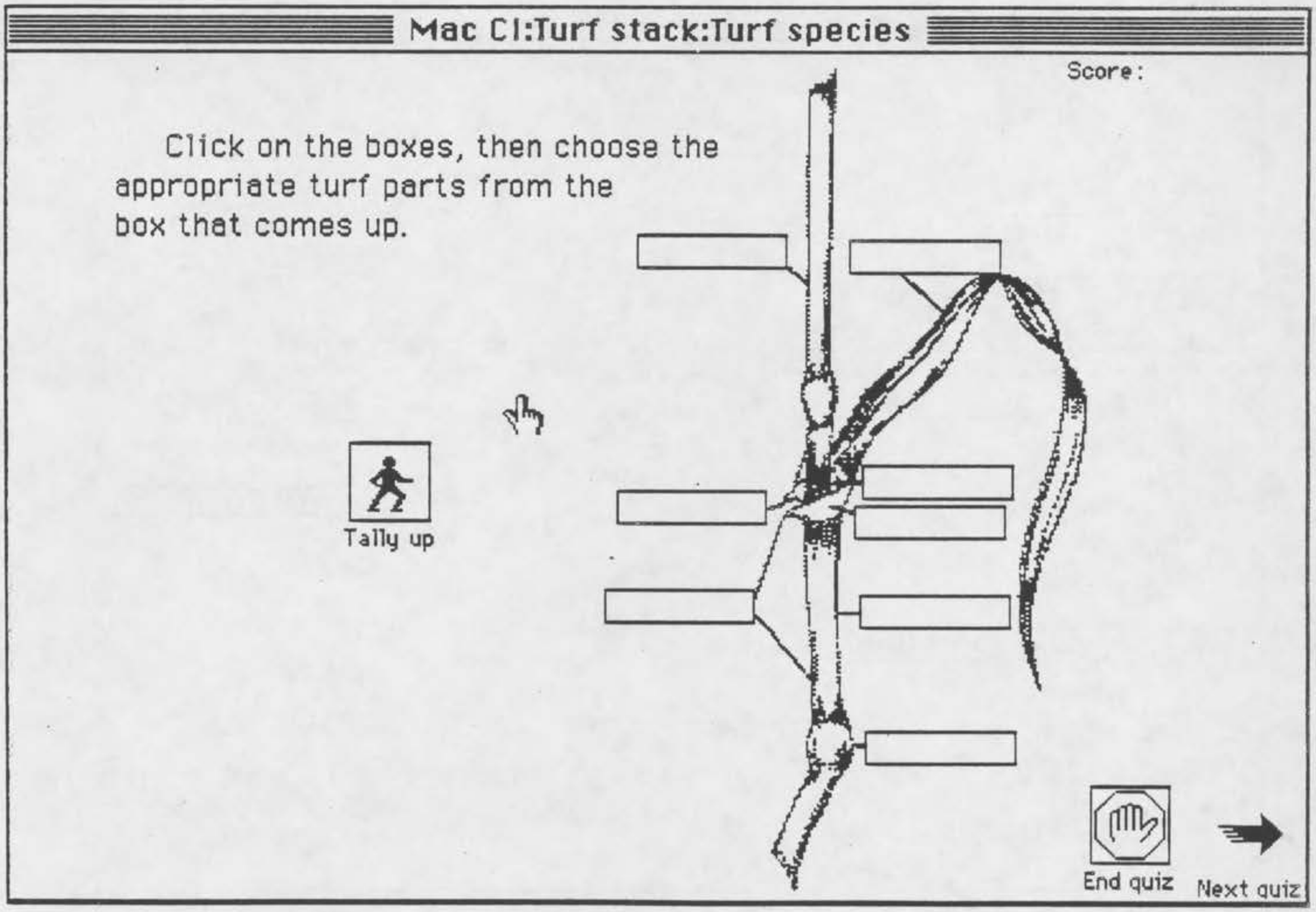


Fig. 4. TURF SPECIES Quiz

TALL FESCUE MANAGEMENT EVALUATION

J. E. Haley and T. B. Voigt

INTRODUCTION

The introduction of improved "turf type" tall fescue (Festuca arundinacea Schreb.) cultivars has led to increased tall fescue use where a higher quality turf is desired. These cultivars appear to have a finer texture, increased density and better tolerance to low mowing than the pasture-type tall fescues. Research indicates that the improved cultivars have retained all the the good drought, heat and wear tolerance needed in a low maintenance turf. The purpose of this study is to evaluate the fertilizer needs and mowing height required to provide a high quality tall fescue turf.

MATERIALS AND METHODS

Treatments consist of 4 fertilizer rates and 3 mowing heights laid out in a strip plot design. Fertilizer rates consist of no nitrogen; 2 lbs N/1000 sq ft/year applied at 1 lb N/1000 sq ft in May and September; 4 lbs N/1000 sq ft/year applied at 0.5 lb N/1000 sq ft in June and July and 1 lb N/1000 sq ft in May, August and October; and 6 lbs N/1000 sq ft/year applied at 0.5 lb N/1000 sq ft in April and July and at 1 lb N/1000 sq ft in May, June, August, September and October. The fertilizer, Tyler 25-5-15, was applied by hand on 10 May, 1 June, 22 June, 14 July, 11 August, 12 September, and 11 October. Mowing treatments consist of 1 inch, 2 inch and 3 inch mowing heights. Plots were mowed 1 time per week with a rotary mower and clippings were collected. Treatments are replicated three times.

RESULTS

The best quality was observed in plots maintained at 2 and 3 inch mowing height (Table 1). At the 1 inch mowing height crabgrass competition and mower scalping was a problem. Four to six pounds of nitrogen per year consistantly provided the best tall fescue quality. There was no significant interaction between fertility and mowing height on any of the rating dates.

Table 1. The evaluation of 4 fertility levels and 3 mowing heights when applied to a tall fescue turf blend at during the 1989 growing season.[1]

Mowing Height	Quality[2] 6/26	7/25	9/11	10/02
1 inch	4.8c	4.6b	5.1b	5.3c
2 inches	7.8b	7.4a	6.1a	6.9b
3 inches	8.4a	7.7a	6.8a	7.7a
$LSD_{0.05}$	0.4	0.5	0.7	0.2

Fertility Level (lbs N/M/year)	Quality[2] 6/26	7/25	9/11	10/02
0	5.8c	5.9b	5.1b	5.6c
2	7.1b	6.2b	5.2b	6.8b
4	7.4ab	6.9a	6.7a	6.8b
6	7.6a	7.2a	6.9a	7.3a
$LSD_{0.05}$	0.4	0.7	0.5	0.4

[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.

LATE FALL FERTILIZATION TIMING

D. J. Wehner and J. E. Haley

INTRODUCTION

The fertilization of cool season turfgrasses in the late fall is becoming a common practice in Illinois. Late fall fertilization results in excellent early spring green-up and reduces the need for an early spring fertilization with nitrogen. However, questions still remain regarding the optimum timing of fertilization. The purpose of this experiment is to evaluate the timing of application of late fall fertilization treatments. Treatments are being applied in October, November, December, and January to determine what flexability exists in application date.

MATERIALS AND METHODS

This experiment was started in the fall of 1988 on a blend of Glade, Parade, Adelphi, and Rugby Kentucky bluegrass. Applications of Milorganite (6-2-0), SCU (36-0-0), and urea (45-0-0) are made to provide either 1 or 2 lbs N/1000 sq ft/application. Treatments are applied at mid-month during October, November, December, and January. For comparison purposes, two additional urea treatments are applied in April at the rate of 0.5 or 1 lb N/1000 sq ft. Color ratings and clipping weights were taken on a weekly basis starting with first growth in the spring. Color ratings are recorded using a 1 to 9 scale with 1 = yellow turf and 9 = dark green turf. Fresh clipping weights are taken from a mowed strip down the center of each 3 ft by 12 ft. All plots are maintained with 1 lb N/1000 sq ft urea fertilizer during June, July, and September.

RESULTS AND DISCUSSION

The color ratings and clipping weights taken in the spring of 1989 are presented in Tables 1 and 2, respectively. Since this was the first year's data from the experiment, and because the winter of 1988 - 1989 was so mild, additional data will be needed before any strong conclusions can be reached. The basic trend that is evident from the 1989 data is that urea provided a better spring response than either of the other two sources. This may be due to the fact that urea is released more quickly and therefore, more N gets into the plant before the onset of cold weather.

Title 1. The effect of late fall fertilization on the color of an improved Kentucky bluegrass turf blend.[1]

Fertilizer	Rate lb N/M	Month Applied[3]	Color[2] 3/29	4/06	4/14	4/21
Urea	0.5	Apr	4.3h	4.3g	4.7i	5.7g
Urea	1.0	Apr	4.3h	4.7g	5.0hi	5.7g
Urea	0.5/1.0	Apr/Nov	6.0c-e	7.0c-e	7.3b-e	7.3c-e
Urea	1.0	Oct	5.7d-f	6.7de	7.0c-f	7.0de
Urea	2.0	Oct	6.3b-d	8.3ab	8.7a	8.3ab
Urea	1.0	Nov	6.3b-d	6.3de	6.7d-f	7.3c-e
Urea	2.0	Nov	8.7a	9.0a	8.7a	8.7a
Urea	1.0	Dec	6.3b-d	7.3b-d	7.3b-e	7.0de
Urea	2.0	Dec	8.7a	9.0a	8.3ab	8.3ab
Urea	1.0	Jan	6.7bc	7.0c-e	7.7a-d	7.3c-e
Urea	2.0	Jan	9.0a	8.7a	8.3ab	8.3ab
Milorganite	1.0	Oct	4.3h	4.7g	5.3g-i	6.7ef
Milorganite	2.0	Oct	6.0c-e	6.7de	7.7a-d	7.3c-e
Milorganite	1.0	Nov	4.7gh	5.0fg	5.0hi	6.0fg
Milorganite	2.0	Nov	6.3b-d	7.3b-d	7.3b-e	7.3c-e
Milorganite	1.0	Dec	4.7gh	6.0ef	6.0f-h	6.7ef
Milorganite	2.0	Dec	7.0b	7.0c-e	8.0a-c	7.7b-d
Milorganite	1.0	Jan	5.0f-h	6.0ef	6.3e-g	6.7ef
Milorganite	2.0	Jan	5.7d-f	6.7de	6.7d-f	7.0de
SCU	1.0	Oct	5.0f-h	6.7de	6.7d-f	7.0de
SCU	2.0	Oct	5.3e-g	7.3b-d	7.7a-d	8.3ab
SCU	1.0	Nov	5.3e-g	6.7de	6.7d-f	6.7ef
SCU	2.0	Nov	7.0b	8.0a-c	7.7a-d	7.7b-d
SCU	1.0	Dec	6.0c-e	6.0ef	7.0c-f	6.7ef
SCU	2.0	Dec	6.7bc	7.3b-d	7.7a-d	7.3c-e
SCU	1.0	Jan	5.3e-g	6.3de	7.0c-f	7.0de
SCU	2.0	Jan	7.0b	8.3ab	8.0a-c	8.0a-c
$LSD_{0.05}$			1.0	1.1	1.2	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.

[3]April applications were made 20 April 89. October applications were made 14 Oct 88 and 11 Oct 89. November applications were made 17 Nov 88 and 21 Nov 89. December applications were made 14 Dec 88 and 3 Jan 89. January applications were made 13 Jan 89 and 29 Jan 90. All test plots were fertilized with urea (46-0-0) at 1 lb N/1000 sq ft on 16 Sept 88, 14 June 89, 28 July 89, and 15 Sept 89.

Title 1. The effect of late fall fertilization on the color of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

Fertilizer	Rate lb N/M	Month Applied[3]	Color[2] 5/02	5/11	5/18	5/26
Urea	0.5	Apr	8.3a-c	7.0b-d	7.3a-c	6.7ab
Urea	1.0	Apr	8.3a-c	8.0a	8.0a	7.0a
Urea	0.5/1.0	Apr/Nov	8.3a-c	8.0a	7.7ab	6.3bc
Urea	1.0	Oct	8.0b-d	7.3a-c	6.3de	6.0cd
Urea	2.0	Oct	8.7ab	7.7ab	6.0e	6.0cd
Urea	1.0	Nov	8.0b-d	7.7ab	7.0b-d	6.0cd
Urea	2.0	Nov	9.0a	7.3a-c	6.7c-e	6.0cd
Urea	1.0	Dec	7.7c-e	7.7ab	7.0b-d	6.0cd
Urea	2.0	Dec	9.0a	7.7ab	7.0b-d	6.0cd
Urea	1.0	Jan	8.0b-d	7.7ab	6.7c-e	6.0cd
Urea	2.0	Jan	9.0a	7.3a-c	7.0b-d	6.0cd
Milorganite	1.0	Oct	7.3d-f	6.7cd	6.7c-e	6.0cd
Milorganite	2.0	Oct	8.0b-d	7.7ab	6.7c-e	5.7d
Milorganite	1.0	Nov	6.7f	6.3d	6.3de	6.0cd
Milorganite	2.0	Nov	8.3a-c	7.7ab	6.7c-e	6.0cd
Milorganite	1.0	Dec	7.0ef	6.7cd	6.3de	6.0cd
Milorganite	2.0	Dec	8.0b-d	8.0a	7.7ab	6.3bc
Milorganite	1.0	Jan	7.3d-f	6.3d	6.7c-e	6.0cd
Milorganite	2.0	Jan	8.0b-d	7.7ab	7.7ab	6.0cd
SCU	1.0	Oct	7.7c-e	7.7ab	7.0b-d	6.0cd
SCU	2.0	Oct	8.7ab	7.7ab	7.3a-c	6.0cd
SCU	1.0	Nov	7.7c-e	7.0b-d	7.0b-d	6.0cd
SCU	2.0	Nov	8.7ab	8.0a	7.7ab	6.0cd
SCU	1.0	Dec	7.3d-f	7.7ab	7.0b-d	6.3bc
SCU	2.0	Dec	8.3a-c	8.0a	8.0a	6.7ab
SCU	1.0	Jan	8.0b-d	8.0a	7.7ab	6.0cd
SCU	2.0	Jan	9.0a	8.0a	8.0a	6.7ab
$LSD_{0.05}$			0.8	0.9	0.7	0.4

(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.

[3]April applications were made 20 April 89; October applications were made 14 Oct 88 and 11 Oct 89; November applications were made 17 Nov 88 and 21 Nov 89; December applications were made 14 Dec 88 and 3 Jan 89; January applications were made 13 Jan 89 and 29 Jan 90. All test plots were fertilized with urea (46-0-0) at 1 lb N/1000 sq ft on 16 Sept 88, 14 June 89, 28 July 89, and 15 Sept 89.

Title 1. The effect of late fall fertilization on the color of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

Fertilizer	Rate lb N/M	Month Applied[3]	Color[2] 6/02	6/09	6/16	7/04
Urea	0.5	Apr	7.3b	7.0a	6.3a-c	8.0bc
Urea	1.0	Apr	8.0a	7.0a	7.0a	8.0bc
Urea	0.5/1.0	Apr/Nov	6.3de	6.7ab	5.7c-e	8.0bc
Urea	1.0	Oct	6.0e	6.0b	5.7c-e	7.7cd
Urea	2.0	Oct	6.0e	6.0b	5.0e	7.7cd
Urea	1.0	Nov	6.0e	6.7ab	6.0b-d	8.0bc
Urea	2.0	Nov	6.0e	6.0b	5.7c-e	8.0bc
Urea	1.0	Dec	6.7cd	6.3ab	6.0b-d	7.3d
Urea	2.0	Dec	6.0e	6.0b	5.3de	8.0bc
Urea	1.0	Jan	6.0e	6.0b	5.7c-e	7.7cd
Urea	2.0	Jan	6.0e	6.0b	5.3de	7.3d
Milorganite	1.0	Oct	6.0e	7.0a	6.0b-d	8.3ab
Milorganite	2.0	Oct	6.0e	6.3ab	5.7c-e	8.0bc
Milorganite	1.0	Nov	6.0e	6.3ab	6.0b-d	7.7cd
Milorganite	2.0	Nov	6.7cd	6.7ab	6.3a-c	8.0bc
Milorganite	1.0	Dec	6.3de	6.7ab	6.0b-d	8.0bc
Milorganite	2.0	Dec	6.3de	6.7ab	6.3a-c	8.3ab
Milorganite	1.0	Jan	6.0e	6.3ab	6.0b-d	8.0bc
Milorganite	2.0	Jan	7.0bc	6.3ab	6.7ab	8.0bc
SCU	1.0	Oct	6.0e	6.0b	6.0b-d	8.0bc
SCU	2.0	Oct	6.3de	6.0b	6.0b-d	8.0bc
SCU	1.0	Nov	6.0e	7.0a	6.0b-d	8.0bc
SCU	2.0	Nov	6.3de	6.7ab	6.0b-d	8.0bc
SCU	1.0	Dec	6.0e	7.0a	6.7ab	8.3ab
SCU	2.0	Dec	6.3de	6.7ab	6.7ab	8.7a
SCU	1.0	Jan	6.7cd	6.3ab	6.3a-c	8.0bc
SCU	2.0	Jan	6.7cd	6.7ab	6.0b-d	8.7a
$LSD_{0.05}$			0.6	0.7	0.7	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]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

[3]April applications were made 20 April 89; October applications were made 14 Oct 88 and 11 Oct 89; November applications were made 17 Nov 88 and 21 Nov 89; December applications were made 14 Dec 88 and 3 Jan 89; January applications were made 13 Jan 89 and 29 Jan 90. All test plots were fertilized with urea (46-0-0) at 1 lb N/1000 sq ft on 16 Sept 88, 14 June 89, 28 July 89, and 15 Sept 89.

Title 2. The effect of late fall fertilization on the clipping weights of an improved Kentucky bluegrass turf blend during 1989.[1]

Fertilizer	Rate lb N/M	Month Applied[3]	Weight[2] 4/21	5/02	5/12	5/23
Urea	0.5	Apr	7.5e	105.1d-h	80.4f-k	127.7e-h
Urea	1.0	Apr	3.5e	139.9c-g	110.1d-h	156.1b-e
Urea	0.5/1.0	Apr/Nov	18.2c-e	244.6ab	171.6ab	201.1a-c
Urea	1.0	Oct	57.6b-e	166.1a-f	113.c-h	135.6d-g
Urea	2.0	Oct	175.9a	264.0a	145.6a-e	153.5b-e
Urea	1.0	Nov	34.3b-e	176.3a-e	125.3b-h	149.1b-f
Urea	2.0	Nov	189.5a	246.6a	185.9a	198.5a-c
Urea	1.0	Dec	9.0e	98.2d-h	73.5g-k	135.1d-g
Urea	2.0	Dec	87.8bc	216.1a-c	144.2a-e	192.5a-d
Urea	1.0	Jan	20.9c-e	191.7a-d	97.9e-i	151.8b-e
Urea	2.0	Jan	94.7b	222.0a-c	148.8a-e	178.7a-e
Milorganite	1.0	Oct	12.3e	83.5e-h	77.0f-k	141.8c-f
Milorganite	2.0	Oct	69.7b-e	191.2a-d	128.1b-g	201.6a-c
Milorganite	1.0	Nov	1.1e	27.0h	31.1k	69.7h
Milorganite	2.0	Nov	17.2c-e	142.4b-f	115.6c-h	158.0b-e
Milorganite	1.0	Dec	2.4e	39.2gh	36.0jk	80.7gh
Milorganite	2.0	Dec	40.9b-e	184.8a-e	126.0b-h	166.3b-e
Milorganite	1.0	Jan	8.4e	72.6f-h	52.1i-k	88.3f-h
Milorganite	2.0	Jan	9.6e	86.4e-h	72.7h-k	136.8d-g
SCU	1.0	Oct	16.1de	134.7c-g	101.7e-i	175.2a-e
SCU	2.0	Oct	86.3b-d	245.0a	163.0a-d	205.9ab
SCU	1.0	Nov	6.9e	88.4e-h	80.1f-k	130.7e-g
SCU	2.0	Nov	19.0c-e	166.9a-f	130.2b-f	207.6ab
SCU	1.0	Dec	28.0b-e	120.1c-h	88.3f-j	154.8b-e
SCU	2.0	Dec	86.7b-d	246.0a	167.4a-c	234.1a
SCU	1.0	Jan	10.6e	123.1c-h	103.5e-i	179.9a-e
SCU	2.0	Jan	21.7c-e	219.2a-c	159.7a-d	227.6a
$LSD_{0.05}$			71.0	102.5	54.9	61.0

(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 17.2 sq ft (all dates before 12 May) or 17.9 sq ft (all remaining dates).

[3]April applications were made 20 April 89; October applications were made 14 Oct 88 and 11 Oct 89; November applications were made 17 Nov 88 and 21 Nov 89; December applications were made 14 Dec 88 and 3 Jan 89; January applications were made 13 Jan 89 and 29 Jan 90. All test plots were fertilized with urea (46-0-0) at 1 lb N/1000 sq ft on 16 Sept 88, 14 June 89, 28 July 89, and 15 Sept 89.

Title 2. The effect of late fall fertilization on the clipping weights of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

Fertilizer	Rate lb N/M	Month Applied[3]	Weight[2] 5/30	6/06	6/13	6/20
Urea	0.5	Apr	38.3e-h	52.2e-l	83.5c-h	56.9
Urea	1.0	Apr	59.6b-d	60.6b-i	90.1b-g	59.6
Urea	0.5/1.0	Apr/Nov	56.4b-e	65.6a-g	89.0b-g	58.9
Urea	1.0	Oct	39.2e-h	45.7h-m	76.7f-h	56.5
Urea	2.0	Oct	40.4d-h	44.8i-m	78.0e-h	48.5
Urea	1.0	Nov	45.4c-g	48.6g-m	81.7d-h	51.3
Urea	2.0	Nov	59.9b-d	59.4b-i	101.9a-d	68.7
Urea	1.0	Dec	36.2f-h	43.3i-m	74.1f-h	49.6
Urea	2.0	Dec	48.3c-g	54.5d-k	82.1d-h	52.7
Urea	1.0	Jan	36.9f-h	37.1k-m	70.9gh	50.7
Urea	2.0	Jan	46.1c-g	57.6c-i	76.6f-h	57.9
Milorganite	1.0	Oct	48.2c-g	49.9f-l	83.7c-h	59.6
Milorganite	2.0	Oct	57.3b-e	70.4a-d	110.2ab	74.9
Milorganite	1.0	Nov	22.6h	34.4lm	62.9h	51.4
Milorganite	2.0	Nov	62.0a-c	67.1a-f	101.6a-d	72.9
Milorganite	1.0	Dec	29.9gh	37.8j-m	71.0gh	51.0
Milorganite	2.0	Dec	61.4a-c	64.7a-g	104.2a-c	73.7
Milorganite	1.0	Jan	32.6f-h	31.6m	71.6gh	52.0
Milorganite	2.0	Jan	46.0c-g	56.5c-i	90.7b-g	57.1
SCU	1.0	Oct	51.9c-f	55.4d-j	95.2b-f	57.1
SCU	2.0	Oct	71.7ab	76.2ab	106.5ab	70.1
SCU	1.0	Nov	46.5c-g	59.7b-i	99.3b-e	62.9
SCU	2.0	Nov	63.8a-c	70.6a-d	102.4a-d	59.7
SCU	1.0	Dec	50.2c-f	63.5b-h	108.2ab	69.6
SCU	2.0	Dec	79.2a	81.4a	122.4a	73.2
SCU	1.0	Jan	57.3b-e	69.5a-e	104.3a-c	70.1
SCU	2.0	Jan	75.8ab	73.8a-c	99.0b-e	66.4
$LSD_{0.05}$			19.5	18.0	21.7	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 17.2 sq ft (all dates before 12 May) or 17.9 sq ft (all remaining dates).

[3]April applications were made 20 April 89; October applications were made 14 Oct 88 and 11 Oct 89; November applications were made 17 Nov 88 and 21 Nov 89; December applications were made 14 Dec 88 and 3 Jan 89; January applications were made 13 Jan 89 and 29 Jan 90. All test plots were fertilized with urea (46-0-0) at 1 lb N/1000 sq ft on 16 Sept 88, 14 June 89, 28 July 89, and 15 Sept 89.

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 sulfur + urea treatment were included for comparison purposes.

MATERIALS AND METHODS

All treatments except MIL 1 were applied at the rate of 1 lb N/1000 sq ft on 21 April, 15 June, 27 September and 21 November 1989 to a blend of Adelphi, Glade and Parade Kentucky bluegrass. MIL 1 was applied at the rate of 4 lbs N/1000 sq ft on 14 April 1989. 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 weekly from a 21" strip lengthwise through the center of each 3 ft by 12 ft plot. Color ratings were assigned on a weekly basis throughout the growing season using a 1 to 9 scale with 9 = dark green turf.

RESULTS AND DISCUSSION

This study received its second full year of treatments in 1989. The color ratings for 1989 for the treated turf are presented in Table 1. Among the experimental treatments, turf fertilized with MIL 5, MIL 7, and MIL 12 consistently received the highest color ratings. Initially, turf fertilized with MIL 1 received high ratings, however, the ratings declined as the season progressed. 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 1989 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 1989 growing season.[1]

	Color[2]						
Fertilizers	5/05	5/11	5/18	5/26	6/02	6/09	6/16
Milorganite 1	7.0d	7.0a-c	9.0a	7.0a	8.3a	7.7a	7.7a
Milorganite 2	7.3cd	6.0c	6.3e	6.0c	6.0c	6.0c	6.0c
Milorganite 3	7.0d	6.0c	6.3e	6.0c	6.0c	6.0c	6.0c
Milorganite 4	8.0bc	7.0a-c	6.7de	6.0c	6.3bc	6.0c	6.0c
Milorganite 5	7.3cd	7.7a	7.0c-e	6.0c	6.3bc	6.0c	6.0c
Milorganite 6	7.3cd	6.3bc	6.3e	6.3bc	6.3bc	6.0c	6.0c
Milorganite 7	8.0bc	7.0a-c	7.0c-e	6.0c	6.7bc	6.0c	6.0c
Milorganite 8	7.0d	6.3bc	6.7de	6.3bc	6.0c	6.0c	6.0c
Milorganite 9	7.3cd	6.3bc	6.3e	6.0c	6.3bc	6.0c	6.0c
Milorganite 10	7.3cd	7.0a-c	6.7de	6.0c	6.7bc	6.0c	6.0c
Milorganite 11	7.3cd	7.0a-c	6.7de	6.0c	6.0c	6.0c	6.0c
Milorganite 12	7.0d	7.3ab	7.0c-e	6.7ab	6.7bc	6.0c	6.0c
Ammonium Sulfate	9.0a	7.0a-c	7.3b-d	6.3bc	6.3bc	6.0c	6.0c
Ammonium Nitrate	8.7ab	7.0a-c	7.7bc	6.7ab	6.7bc	6.0c	6.0c
Urea	8.7ab	7.3ab	7.7bc	6.0c	6.0c	6.0c	6.0c
SCU	9.0a	8.0a	8.0b	6.7ab	7.0b	7.0b	7.0b
Urea + Sulfur	8.0bc	7.7a	8.0b	6.0c	6.7bc	6.0c	6.0c
Check	4.7e	3.3d	3.0f	5.0d	3.7d	2.7d	4.0d
$LSD_{0.05}$	0.8	1.2	0.7	0.6	0.8	0.3	0.2

(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 1989 growing season (continued).[1]

	Color[2]							
Fertilizers	8/15	8/21	9/11	9/18	10/02	10/11	10/23	10/30
Milorganite 1	5.0b	5.0b	5.0	4.7b-d	4.0ef	3.0f	3.3d	3.7d
Milorganite 2	5.3ab	5.3ab	5.3	5.3ab	5.0b-d	5.3de	5.7c	5.3c
Milorganite 3	5.3ab	5.3ab	5.0	5.0a-c	4.7c-e	6.0cd	6.3c	6.3a-c
Milorganite 4	5.3ab	5.0b	5.0	5.0a-c	5.3bc	5.7c-e	6.3c	6.0bc
Milorganite 5	5.3ab	5.3ab	5.7	5.3ab	6.7a	7.3a	7.7ab	7.0ab
Milorganite 6	5.0b	5.0b	5.7	5.0a-c	5.3bc	5.3de	6.0c	5.7c
Milorganite 7	5.7ab	5.0b	5.3	5.0a-c	5.0b-d	6.3bc	6.7bc	6.3a-c
Milorganite 8	5.3ab	5.3ab	5.7	5.7a	5.0b-d	6.3bc	6.7bc	6.3a-c
Milorganite 9	5.7ab	5.7ab	4.7	5.0a-c	5.3bc	6.3bc	6.3c	6.0bc
Milorganite 10	5.7ab	6.0a	5.7	5.3ab	5.0b-d	5.3de	6.3c	5.7c
Milorganite 11	5.3ab	5.3ab	5.7	5.0a-c	4.3de	5.0e	5.7c	5.7c
Milorganite 12	6.0a	5.3ab	5.7	5.0a-c	4.3de	5.0e	6.3c	6.3a-c
Ammonium Sulfate	5.0b	5.0b	5.0	4.3c-e	5.3bc	7.0ab	8.0a	7.3a
Ammonium Nitrate	5.3ab	5.3ab	5.7	4.7b-d	5.0b-d	7.7a	8.0a	7.3a
Urea	5.0b	5.0b	5.0	4.7b-d	5.7b	7.7a	8.0a	7.0ab
SCU	6.0a	5.7ab	5.7	5.7a	4.3de	5.0e	6.0c	6.0bc
Urea + Sulfur	5.0b	5.0b	5.0	4.0de	5.3bc	7.3a	8.0a	7.0ab
Check	3.7c	4.0c	5.0	3.7e	3.3f	3.0f	3.0d	3.3d
$LSD_{0.05}$	0.7	0.7	NS	0.7	1.0	0.9	1.1	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]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 1989 growing season (continued).[1]

Fertilizers	Color[2]						
	6/26	7/04	7/10	7/17	7/24	7/31	8/07
Milorganite 1	6.3ef	6.0d	6.3cd	6.0b	6.3a	5.7b-d	5.3ab
Milorganite 2	6.3ef	6.3cd	6.3cd	6.0b	6.0a	6.3ab	5.7a
Milorganite 3	6.3ef	6.0d	6.3cd	6.0b	6.3a	5.7b-d	5.0ab
Milorganite 4	7.0de	6.3cd	6.7b-d	6.0b	6.0a	5.7b-d	5.0ab
Milorganite 5	7.3cd	7.0b	7.0bc	6.3ab	6.3a	6.3ab	5.3ab
Milorganite 6	6.7d-f	6.0d	6.0d	6.0b	6.0a	5.7b-d	5.0ab
Milorganite 7	7.0de	7.0b	6.7b-d	6.0b	6.0a	5.3cd	5.3ab
Milorganite 8	6.7d-f	6.0d	6.3cd	6.0b	6.3a	6.3ab	5.3ab
Milorganite 9	6.7d-f	6.3cd	6.7b-d	6.0b	6.0a	5.7b-d	4.7b
Milorganite 10	6.7d-f	6.7bc	6.7b-d	6.0b	6.0a	5.0d	5.7a
Milorganite 11	6.0f	6.3cd	6.7b-d	6.3ab	6.0a	6.0a-c	5.7a
Milorganite 12	7.3cd	7.0b	7.3ab	6.0b	6.3a	6.3ab	5.7a
Ammonium Sulfate	8.7ab	7.7a	7.3ab	6.0a	6.0a	5.3cd	5.3ab
Ammonium Nitrate	9.0a	8.0a	8.0a	6.3ab	6.3a	6.3ab	5.3ab
Urea	8.7ab	7.7a	7.0bc	6.0b	6.0a	5.7b-d	5.0ab
SCU	8.0bc	8.0a	8.0a	6.7a	6.7a	6.7a	5.7a
Urea + Sulfur	8.7ab	8.0a	7.3ab	6.0b	6.0a	5.3cd	5.0ab
Check	4.0g	3.0e	3.3e	3.0c	4.7b	3.7e	2.7c
$LSD_{0.05}$	0.9	0.6	0.8	0.4	0.8	0.9	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 2. The effect of Milorganite fertilizers on the fresh clipping weight of an improved Kentucky bluegrass turf blend growing on clay soil during the 1989 growing season.[1]

	Weight[2]						
Fertilizers	5/05	5/12	5/24	5/30	6/07	6/13	6/20
Milorganite 1	14.9b	19.7e	165.9de	88.1b-d	62.5b-e	71.4b-e	50.6e
Milorganite 2	19.0b	12.2e	115.9ef	75.9c-f	45.8d-f	59.9c-e	54.7de
Milorganite 3	8.2b	5.3e	86.2f	64.7ef	35.8f	57.4c-e	49.5ef
Milorganite 4	22.0b	13.4e	166.9de	66.7d-f	47.0d-f	89.5a-c	52.1
Milorganite 5	51.6	40.1c-e	258.6bc	88.4b-d	64.2b-d	78.4a-d	68.0cd
Milorganite 6	9.0b	11.8e	142.5ef	67.7d-f	43.2d-f	70.0b-e	54.1de
Milorganite 7	145.1ab	94.9a-d	309.6ab	87.7b-d	85.0ab	113.6a	75.4bc
Milorganite 8	34.1b	24.5de	152.4d-f	71.6d-f	44.9d-f	73.8b-e	57.2de
Milorganite 9	8.7b	12.3e	123.5ef	65.1ef	40.3ef	36.7e	51.5e
Milorganite 10	8.5b	9.2e	127.4ef	59.4f	35.2f	57.5c-e	51.9e
Milorganite 11	10.2b	58.0b-e	149.0d-f	71.4d-f	42.5d-f	66.8b-e	32.0f
Milorganite 12	17.1b	20.1e	189.8c-e	76.8c-f	49.5d-f	52.2de	45.4ef
Ammonium Sulfate	195.1a	117.5ab	303.3ab	93.6bc	83.3a-c	82.7a-d	89.4ab
Ammonium Nitrate	229.3a	112.2ab	225.1cd	84.1b-e	74.5bc	78.6a-d	85.7ab
Urea	247.1a	158.7a	307.2ab	101.4b	77.6a-c	80.2a-d	92.5a
SCU	115.0ab	106.7a-c	335.3a	124.5a	98.9a	97.7ab	88.6ab
Urea + Sulfur	199.3a	63.1b-e	319.7ab	96.0bc	61.4c-e	76.8a-d	78.7a-c
Check	6.6b	2.1e	5.3g	7.6g	9.2g	54.5c-e	11.2g
$LSD_{0.05}$	138.7	70.9	76.2	21.8	23.0	37.3	15.2

(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 17.2 sq ft(05 May only) or 17.9 sq ft (all remaining dates).

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 1989 growing season (continued).[1]

	Weight[2]						
Fertilizers	6/28	7/05	7/11	7/21	7/25	8/01	8/08
Milorganite 1	70.7e	61.4f	37.8h	84.5e	32.2g	70.8f	53.2d
Milorganite 2	100.7c-e	92.2de	65.3d-g	113.7b-e	53.9a-d	96.8a-d	67.3a-d
Milorganite 3	82.0e	79.6ef	52.9gh	88.7de	38.6fg	75.8ef	57.3cd
Milorganite 4	98.3de	84.1d-f	55.9fg	107.0b-e	46.1c-f	84.8c-f	62.3b-d
Milorganite 5	130.1bc	122.1c	64.5d-g	85.9de	50.3b-f	94.3b-e	69.3a-d
Milorganite 6	97.0de	85.7de	52.5gh	87.2de	41.5d-g	81.9d-f	60.8b-d
Milorganite 7	118.6b-d	121.6c	80.4b-d	118.8a-d	52.7b-e	105.5ab	76.2ab
Milorganite 8	90.1de	84.1d-f	58.6e-g	105.1b-e	42.0d-g	85.3b-f	65.3b-d
Milorganite 9	89.2de	86.1de	57.7e-g	100.6c-e	43.7c-g	88.7b-f	61.2b-d
Milorganite 10	84.7e	83.7d-f	56.9e-g	105.6b-e	40.7e-g	80.0d-f	59.9cd
Milorganite 11	74.2e	82.7d-f	56.6e-g	90.6de	43.7c-g	79.2d-f	63.1b-d
Milorganite 12	89.9de	106.0cd	71.0c-f	108.2b-e	49.5b-f	96.6a-d	69.3a-d
Ammonium Sulfate	181.3a	149.1b	92.3ab	135.2ab	46.8c-f	96.3a-e	67.7a-d
Ammonium Nitrate	194.3a	174.4a	91.6ab	133.7a-c	62.2ab	104.2a-c	73.2a-c
Urea	187.1a	170.3ab	86.7a-c	125.3a-c	55.5a-c	98.8a-d	69.7a-c
SCU	141.3b	150.2b	98.7a	151.2a	66.6a	115.6a	81.9a
Urea + Sulfur	184.9a	165.2ab	72.6c-e	114.4b-e	45.7c-f	89.1b-f	64.3b-d
Check	19.8f	19.0g	9.7i	24.6f	9.1h	27.7g	17.4e
$LSD_{0.05}$	31.3	24.1	16.6	33.3	12.7	20.5	16.2

(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 17.2 sq ft (05 May only) or 17.9 sq ft (all remaining dates).

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 1989 growing season (continued).[1]

	Weight[2]							
Fertilizers	8/17	8/30	9/07	9/22	9/28	10/12	10/16	10/26
Milorganite 1	48.5c	101.8	61.8a	75.3	14.8	18.5gh	5.8f	1.5f
Milorganite 2	66.9a-c	137.0	87.3a	105.4	18.8	49.2cd	17.3c	12.9d
Milorganite 3	54.2bc	113.7	74.4a	86.5	16.3	42.5c-e	14.0c-e	12.1d
Milorganite 4	58.4a-c	117.7	65.7a	86.6	16.1	47.4cd	14.7c-e	13.7d
Milorganite 5	64.7a-c	126.0	76.9a	86.8	18.5	55.9bc	20.4bc	22.9c
Milorganite 6	58.3a-c	113.7	65.3a	86.1	17.6	39.8d-f	13.6c-e	11.4d
Milorganite 7	72.9ab	142.5	84.3a	93.9	17.6	41.6c-f	16.5cd	13.6d
Milorganite 8	61.0a-c	136.2	83.0a	95.5	18.8	49.0cd	16.6cd	14.0d
Milorganite 9	56.6a-c	122.5	76.5a	87.6	17.9	42.8c-e	14.0c-e	13.3d
Milorganite 10	55.1bc	116.7	69.9a	88.1	15.5	37.6d-f	7.7ef	10.3d
Milorganite 11	53.1bc	108.9	64.7a	78.6	13.0	27.3fg	9.1d-f	7.9d-f
Milorganite 12	62.7a-c	122.0	72.0a	81.6	15.2	29.3e-g	9.5d-f	9.8de
Ammonium Sulfate	63.1	121.9	77.1a	87.4	17.2	81.0a	36.2a	36.9a
Ammonium Nitrate	66.1a-c	123.6	72.6a	86.6	18.0	79.8a	35.4a	33.2ab
Urea	63.4a-c	125.9	71.7	90.2	12.7	78.4a	35.8a	33.2ab
SCU	75.7a	136.7	80.3a	94.9	18.4	39.8d-f	14.5c-e	14.2d
Urea + Sulfur	55.9a-c	102.2	62.9	68.5	13.1	66.1ab	27.7b	30.2b
Check	18.2d	49.4	28.9	65.6	8.6	8.8h	2.4f	3.3ef
$LSD_{0.05}$	19.9	NS	26.0	NS	NS	15.1	7.5	6.7

[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 17.2 sq ft (05 May only) or 17.9 sq ft (all remaining dates).

EVALUATION OF RESIN COATED UREA

D. J. Wehner and J. E. Haley

INTRODUCTION

The purpose of this study is to evaluate turfgrass response to fertilization with a resin coated urea in comparison to fertilization with sulfur coated urea (SCU) and isobutylidene diurea (IBDU). The resin coated urea is marketed by Grace/Sierra under the trade name of "Once". "Once" is a blend of coated and uncoated fertilizers. Seventy percent of the product is coated, and the coated fraction is further divided into 3 - 4 month resin coated urea and 8 - 9 month resin coated urea with 15% of the product as uncoated urea. Potassium sulfate is the K source.

MATERIALS AND METHODS

This study was started on 8 May 1989. The fertilizer sources are IBDU (31-0-0), SCU (36-0-0) and resin coated urea (RCU, 34-0-7, "Once"). Each material was applied to provide either a single spring application of 4 lbs N/1000 sq ft, a single fall application at the same nitrogen rate, or a combination spring and fall application at the rate of 2 lbs N/1000 sq ft/application. Potassium was added to the SCU and IBDU treatments equivalent to that supplied by the RCU. In 1989, the first application was made on 8 May and the second application on 19 September. The fertilizers were applied by hand to plots, a blend of Parade, Adelphi, Glade, and Rugby Kentucky bluegrass, measuring 3 ft by 12 ft. Each treatment was replicated three times. Clippings were collected on a 21" wide strip lengthwise throughout each plot, and color ratings were assigned using a scale of 1 to 9 where 9 = dark green turf and 1 = yellow turf. Irrigation was supplied to prevent drought stress.

RESULTS AND DISCUSSION

The weekly color ratings for turf fertilized with the three N sources are listed in Table 1. The RCU fertilized turf showed similarities to both the SCU and IBDU fertilized turf at different times of the season. During the first few weeks after the spring application at the 4 pound rate, RCU fertilized turf received color ratings slightly lower than the SCU fertilized turf. As expected, the IBDU fertilized turf received lower color ratings than the other sources for this time period since there is an initial lag phase in N release from IBDU. However, later in the season, when the IBDU provided a stronger color response, the RCU treated turf was still being rated high for color. The response from the SCU had declined somewhat by the 31 July rating date. Thus, the RCU treatment seems to provide early color almost equivalent to an SCU application and long term response equal to the IBDU treatment. All three sources did not provide acceptable turfgrass response from a single spring application after the 2 October rating date.

Similar trends were observed when the sources were compared at the 2 pounds of N application rate. The RCU fertilized turf received slightly lower color ratings than the SCU treated turf during the first few weeks after application. The longer term turf response from the RCU was similar to that found with IBDU application.

The clipping weights for the treatments are presented in Table 2. The same trends evident in the color ratings were demonstrated by the clipping weights.

Table 1. The effect of resin coated urea on the color of an improved Kentucky bluegrass turf blend during 1989.[1]

	Rate	Time	Color[2]						
Source	lb N/M	Applied3	5/18	5/26	6/02	6/09	6/16	6/26	7/04
RCU	4	spring	9.0a	8.0b	8.0b	8.0ab	7.7b	9.0a	9.0a
RCU	2	spring/fall	8.0b	7.7b	7.7bc	7.0cd	7.0c	7.3c	8.3ab
RCU	4	fall	---	---	---	---	---	---	---
IBDU	4	spring	7.0c	7.0c	7.3cd	7.3bc	7.0c	8.0b	8.3ab
IBDU	2	spring/fall	7.0c	7.0c	7.0d	6.7c-e	6.7c	6.7d	7.7b
IBDU	4	fall	---	---	---	---	---	---	---
SCU	4	spring	9.0a	9.0a	9.0a	8.7a	8.7a	9.0a	9.0a
SCU	2	spring/fall	8.0b	8.0b	9.0a	8.7a	8.0b	7.3c	7.7b
SCU	4	fall	---	---	---	---	---	---	---
check			6.7cd	6.0e	6.0e	6.3de	6.0d	5.0e	5.3c
$LSD_{0.05}$			0.5	0.6	0.4	0.9	0.5	0.5	1.0

(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.

[3]Spring applications were made 8 May 89 and fall applications were made 19 September 89.

Table 1. The effect of resin coated urea on the color of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

	Rate	Time	Color[2]						
Source	lb N/M	Applied[3]	7/10	7/17	7/24	7/31	8/07	8/15	8/21
RCU	4	spring	9.0a	9.0a	8.0b	9.0a	8.7a	8.7a	8.3a
RCU	2	spring/fall	7.3c	7.0cd	7.3bc	7.3c	6.7c	7.0b	6.3d
RCU	4	fall	---	---	---	---	---	---	---
IBDU	4	spring	8.3ab	8.0b	9.0a	8.3ab	9.0a	9.0a	8.7a
IBDU	2	spring/fall	7.3c	6.3de	7.0c	7.0c	7.7b	7.0b	7.0c
IBDU	4	fall	---	---	---	---	---	---	---
SCU	4	spring	7.7bc	7.3bc	7.3bc	7.7bc	8.0b	7.0b	7.7b
SCU	2	spring/fall	7.0c	6.0e	6.0d	6.0d	6.3c	6.0c	6.0d
SCU	4	fall	---	---	---	---	---	---	---
check			4.3d	5.0f	4.3e	5.3de	4.0d	5.0d	4.7e
$LSD_{0.05}$			0.9	0.7	0.7	0.7	0.6	0.9	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.

[3]Spring applications were made 8 May 89 and fall applications were made 19 September 89.

Table 1. The effect of resin coated urea on the color of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

Source	Rate lb N/M	Time Applied[3]	Color[2] 8/30	9/18	10/02	10/11	10/23	10/30
RCU	4	spring	7.7ab	8.0a	6.3cd	6.0e	6.0cd	4.7d
RCU	2	spring/fall	7.0cd	7.0b	6.7c	7.3cd	7.0b	6.7c
RCU	4	fall	---	---	9.0a	9.0a	8.3a	9.0a
IBDU	4	spring	8.0a	8.0a	6.0cd	5.7e	5.3de	4.0d
IBDU	2	spring/fall	7.3bc	7.7bc	6.0cd	7.0d	6.7bc	6.7c
IBDU	4	fall	---	---	5.7d	7.7c	6.0cd	7.0bc
SCU	4	spring	7.3bc	8.0a	5.7d	6.0e	5.0e	4.3d
SCU	2	spring/fall	6.7d	7.0b	8.0b	8.3e	8.0a	7.7b
SCU	4	fall	---	---	9.0a	9.0a	8.7a	8.7a
check			6.0e	6.0c	4.3e	4.0f	4.0f	4.0d
$LSD_{0.05}$			0.6	0.7	0.8	0.6	0.7	0.7

[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.

[3]Spring applications were made 8 May 89 and fall applications were made 19 September 89.

Table 2. The effect of resin coated urea on the fresh clipping weight of an improved Kentucky bluegrass turf blend during 1989.[1]

	Rate	Time	Weight[2]					
Source	lb N/M	Applied[3]	5/24	5/31	6/07	6/14	6/21	6/28
RCU	4	spring	195.8ab	140.0b	184.4b	164.3b	147.9b	105.3a
RCU	2	spring/fall	74.1c-e	63.de	75.1de	121.4c	114.4cd	79.2b
RCU	4	fall	-----	-----	-----	-----	-----	-----
IBDU	4	spring	107.3cd	115.9bc	141.3bc	157.4bc	121.8c	94.4ab
IBDU	2	spring/fall	79.1c-e	72.1cd	96.6cd	122.3c	90.5e	78.0b
IBDU	4	fall	-----	-----	-----	-----	-----	-----
SCU	4	spring	212.2a	254.9a	262.1a	250.4a	172.6a	104.8a
SCU	2	spring/fall	124.5bc	131.6b	160.9b	146.5bc	114.4cd	83.3b
SCU	4	fall	-----	-----	-----	-----	-----	-----
check			66.7c-e	40.3de	43.8de	72.3d	48.2f	40.0c
$LSD_{0.05}$			74.1	44.0	53.8	38.7	22.2	17.5

(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.

[3]Spring applications were made 8 May 89 and fall applications were made 19 September 89.

Table 2. The effect of resin coated urea on the fresh clipping weight of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

Source	Rate lb N/M	Time Applied[3]	Weight[2] 7/06	7/12	7/21	7/25	8/01	8/08
RCU	4	spring	148.1a	121.0a	173.3ab	95.2b	158.9a	145.6ab
RCU	2	spring/fall	93.9b	85.7c	141.1bc	71.1c	122.5b	110.0cd
RCU	4	fall	-----	-----	-----	-----	-----	-----
IBDU	4	spring	135.9a	112.9ab	184.7a	109.9a	167.0a	166.9a
IBDU	2	spring/fall	102.5b	93.3c	149.8bc	88.2b	136.8b	125.7bc
IBDU	4	fall	-----	-----	-----	-----	-----	-----
SCU	4	spring	140.5a	98.6bc	145.3bc	71.1c	120.7bc	115.6c
SCU	2	spring/fall	82.5b	58.6d	124.6c	52.0d	100.8cd	89.0de
SCU	4	fall	-----	-----	-----	-----	-----	-----
check			39.1c	39.0e	77.4d	46.1de	82.0de	71.2ef
$LSD_{0.05}$			21.9	19.2	34.2	14.6	21.6	25.7

(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.

[3] Spring applications were made 8 May 89 and fall applications were made 19 September 89.

Table 2. The effect of resin coated urea on the fresh clipping weight of an improved Kentucky bluegrass turf blend during 1989 (continued).[1]

Source	Rate lb N/M	Time Applied[3]	Weight[2] 8/17	8/30	9/19	9/26	10/03	10/11	10/24
RCU	4	spring	173.8a	361.3ab	484.4ab	25.7	46.1b-e	18.2cd	19.2d
RCU	2	spring/fall	126.6cd	199.6e	372.1c-e	29.9	58.9bc	21.6c	33.0c
RCU	4	fall	-----	-----	-----	23.7	57.9bc	28.7b	56.3b
IBDU	4	spring	182.5a	386.6a	537.7a	28.3	51.5b-e	18.2cd	19.d
IBDU	2	spring/fall	144.4bc	322.2bc	466.9a-c	28.2	56.7b-d	22.1c	33.1c
IBDU	4	fall	-----	-----	-----	15.9	32.3de	16.1cd	24.6cd
SCU	4	spring	106.7d-f	302.7cd	451.5a-c	23.8	42.4c-e	17.5cd	19.4d
SCU	2	spring/fall	116.8c-e	258.7d	415.7b-d	23.1	69.9b	32.4b	57.5b
SCU	4	fall	-----	-----	-----	29.2	96.7a	51.2a	99.4a
check			83.5e-g	197.8e	328.2de	11.4	30.7e	11.9d	14.5d
$LSD_{0.05}$			36.3	54.3	100.8	NS	24.5	6.5	11.6

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

[3]Spring applications were made 8 May 89 and fall applications were made 19 September 89.

LAKE COUNTY FERTILITY STUDY

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

INTRODUCTION

Professional turf managers, lawn care applicators, and home owners can choose from a myriad of turf fertilizer products. Fertilizers of various formulations, analyses, and mineral availability exist, and application scheduling and rates can also vary greatly. Application regimes should correspond to the turf, its use, budget, and environment. A turf manager should consider these variables when selecting fertilizer products and establishing a fertilization program. The objectives of this study were: (a) to determine fertilizer effects on soil pH, and (b) to evaluate the effects of several specific fertilizer formulations on general turf quality.

MATERIALS AND METHODS

This study was initiated on 25 April 1988, when nine fertilizer treatments were applied to a poorly managed Kentucky bluegrass turf. The four fertilizers used in this study were Vitex Lawn and Turf (8-4-5, Dynamic International, Inc., Libertyville, Illinois), 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 of the three replications, four plots received three applications of 1 lb. N/1,000 sq ft of the above fertilizers at eight week intervals. A second set of four plots received six applications of 0.5 lb. N/1,000 sq ft of the above fertilizers at four week intervals. A final unfertilized plot was left as a check. Past season fertilizer applicationa began 2 May 1989 for both application regimes. Each plot measured 5' x 6'.

The test area received no irrigation and was heavily trafficked by automobiles during the last week in July and first week in August. General turf quality was evaluated using a 1-9 scale (1=tan turf, bare soil, lowest overall quality, 6=minimal turfgrass quality, and 9=darkest green, very dense, highest overall quality). Plots were rated weekly, beginning 2 May and concluding 3 October, except during a period from 24 July through 16 August. The soil pH tests were conducted 4 April 1988 prior to the start of the study and again 15 November 1988 and 27 November 1989. Soil pH tests were made three times: prior to application of fertilizer treatments, between the 1988 and 1989 growing seasons, and following the conclusion of the study. For the second and third soil tests, samples from each replication were combined to produce one soil sample representing each treatment.

RESULTS

From the initiation of this study, fertilization practices potentially contributing to a soil pH rise were a concern of the investigators. Prior to fertilization, the test area soil pH was 7.4. Soil pH test results from 15 November 1988 and 27 November 1989 indicate a general trend of lowered soil pH levels (Table 1), and suggest fertilizer treatments did not cause an increase in soil alkalinity over the two years of testing. It should be noted that the soil test made prior to the start of the study was conducted by a different laboratory than the soil tests conducted during and following the study, thus accounting for some variability. The tests made during the study (November, 1988) and following the conclusion of the study (November, 1989) were conducted by the same laboratory.

For all but three evaluation dates, the unfertilized check plot was the only plot of significantly lower overall quality (Table 1). Fertilizer response would be expected, and during these evaluation dates the different fertilizer products and application schedules produced similar quality turf. The three dates in which statistical differences among treatments occurred were May 9 and 30 and September 14. The differences, however, were slight.

Table 1. Soil test pH levels following two years of study and mean general turf quality for three ratings during the 1989 growing season.

Treatment[1]	Soil pH[2] 11/88	Soil pH[2] 11/89	Turf Quality[3] Evaluation Date 5/9	Turf Quality[3] Evaluation Date 5/30	Turf Quality[3] Evaluation Date 9/14
1. Vitex (8-4-5 3 applications	7.5	7.3	4.6a	5.3ab	7.0a
2. Vitex (8-4-5) 6 applications	7.4	7.2	4.3ab	5.7ab	7.0a
3. Vitex Soil Enricher (9-3-6) 3 applications	7.4	7.4	4.0b	5.3ab	7.0a
4. Vitex Soil Enricher (9-3-6) 6 applications	7.5	7.3	4.0b	5.3ab	7.0a
5. Urea (46-0-0) 3 applications	7.4	7.3	4.0b	5.0b	7.0a
6. Urea (46-0-0) 6 applications	7.3	7.1	4.0b	5.3ab	7.0a
7. Locally formulated (8-4-5) 3 applications	7.3	7.2	4.3ab	5.0b	6.3b
8. Locally formulated (8-4-5) 6 applications	7.3	7.0	4.0b	6.0a	7.0a
9. Check	7.5	7.2	3.3c	4.0c	6.0c
$LSD_{0.05}$			0.6	0.8	0.3

[1]Treatments
1. Vitex (8-4-5) Lawn and Turf; 1# N/application; 3 applications
2. Vitex (8-4-5) Lawn and Turf; 0.5# N/application; 6 applications
3. Vitex Soil Enricher (9-3-6) Greens; 1# N/application; 3 applications
4. Vitex Soil Enricher (9-3-6) Greens; 0.5# N/application; 6 applications
5. Urea (46-0-0); 1# N/application; 3 applications
6. Urea (46-0-0); 0.5# N/application; 6 applications
7. Locally formulated (8-4-5); 1# N/application; 3 applications
8. Locally formulated (8-4-5); 0.5# N/application; 6 applications
9. Check; No fertilizer applications

[2]The soil pH level prior to the start of the study was 7.4.

[3]Mean quality rating is the mean of three 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. Evaluated on a 1-9 scale (1=tan turf, bare soil, lowest overall quality and 9=darkest green, very dense, highest overall quality).

CANOPY TEMPERATURE BASED IRRIGATION SCHEDULING OF COOL SEASON GRASSES

D.L. Martin and D.J. Wehner

INTRODUCTION

Several methods are currently used to schedule irrigation of plants including strict calendar scheduling, visual evaluation of soil and turf, use of soil moisture sensing devices, and estimating evapotranspiration. Methods of irrigation scheduling based on plant canopy temperature have been developed in recent years. The advantages of canopy temperature based irrigation scheduling over traditional methods have been a) the reduction of irrigation water applied without reduction in quality and b) the ability to provide a direct quantitative measure of the water status of the plants under consideration.

An infrared thermometer is used to measure the overall temperature of the plant canopy in each of the temperature based methods. The infrared thermometer, typically gun shaped, is pointed at the plant canopy under consideration and provides an instantaneous temperature reading (by measuring long wave or infrared radiation). The principle operating behind each canopy temperature based scheduling method is that when plants transpire, the temperature of the leaves are lowered relative to that of the surrounding air. When water becomes limiting, less transpiration occurs, and thus the leaves are not cooled to as great of a degree.

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 canopy and surrounding air, and then correcting the value for environmental conditions such as humidity, solar radiation and windspeed prevailing at the time of the canopy temperature measurement. The most simple models correct only for the humidity of the air, while more complex models correct for additional environmental variables.

The CWSI scale varies from 0 to 1, with 0 being no water stress and values approaching 1 being severe water stress. Irrigation is performed when the plants under consideration reach a predetermined CWSI value depending upon the species present and the management regime.

Use of canopy temperature based methods to schedule irrigation of turfgrass is still in its infancy; only recently has commercial equipment designed for turfgrass managers been introduced to the market. Several questions exist regarding the scheduling of irrigation using the CWSI method such as i) is a single model applicable across all turfgrass species and management regimes, ii) how complex of a model is needed to accurately determine the water stress to which turf is being subjected, and iii) at what CWSI value should irrigation be undertaken for turfgrasses to achieve a desired level of quality? Our research was aimed at finding answers to these questions.

MATERIALS AND METHODS

STUDY ONE

The objectives of this study were to i) determine whether a single model is appropriate for predicting the canopy-air temperature difference of well watered Kentucky bluegrass and creeping bentgrass (essential in constructing a CWSI model) as well as ii) to determine which environmental variables were 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, with creeping bentgrass maintained at 3/8 inch. Fertilization consisted of 4 lbs of N/1000 sq ft/yr for all grasses. All turf was maintained under moist conditions.

Canopy temperature, air temperature, relative humidity, net radiation and windspeed were measured on/over 17 x 17 ft non-replicated plots of Penncross creeping bentgrass; South Dakota Common, America, Kenblue, and Bristol Kentucky bluegrass; and a blend of Adelphi, Glade, Parade and Rugby Kentucky bluegrasses. The measurements were taken on 17 dates in 1988 and on 31 dates in 1989. Each plot was monitored for three to four - one minute periods, with samples taken every 5 seconds and then averaged to provide a mean for each of the one minute sampling periods. Sampling was performed between 12 and 3 pm. Data was pooled from all but 15 dates during 1989, and various regression models were fit to the canopy-air temperature difference of each cultivar/species. The predictive ability of these regression models was then tested on data gathered from the remaining 15 sampling dates in 1989. The actual measured canopy-air temperature difference was regressed on the predicted canopy-air temperature difference and the R-square and slope values were used as indication of predictive capability. The predictive capability of a complete energy balance approach was also tested on data from the remaining 15 sampling dates in 1989.

STUDY II

The objectives of this study were to i) determine whether a single model was appropriate for predicting the canopy-air temperature difference of senescent Kentucky bluegrasses and creeping bentgrasses (essential in constructing a CWSI model) as well as ii) to determine which environmental variables were necessary to accurately predict the value of that difference. Slabs of each of the previously mentioned cultivars/species were cut from a stock area, and rapid dried and killed. The slabs were then placed into aluminum pans for storage and ease of handling. The senescent turf was placed into recessions in the turfgrass stand on dates when sampling was to occur. Environmental parameters were monitored on/over the senescent turfgrasses on 11 and 17 dates in 1988 and 1989 respectively. The environmental parameters measured were as previously described. Data from the two years was pooled and various regression models were fit to the canopy-air temperature difference of the senescent turf.

STUDY III

The specific objective of this study was to evaluate the color response of creeping bentgrass to irrigations scheduled by different Crop Water Stress Index Models utilizing several CWSI set points values. Bentgrass maintenance was as described for Study I with the exception of the irrigation practiced. The experimental design was a randomized complete block utilizing a factorial arrangement of treatments and 3 replications (4 CWSI models x 3 CWSI set points x 3 reps). The 3 CWSI set point values were 0.25, 0.50 and 0.75.

When CWSI models I, II and III were employed, the CWSI was calculated by the equation:

$$CWSI = (DTact - DTns)/(DTss - DTns)$$

where DTact is the actual measured canopy-air temperature difference, DTns was the calculated canopy-air temperature difference of non-stressed turf from equations developed in Study I, and DTss was the calculated canopy-air temperature difference of senescent turf from equations developed in Study II. CWSI Models I, II and III used the best 1, 2 and 3 variable regression models developed in Study I to predict the canopy-air temperature difference of non-stressed bentgrass respectively. Model I also used the best 1 variable model from Study I as well as a previously published technique to predict the canopy-air temperature difference of senescent bentgrass. Models II and III used the best 1 and 2 variable regression models found in Study II for predicting the canopy-air temperature difference of senescent bentgrass. Model IV calculated the CWSI through a complete energy balance approach.

Environmental sampling and administering of irrigation treatments was conducted from 21 June through 21 August. Variables sampled were the same as those discussed in Study I and II. Irrigation in the amount of 1/2 inch was applied to a plot when the measured CWSI of the plot equaled or exceeded the assigned CWSI set point value. Sampling of environmental variables and administering of irrigation was concluded on 21 August as heavy rains ensued after this date.

Color ratings were taken every 3 to 4 days from 22 June to 27 August. A scale of 1 to 9 was utilized, where 1 was straw colored turf and 9 was very dark green turf. Two periods occurred when there was little interference from rainfall. A separate analysis of variance was performed on color ratings collected from these two time periods. The analysis was conducted as a split plot in time with CWSI model and CWSI set points as whole plots and sampling dates as subplots.

RESULTS AND DISCUSSION

STUDY I

The most reasonable progression in model complexity for predicting the canopy-air temperature difference of non-stressed turf was first to utilize vapor pressure deficit of the air (VPD) (a more meaningful measure of moisture in the air than relative humidity), next VPD and net radiation and finally VPD, net radiation and windspeed. Predictive capability of the regression models increased as additional variables were added. From a statistical stand point it was most appropriate to have a predictive model for each individual cultivar within the species tested rather than utilizing an "all bluegrass" or "all turfgrass" model. Although statistically significantly different from each other, bluegrass models were more similar to each other than to the models developed on bentgrass.

The predictive capability of the best 1, 2 and 3 variable models used for calculating the canopy-air temperature difference on non-stressed turf were tested on an independent data set. When tested on the independent data set the predictive capability of all 1 and 2 variable models were low and unsatisfactory. The complete energy balance approach performed better than either the 1 or 2 variable approach, but not as well as the 3 variable models. When tested on the independent data set, the "all bluegrass" model performed equally well as models developed specifically for individual Kentucky bluegrass cultivars. Performance of all models other than those developed on creeping bentgrass were unsatisfactory when tested on independent data gathered from creeping bentgrass. Results of this study suggest that a general model for predicting the canopy-air temperature difference across cultivars within the Kentucky bluegrass species grown under similar cultural practices may be appropriate. A separate model appears to be necessary for creeping bentgrass, probably due to the difference in mowing height practiced on creeping bentgrass compared to Kentucky bluegrass. Additional research is necessary to determine if a general model is appropriate for use across species managed under identical cultural practices.

STUDY II

The best 1 and 2 variable regression models for predicting the canopy-air temperature difference of senescent turf contained i) net radiation and ii) net radiation and windspeed. All 1 variable models accounted for an unsatisfactory quantity of variation in the canopy-air temperature difference of the senescent turf. The predictive capability of the "all bluegrass" models was more satisfactory than that of models developed specifically for each bluegrass cultivar. Models developed for bluegrasses were statistically different from those developed for creeping bentgrass. These results suggest both net radiation and windspeed should be accounted for when developing a model to predict the canopy-air temperature difference of senescent turf. A single model may be appropriate for use across cultivars within the Kentucky bluegrass species when the cultivars are managed under the same cultural practices. A separate model appears to be needed for creeping bentgrass, due in part to the difference in the culture of bentgrass and Kentucky bluegrass. The time schedule for this work did not allow for construction of an independent data set gathered from senescent turf. Testing of our best 1 and 2 variable models for predicting the canopy-air temperature difference of senescent turf using an independent data set would be most desirable.

STUDY III

Mean color ratings collected from bentgrass managed under models I through IV are shown graphically in figure 1a-d. Color rating varied according to the model being employed, the index set point at which irrigation was scheduled to occur, and the date of color rating evaluation (analysis not shown). The total number of irrigation events and thus quantity of water applied through irrigation declined with increasing value of the CWSI set point (Table 1). Also, the number of irrigation events and thus quantity of water added through irrigation declined at a given CWSI set point as model complexity increased (Table 1). From the previous 2 trends it is not surprising to note that i) the overall mean color ratings of creeping bentgrass declined with increasing value of the CWSI set point and that ii) for a given CWSI set point, overall mean color rating declines with model complexity (Table 1). Thus, to maintain the same level of creeping bentgrass color, a smaller CWSI set point value must be chosen as the model becomes more complex.

The overall goal of this work was to minimizing water application while achieving an acceptable level of creeping bentgrass quality. The next step toward achieving this goal is to investigate a narrower range of CWSI set points to find the optimum set point range at which acceptable color can be maintained. The number of dates on which the mean color rating of bentgrass was unsatisfactory (below a value of 7) (Table 1) is a key to finding this optimum range. Use of the overall mean color rating is undesirable because ratings on individual dates may have been below the acceptable level of 7 on several dates, even though the overall mean may have been above 7. In future research utilizing model I, the color response of creeping bentgrass to irrigation scheduled by set points within the range 0.25 to 0.50 should be further investigated. Future research with models II, III or IV should investigate the response of bentgrass to irrigation scheduled at CWSI set points between 0 and 0.25.

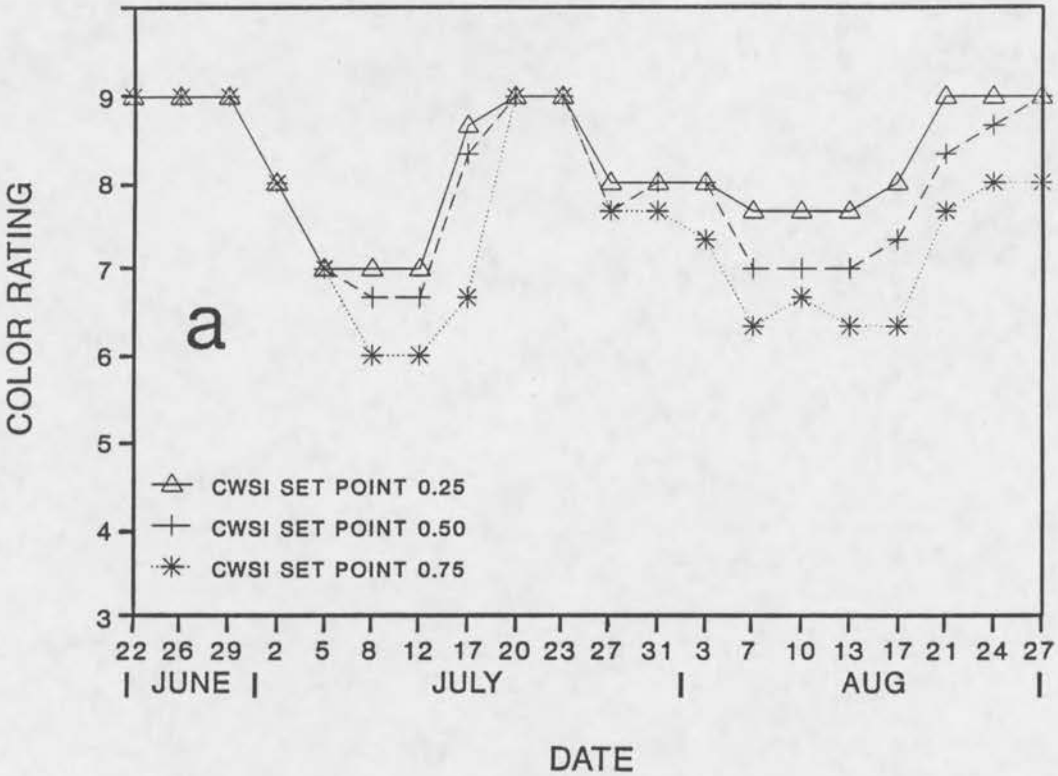
Table 1. Irrigation and color rating data for Penncross creeping bentgrass during the period 21 June - 21 August, 1989.

Model	CWSI SP[1]	Mean Number of Irrigation Events	Amount of water Applied[2]	Irrigation Plus Rainfall	Mean Color Rating[3]	No. of Dates When Color < 7
I	0.25	29.7	14.9	21.3	8.15	0
	0.50	23.7	11.8	18.3	7.89	2
	0.75	15.0	7.5	14.0	7.48	7
II	0.25	21.3	10.7	17.2	7.92	2
	0.50	7.7	3.8	10.3	7.15	10
	0.75	2.3	1.2	7.7	6.67	12
III	0.25	10.0	5.0	11.5	7.19	9
	0.50	2.3	1.2	7.7	6.44	11
	0.75	0.0	0.0	6.5	6.59	12
IV	0.25	5.3	2.7	9.2	6.89	10
	0.50	1.0	0.5	7.0	6.59	12
	0.75	0.0	0.0	6.5	6.13	12

[1]CWSI SP is the Crop Water Stress Index Set Point at which irrigation was scheduled to occur.

[2]One-half inch of water was applied to those plots which had calculated CWSI $\geq$ the CWSI Set Point.

[3]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color. Ratings of 7 and above are considered acceptable. Means are the overall average of 3 plots over the 18 rating dates between 21 June and 21 August, 1989.



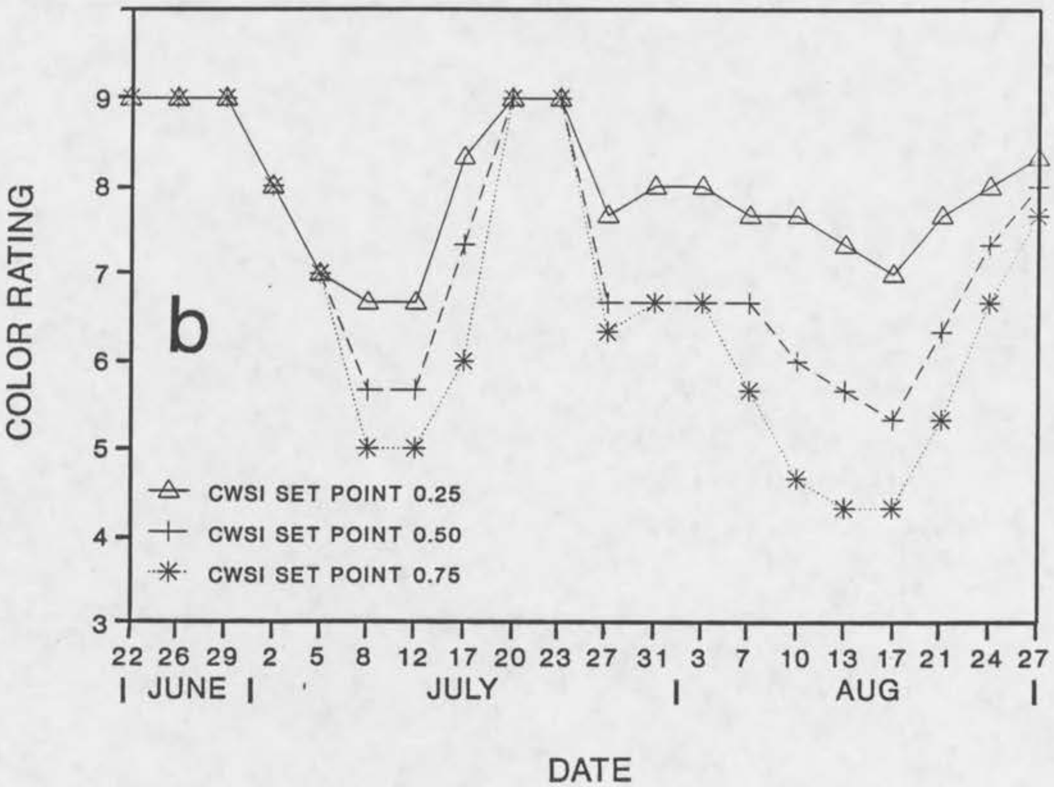
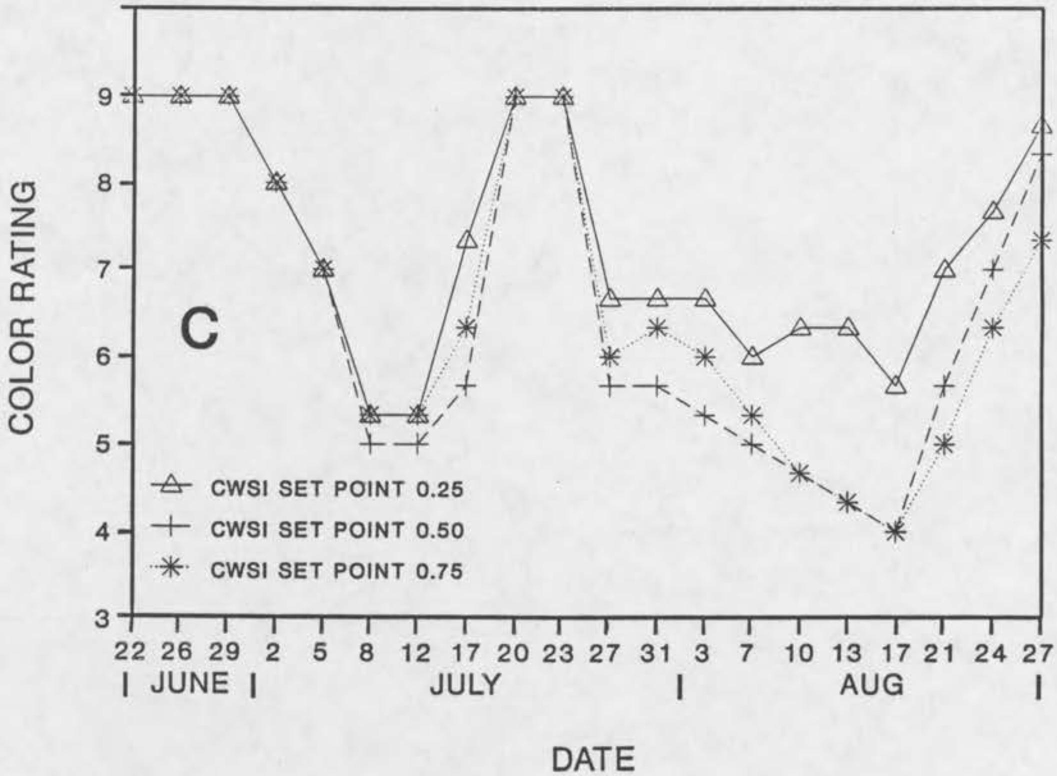


Figure 1. Mean color ratings of Penncross creeping bentgrass managed under a) Crop Water Stress Index Model I and b) Crop Water Stress Index Model II.



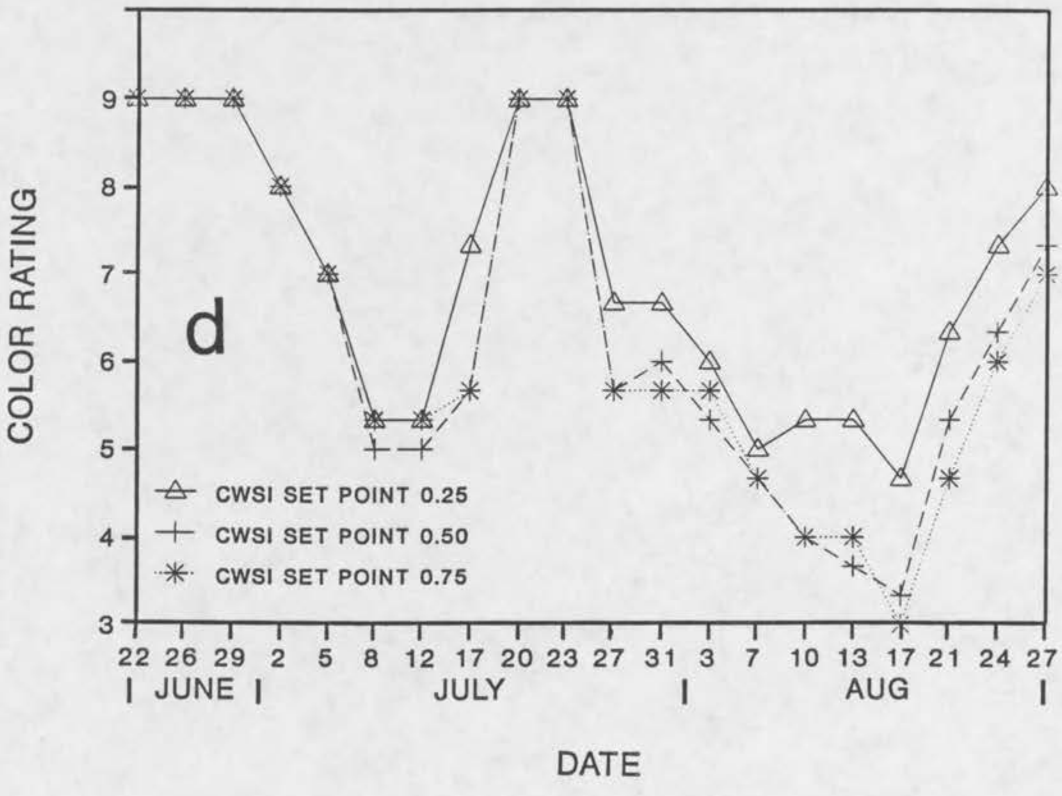


Figure 1. Mean color ratings of Penncross creeping bentgrass managed under c) Crop Water Stress Index Model III and d) Crop Water Stress Index Model IV (continued).

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 or 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 prodiamine, BAS 514, Mon 15104 and Mon 15151 and new formulations of Ronstar and Balan for crabgrass control.

MATERIALS AND METHODS

New products evaluated in this study included Mon 15104 1EC and Mon 15151 1EC (Dimension, dithiopyr, Monsanto Agricultural Co.) at 0.38, 0.5, and 0.75 lb ai/A. Also evaluated were BAS 514 50WP (quinclorac, BASF) at 1.0 and 1.5 lbs ai/A; and prodiamine (Barricade, Sandoz Crop Protection) at 0.5, 0.75, and 1.0 lb ai/A. Also evaluated were new formulations of oxadiazon (Ronstar 50WP, Rhone Poulenc Ag. Co.) at 3.0 lbs ai/A; and benefin (Balan 60DF, Elanco) at 2.0 + 2.0* lbs ai/A (* second application). Herbicides used as industry standards in this evaluation were Ronstar 2G at 3.0 lbs ai/A; Balan 2.5G at 2.0 + 2.0* lbs ai/A; Team 2G (benefin + trifluralin, Elanco) at 2.0 + 1.0* lbs ai/A; Team 2G at 3.0 lbs ai/A; Pre-M 60DG (pendimethalin, LESCO, Inc.) at 1.5 lbs ai/A; Pre-M 60DG at 3.0 lbs ai/A; and Bensumec 4LF (bensulide, PBI Gordon) at 7.5 lbs ai/A. Also applied were Team 2G at 2.0 lbs ai/A plus Gallery 75DF (isoxaben, Elanco) at 0.75 lbs ai/A; and Team 2G at 1.5 lbs ai/A plus Gallery 75DF at 0.56 lbs ai/A. All treatments were applied 26 April 1989 to an improved Kentucky bluegrass turf blend. Where a second application is indicated (*) herbicides were applied 20 June 1989. Herbicides mixed with water were applied at a spray volume of 40 gpa using a small plot CO_2 backpack sprayer. Granular materials were applied by hand. All treatments were replicated 3 times and an untreated check was included with each replication. In June the turf was mowed at 3/8 inch and irrigated frequently to encourage crabgrass germination. Plots were evaluated for percent crabgrass control when compared with the untreated plot.

RESULTS

Crabgrass germination in the untreated check plots ranged from 15% to 25% on 24 July and from 15% to 60% on 15 August. In previous years crabgrass pressure in the untreated checks has been greater. Reduced populations might be due to a late frost on 7 May that killed many seedling crabgrass plants. Products that provided the best seasonlong control were Ronstar 2G, Ronstar 50WP, Balan 60DF, Balan 2.5G, Team 2G, and prodiamine (Table 1). Mon 15104 1EC and 15151 1EC provided good crabgrass control at 0.75 lb ai/A only.

Table 1. The evaluation of herbicides applied 26 April 1989 for preemergence control of crabgrass in an improved Kentucky bluegrass turf blend.[1]

	Rate	% Crabgrass Control[2]	
		7/24	8/15
	lb ai/A	89 DAT[3]	111 DAT
Ronstar 2G	3.0	92.9ab	89.2a
Ronstar 50WP	3.0	94.2a	95.9a
Balan 60DF	2 + 2*	95.6a	84.3a
Balan 2.5G	2 + 2*	95.6a	96.4a
Team 2G	2 + 1*	95.6a	97.8a
Team 2G	3.0	72.9a-c	50.6bc
Team 2G + Gallery 75DF	2.0 + 0.75	94.2a	88.2a
Team 2G + Gallery 75DF	1.5 + 0.56	60.0c	27.8cd
Prodiamine 65DG	0.5	94.2a	92.2a
Prodiamine 65DG	0.75	98.7a	98.1a
Prodiamine 65DG	1.0	100.0a	100.0a
Bas 514 50WP	1.0	6.7f	5.6d
Bas 514 50WP	1.5	26.7ef	22.2cd
Mon 15104 1EC	0.38	52.9c-e	35.6cd
Mon 15104 1EC	0.5	62.2c	23.3cd
Mon 15104 1EC	0.75	92.0ab	73.7ab
Mon 15151 1EC	0.38	57.3cd	35.6cd
Mon 15151 1EC	0.5	60.9c	50.6bc
Mon 15151 1EC	0.75	94.2a	73.7ab
Pre-M 60DG	1.5	31.1d-f	38.3c
Pre-M 60DG	3.0	66.7bc	35.6cd
Bensumec 4LF	7.5	72.9a-c	45.6bc
$LSD_{0.05}$		27.4	31.6

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

[3]DAT refers to days after treatment.

*The second application was made 20 June 1989.

EVALUATION OF PRODIAMINE FOR PREEMERGENCE CONTROL OF CRABGRASS

J. E. Haley and T. W. Fermanian

INTRODUCTION

Prodiamine (Barricade, Sandoz Crop Protection) is a preemergence crabgrass control herbicide currently under evaluation at the University of Illinois. Little is known about the effect of prodiamine on immature turfgrass or its effect on overseeding operations. The purpose of these studies was to evaluate the effects of prodiamine on an improved Kentucky bluegrass turf established less than a year and to evaluate the effects of fall applied prodiamine on a spring overseeding program.

PHYTOTOXICITY EVALUATION

MATERIALS AND METHODS

On 26 April 1989 prodiamine was applied to a Kentucky bluegrass blend (Trenton, Parade, Aspen and Glade) that had been seeded 16 September 1988. Treatments 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 22 June 1989. 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 ft by 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

Significant turf injury was visible at rates of 1.25, 1.5, 1.75 and 2.0 lbs ai/A 90 days following treatment (Table 1). Although this injury was still visible 111 days after treatment turf quality had greatly improved. At this time, some injury from the second applications of split treatments became noticeable. Although significant herbicide damage was visible at the 0.50 + 0.50 and 0.75 + 0.25 lbs ai/A rates, turf quality remained good. The current rate of prodiamine recommended by the manufacturer is 0.3 - 0.5 lb ai/A with a total annual rate of 1.0 lb ai/A. The results from this study would indicate that prodiamine is safe on a 7 month old turf at manufacturer's rates.

OVERSEEDING EVALUATION

MATERIALS AND METHODS

Prodiamine was applied at 0.5, 0.75, 1.0, 1.25, 1.5, 1.75, and 2.0 lbs ai/A to a mature perennial ryegrass turf on 8 November 1988. Dacthal (DCPA, Fermenta Plant Protection) applied at 5.25, 10.5 and 21.0 lbs ai/A was included in the evaluation for comparison as one industry standard for preemergence crabgrass control. Each treatment was replicated 3 times and an untreated check plot was included with each replication. Plot size was 3 ft by 10 ft. Herbicides were applied at 40 gpa with a backpack sprayer. On 27 April 1989 (24 weeks after treatment) the existing turf was killed with Roundup (glyphosate, Monsanto Agricultural Co.). A blend of Trenton, Parade, Aspen and Glade Kentucky bluegrass was slit seeded into the dead vegetation on 18 May 1989 at 1.5 lbs pure live seed/1000 sq ft. The area was irrigated as necessary to insure germination.

RESULTS

In some plots, weed competition, primarily from common purslane (<u>Portulaca oleracea</u>), made it difficult to count Kentucky bluegrass seedlings. Purslane populations were very high in all Dacthal and check plots. Some weeds were present in plots treated with prodiamine at 0.5 and 0.75 lbs ai/A. Although turf density was undoubtedly effected by weed competition, turf populations were significantly higher in plots treated with Dacthal at 5.25 and 10.5 lbs ai/A, prodiamine at 0.5 lb ai/A and in the untreated check plots (Table 2). This would indicate that low rates of prodiamine applied in the fall would not effect a spring overseeding program.

Table 1. The evaluation of prodiamine applied on 26 April 1989 to an improved Kentucky bluegrass turf established less than a year.[1]

Herbicide	Rate lb ai/A	Phytotoxicity[2] 7/25/89	8/15/89
Prodiamine 65DG	0.5	9.0a	9.0a
Prodiamine 65DG	0.75	9.0a	8.7ab
Prodiamine 65DG	1.0	9.0a	8.3a-c
Prodiamine 65DG	1.25	6.7b	7.3d
Prodiamine 65DG	1.5	5.7bc	7.7cd
Prodiamine 65DG	1.75	6.0b	7.3d
Prodiamine 65DG	2.0	4.7c	7.3d
Prodiamine 65DG	0.25 + 0.25*	9.0a	9.0a
Prodiamine 65DG	0.50 + 0.25*	9.0a	9.0a
Prodiamine 65DG	0.50 + 0.50*	8.7a	8.7ab
Prodiamine 65DG	0.75 + 0.25*	8.7a	7.7cd
Prodiamine 65DG	0.75 + 0.50*	8.0a	8.0b-d
Check	---	9.0a	9.0a
$LSD_{0.05}$		1.3	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]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 22 June 1989.

Table 2. The evaluation of prodiamine applied 8 November 1988 and overseeded 18 May 1989.[1]

Herbicide	Rate lb ai/A	Density[2] 7/13/89
Prodiamine 65DG	0.5	11.5ab
Prodiamine 65DG	0.75	6.5bc
Prodiamine 65DG	1.0	2.0c
Prodiamine 65DG	1.25	1.0c
Prodiamine 65DG	1.5	0.4c
Prodiamine 65DG	1.75	0.2c
Prodiamine 65DG	2.0	0c
Dacthal 75WP	5.25	10.6ab
Dacthal 75WP	10.5	18.4a
Dacthal 75WP	21.0	7.8bc
untreated check		17.4a
$LSD_{0.05}$		8.4

[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]Density refers to the average number of shoots per 25 square centimeters.

THE EVALUATION OF RONSTAR APPLIED IN LATE FALL

J.E. Haley and T.W. Fermanian

INTRODUCTION

A good crabgrass control program includes the proper use of preemergence herbicides. To be effective these herbicides must be applied in early spring prior to weed germination. Early herbicide application may be difficult for many turf managers. Adverse weather conditions, heavy customer load, equipment breakdown, and understaffing may all prevent timely herbicide application. Preemergence herbicides that could be applied in late fall/early winter and still control early germinating crabgrass the following spring would be very valuable to the turf industry. The purpose of this study was to evaluate the use of Ronstar 50WP (oxadiazon, Rhone Poulenc, Inc.) and Ronstar 2G in a fall application program.

MATERIALS AND METHODS

Both Ronstar 2G and Ronstar 50WP were applied 8 November 1988 at 2.0 and 3.0 lbs ai/A. Ronstar 50WP was also applied 8 November 1988 at 2.0 lbs ai/A with a repeat application 26 April 1989 at 0.5 or 1.0 lb ai/A. Other 26 April applications made to previously untreated turf included Ronstar 2G at 3.0 lbs ai/A and Ronstar 50WP at 2.0 lbs ai/A. A spring treatment of pendimethalin 2G (O.M. Scott) at 3.0 lbs ai/A was included for comparison. Each treatment and an untreated plot were replicated 3 times. The turf was a mature Kentucky bluegrass turf (*Poa pratensis*, 'Newport'). Ronstar 50WP was applied in a spray volume of 40 gpa using a small plot CO_2 backpack sprayer. Granular materials were applied by hand. Plots were evaluated for crabgrass control as compared to the untreated plot.

RESULTS

Good season long control was obtained with spring applications of Ronstar 2G at 3.0 lbs ai/A and Ronstar 50WP at 2 lbs ai/A (Table 1). Although fall applications and split fall/spring applications did provide some crabgrass control, it would not be adequate in areas where weed pressure is high.

Table 1. The evaluation of Ronstar 2G and 50WP applied in the fall for preemergence control of crabgrass the following spring.[1]

Herbicide	Rate lb ai/A	Timing[3]	% Crabgrass Control[2] 7/25/89	8/15/89
Ronstar 2G	2.0	Fall	33.3bc	48.3bc
Ronstar 2G	3.0	Fall	62.2ab	28.3c
Ronstar 50WP	2.0	Fall	13.c	31.7c
Ronstar 50WP	3.0	Fall	31.1bc	33.3c
Ronstar 50WP	2.0/0.5	Fall/Spring	33.3bc	47.8bc
Ronstar 50WP	2.0/1.0	Fall/Spring	68.9a	67.5ab
Ronstar 2G	3.0	Spring	80.0a	79.4a
Ronstar 50WP	2.0	Spring	80.9a	77.2a
Pendimethalin 2G	3.0	Spring	55.6ab	41.1bc
$LSD_{0.05}$			34.2	28.1

[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]Fall applications were made 8 November 1988 and Spring applications were made 26 April 1989.

Comparison of Preemergence Control of Crabgrass by BASF 514 and Pendimethalin in a Dethatched and Thatchy 10-year Old Kentucky Bluegrass Turf

Kenneth L. Diesburg

OBJECTIVE

To determine if thatch inhibits the effectiveness of a 514 in controlling crabgrass.

MATERIALS AND METHODS

The trial was conducted on a Kentucky bluegrass blend, established 1978 in a Hosmer silt loam. Thatch thickness ranged from 3/4 to 1 inch. The trial remained moist and no other chemicals were applied throughout the testing period. The area had been fertilized at 3 lb N/1000 square feet during 1988. Nitroform was applied during June 1989, at 1 lb N/1000 square feet. Dethatching was done with a Ryan Mattaway on April 5, 1989. Chemicals were applied April 12, according to Table 1. Treatments were replicated four times in a split-split plot design with chemicals as whole plots, thatch levels as subplots and crabgrass seeding as sub-subplots. Data were recorded July 5 as subjective ratings of percent plot coverage by crabgrass.

RESULTS

Dethatching removed most of the thatch. Soil was nearly exposed and could be touched easily when the turf was probed with a finger. Seedings of crabgrass at 1.5 lb/1000 increased its incidence over the indigenous population (36% vs. 11%) averaged over all plots (Table 2). Dethatching also increased the incidence of crabgrass (29% vs. 17% averaged over all plots).

Pendimethalin was more effective than 514 in controlling crabgrass in both thatchy and dethatched turf. Both chemicals were more effective in the thatchy turf. Pendimethalin averaged 98% vs. 93% control over the untreated plots, while 514 averaged 68% vs. 53% control over the untreated plots in thatchy vs. dethatched turf, respectively. There was a significant chemical by crabgrass seeding interaction. Prevention of crabgrass by pendimethalin was equally effective in both the seeded and nonseeded plots (2% vs. 3%) while the incidence of crabgrass increased proportionately in the control and 514 plots with the seeding of additional crabgrass, from 25% to 67% and 6% to 37%, respectively.

CONCLUSIONS

The presence of thatch did not inhibit the effectiveness of either 514 or pendimethalin in the absolute sense or relative to the untreated plots.

DISCUSSION

Comparison of 9% vs. 41% crabgrass in the thatchy and dethatched non-seeded control plots respectively, demonstrates the value of thatch and dense turf in restricting natural crabgrass seed germination. The use of preemergence herbicides complements that function. The seeding of crabgrass in this experiment represents an unnatural situation regarding thatchy turf. The seeded plots should, therefore, be considered with less weight. In the nonseeded plots, 78% and 73% control was obtained by 514 over the untreated thatchy and dethatched plots, respectively.

It is interesting to note that 514 was ineffective in preventing the germination of seeds that were not in the soil, while pendimethalin prevented their germination. This reflects the soil activity of 514 while pendimethalin must be active on the seed.

Table 1. Chemicals applied to thatchy and dethatched Kentucky bluegrass turf.

	lb ai per acre	% ai in mat	lb mat per acre	g mat per 30 sq ft
Pendimethalin	1.3	1.1	116.8	36.600
BASF 514	1.0	50.0	2.0	0.625

Table 2. Percent plot coverage by crabgrass in 10-year old Kentucky bluegrass turf in response to chemical treatments.

	Control	Pend.	514	LSD (0.05)
Thatchy	9	0	2	6
Thatchy + crabgrass seed	64	2	27	6
Dethatched	41	3	11	6
Dethatched + crabgrass seed	70	4	47	6
$LSD_{0.05}$	5	5	5	8

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, Hoechst 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. Several chemical companies have developed new herbicides that claim to have both preemergence and early postemergence control capabilities. The purpose of this research was to evaluate two of these new chemicals Dimension (dithiopyr Monsanto Agricultural Co.) and BAS 514 (quinclorac, BASF Corporation) for late preemergence and early postemergence crabgrass control and to evaluate Acclaim when applied with several preemergence crabgrass control herbicides.

MATERIALS AND METHODS

Treatments included Mon 15104 1EC (Dimension) and Mon 15151 1EC (Dimension) applied at 0.38, 0.5 and 0.75 lb ai/A; and BAS 514 50WP applied at 0.75, 1.0, 0.75 + 0.75*, and at 1.0 + 1.0* lb ai/A. The surfactant XM-12 at 0.5% v/v was used with Mon 15104 and Mon 15151. BAS 514 was applied with the surfactant BAS 0902S at a rate of 2.0 pt surfactant/A. The Acclaim treatments included Acclaim at 0.08 lb ai/A plus Pre-M 60DG (pendimethalin, LESCO, Inc.) at 1.5 lbs ai/A; Acclaim at 0.12 lb ai/A plus Pre-M at 1.5 lbs ai/A; Acclaim at 0.08 lb ai/A plus Team 2.5G (benefin + trifluralin, Elanco) at 2.0 lbs ai/A; Acclaim at 0.12 lb ai/A plus Team at 2.0 lbs ai/A; Pre-M (applied 27 April 1989) at 1.5 lbs ai/A plus Acclaim (2-4 tiller application) at 0.25 lb ai/A; and Acclaim at 0.08, 0.12 and 0.18 lb ai/A. Daconate 6 (MSMA, Fermenta Plant Protection) at 2 + 2* lbs ai/A was included as the industry standard.

Herbicides were applied to a common Kentucky bluegrass turf on 30 June 1989 except where noted. Most crabgrass plants were at the 3-4 leaf stage of growth. The second application (*) of Daconate 6 was made on 14 July 1989. The second applications (*) of BAS 514 and the 2-4 tiller application of Acclaim were made 26 July 89. All liquid applications were made in a spray volume of 40 gpa using a small plot CO_2 backpack sprayer. Team 2.5G was applied by hand. Each treatment was replicated 3 times and an untreated check was included with each replication. Plots were evaluated for percent control of crabgrass when compared with the untreated check.

RESULTS

Excellent crabgrass control was observed 25 and 46 days after treatment with all rates of Mon 15151 and Mon 15104 (Table 1). Bas 514 50WP provided excellent control when two herbicide applications were made. Single applications provided good crabgrass control. Applications of Acclaim alone or in a tank mix with preemergence herbicides provided excellent weed control except at the Acclaim 0.08 lb ai/A rate. Herbicide injury was observed with some treatments. However, when the data was analyzed, there was statistically no signifcant difference in phytotoxicity among treatments.

Table 1. The evaluation of herbicides for postemergence control of crabgrass applied to a common Kentucky bluegrass - perennial ryegrass blend during the 1989 growing season.[1]

Herbicide	Rate lb ai/A	% Crabgrass Control[2] 7/25 25 DAT[3]	8/15 46 DAT
Mon 15151 1EC	0.38	91.4ab	90.3bc
Mon 15151 1EC	0.5	97.6a	97.2ab
Mon 15151 1EC	0.75	98.7a	99.4a
Mon 15104 1EC	0.38	94.9ab	95.6a-c
Mon 15104 1EC	0.5	97.0ab	98.6ab
Mon 15104 1EC	0.75	95.9ab	99.4a
Bas 514 50WP[4]	0.75	85.9bc	76.4d
Bas 514 50WP	1.0	93.2ab	87.5c
Bas 514 50WP plus Bas 514 50WP[5]	0.75 + 0.75	90.6a-c	100.0a
Bas 514 50WP plus Bas 514 50WP[5]	1.0 + 1.0	97.0ab	100.0a
Acclaim 1EC + Pre-M 60DG	0.08 + 1.5	95.9ab	93.6a-c
Acclaim 1EC + Pre-M 60DG	0.12 + 1.5	95.9ab	97.2ab
Acclaim 1EC + Team 2.5G	0.08 + 2.0	97.0ab	97.5ab
Acclaim 1EC + Team 2.5G	0.12 + 2.0	95.9ab	93.1a-c
Pre-M 60DG plus Acclaim 1EC[6]	1.5 + 0.25	58.9d	99.4a
Acclaim 1EC	0.08	79.4c	76.7d
Acclaim 1EC	0.12	97.6a	93.9a-c
Acclaim 1EC	0.18	97.6a	95.8a-c
Daconate 6	2.0 + 2.0*	95.9ab	96.9ab
$LSD_{0.05}$		11.6	8.5

[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]DAT refers to days after treatment.

[4]All Bas 514 50WP applications were made with the addition of Bas 0902S, a surfactant, to the spray tank. Bas 0902S was applied at 2 pt/A.

[5]Second applications were made 26 July 1989.

[6]Pre-M 60DG was applied 27 April 1989 and Acclaim 1EC was applied 26 July 1989.

*The second application was made 14 July 1989.

THE EVALUATION OF ACCLAIM WHEN USED IN A COMPLETE WEED CONTROL PROGRAM

J.E. Haley and D.J. Wehner

INTRODUCTION

Acclaim (fenoxaprop, Hoechst Roussel Agri-Vet) has proved to be an effective postemergence crabgrass control herbicide. Acclaim can be safely tank mixed or used in conjunction with many preemergence crabgrass control herbicides for better late spring/early summer weed control. However, it has been observed that Acclaim activity is reduced when used in tank mixes with phenoxy herbicides or with dicamba. The purpose of this study was to evaluate the performance of Acclaim when used in a complete turfgrass weed control program that includes both preemergence crabgrass herbicides and postemergence broadleaf weed herbicides.

MATERIALS AND METHODS

Preemergence crabgrass control treatments included Pre-M (pendimethalin, LESCO, Inc.) at 1.5 lbs ai/A plus Trimec (2,4-D, MCPP, dicamba, Dow Chemical USA) at 3 pts cf/A; and Trimec at 3.0 pts cf/A followed by a postemergence application (3-4 leaf crabgrass) of Acclaim at 0.12 lb ai/A plus Pre-M at 1.5 lbs ai/A. Other treatments applied at the 3-4 leaf stage of crabgrass growth included Acclaim at 0.12 lb ai/A plus Pre-M at 1.5s lb ai/A; Acclaim at 0.12 lb ai/A plus Pre-M at 1.5 lbs ai/A plus Turflon Amine (triclopyr, Dow Chemical USA) at 2.0 pts cf/A; and Acclaim at 0.25 lb ai/A plus Pre-M at 1.5 lbs ai/A plus Trimec at 3.0 pts cf/A. Treatments applied at the 2-4 tiller stage of crabgrass growth were Acclaim at 0.25 lb ai/A; and Acclaim at 0.25 lb ai/A plus Turflon Amine at 2.0 pts cf/A. All treatments were made using a spray volume of 152.5 gpa. A surfactant, XM-12, was used at the rate of 0.25% v/v with all postemergence treatments. Also included in this evaluation were an early application (3-4 leaf) of Acclaim at 0.12 lb ai/A plus Pre-M at 1.5 lb ai/A; and a late application (2-4 tiller) of Acclaim at 0.25 lb ai/A. Both treatments were applied at a spray volume of 40 gpa using a small plot CO_2 backpack sprayer and no surfactant. All treatments were replicated 3 times and an untreated check was included with each replication. The turf was a mature Kentucky bluegrass turf (Poa pratensis, 'Baron'). Preemergence applications were made 28 April 1989, 3-4 leaf stage applications were made 6 July 1989 and 2-4 tiller stage applications were made 26 July 1989. Treatments were evaluated for control of crabgrass when compared with the untreated check.

RESULTS

Postemergence crabgrass control with Acclaim was not reduced with the addition of phenoxy herbicides to the spray tank (Table 1). Excellent weed control was obtained with all treatments of Acclaim alone or in a tank mix.

Table 1. The evluation of Acclaim applied in a complete weed control program during the 1989 growing season.[1]

Herbicide[3]	Rate of Acclaim lb ai/A	Timing[4]	% Crabgrass Control[2] 8/15
Pre-M + Trimec		pre	48.8b
Trimec (pre) plus Acclaim + Pre-M	0.12	3-4 leaf	100.0a
Acclaim + Pre-M	0.12	3-4 leaf	100.0a
Acclaim + Pre-M + Turflon Amine	0.12	3-4 leaf	100.0a
Acclaim + Pre-M + Trimec	0.25	3-4 leaf	98.5a
Acclaim	0.25	2-4 tiller	100.0a
Acclaim + Turflon Amine	0.25	2-4 tiller	100.0a
Acclaim + Pre-M*	0.12	3-4 leaf	99.6a
Acclaim*	0.25	2-4 tiller	100.0a
$LSD_{0.05}$			27.8

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

[3]All Trimec treatments were applied at 3 pt formulation/A. All Pre-M treatments were applied at 1.5 lb ai/A. All Turflon Amine treatments were applied at 2 pt formulation/A. All treatments were applied in a spray volume of 152.5 gpa except where noted.

[4]Timing refers to the growth stage of the crabgrass plant when herbicide applications were made. All preemergence applications were made on 28 April, 1989. All 3-4 leaf applications were made 6 July 1989. All 2-4 tiller applications were made 26 July 1989.

*The spray volume on this treatment was 40 gpa.

THE EVALUATION OF POSTEMERGENCE HERBICIDES FOR THE CONTROL OF PROSTRATE SPURGE

J. E. Haley and D. J. Wehner

INTRODUCTION

Prostrate spurge (Euphorbia humistrata and E. supina) is a difficult weed to control with postemergence herbicides. It has thick waxy leaves that resist herbicide uptake. Combinations of 2,4-D, MCPP and dicamba or 2,4-D and triclopyr usually provide adequate weed control, although in most cases high herbicide rates and multiple applications are necessary. In an effort to reduce or replace 2,4-D in herbicide programs many lawn care companies are searching for another control of this pesky weed. The purpose of this study was to evaluate postemergence control of prostrate spurge with a combination of triclopyr and clopyralid.

MATERIAL AND METHODS

Herbicides evaluated in this study included Confront (triclopyr + clopyralid, Dow Chemical) at 2 pt product/A; Turflon II Amine (2,4-D + triclopyr, Dow Chemical) at 2, 3, and 4 pt product/A; Turflon D (2,4-D + triclopyr, Dow Chemical) at 2, 3, and 4 pt product/A and Trimec (2,4-D, MCPP and dicamba, PBI/Gorden Corporation) at 3 and 4 pt product/A. Treatments were applied to a Kentucky bluegrass turf in a split plot design. The number of herbicide applications was the split treatment. Each herbicide treatment was replicated 3 times and an untreated check plot was included with each replication. Herbicide were applied to 3 x 20 feet plots on 11 August 1989 and again to one half of each plot on 16 September 1989. Spray volume was 152.5 gallons per acre. Prior to the first herbicide application prostrate spurge was evident in all the test plots.

RESULTS

Weed control was evaluated on a 1-9 scale, where 9 = no control of the weed species and 1 = no weeds present. Between 26 August and 1 September 3.9 inches of rain fell, flooding one replication. Many weeds in the untreated check plots were damaged or killed. As a result the average weed control ratings for the untreated check plots were lower than would be expected. It is probable that weed populations in the treated plots in this replication were also effected by the flooding. Prostrate spurge was best controlled where two applications of any herbicide were made (Table 1). In September, Turflon II Amine and Turflon D at 3 and 4 pt product/A provided better weed control than 2 pt product/A of the same herbicides. The best control was observed with Turflon D at 3 and 4 pt product/A. Confront, Trimec, Turflon II Amine and Turflon D at 2 pt product/A provided fair to good control. By October there was no difference in weed control among the herbicides and herbicide rates. There was no significant interaction between herbicide treatments and number of herbicide applications on any of the rating dates.

Table 1. The evaluation of several postemergence herbicides for control of prostrate spurge in a Kentucky bluegrass turf[1].

Herbicide	Rate pt cf/A	Weed Control[2] 9/11	9/29	10/12
Turflon II Amine	2.0	4.0bc	4.5bc	2.8b
Turflon II Amine	3.0	3.3cd	3.5cd	2.2b
Turflon II Amine	4.0	3.3cd	3.3d	2.7b
Turflon D	2.0	3.7cd	4.8b	2.2b
Turflon D	3.0	3.5cd	3.0de	2.8b
Turflon D	4.0	2.5d	2.0e	1.5b
Confront (XRM-5085)	2.0	5.2b	4.5bc	2.8b
Trimec	3.0	3.7cd	3.5cd	2.2b
Trimec	4.0	3.3cd	3.8b-d	3.0b
untreated check	--	7.0a	7.5a	5.7a
$LSD_{0.05}$		1.3	1.1	1.5

Number of Applications	Weed Control[2] 9/11	9/29	10/12
one application	--	3.8a	3.3a
two applications	--	4.3a	2.3b
$LSD_{0.05}$		NS	0.3

[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.

Tolerance of Zoysiagrass to TURFLON D, TURFLON II Amine, XRM-5085, and XRM-3972

Kenneth L. Diesburg

PURPOSE

Determine the phytotoxicity of the titled compounds to Zoysiagrass turf.

MATERIALS AND METHODS

An experiment was conducted at the Horticulture Research Center, Carbondale, on a Hosmer silt-loam soil with a mature 1 1/2 inch turf of Meyer Zoysiagrass from July 10 to October 3, 1989. Treatments were as follows:

TURFLON D	4, 8, 12 pt/A
TURFLON II Amine	3, 6, 9 pt/A
XRM-5085	2, 4, 6 pt/A
XRM-3972	2/3, 1 1/3, 2 pt/A
Nontreated Control	

The chemicals were sprayed-applied in a typical lawn care industry water volume of 3 gallons per 1000 square feet on 4 X 4 foot plots. The experimental design was a Randomized Complete Block with 4 replications. Turf quality ratings were taken the first few days after treatment, then periodically through summer and fall as turfgrass response was evident. Clipping weights were taken after the initial response to treatments and after the long-term response.

RESULTS

The data represented in Figures 1 and 2 indicate that the high and middle rates of XRM-5085, TURFLON D, and TURFLON II lowered turf quality within one day after treatment. This damage carried through to the tenth day after application for all these treatments except XRM-5085 at the medium rate (6 pt). Turf quality at that time was at an unacceptable level with these three compounds at their high rates as well as the medium rate of TURFLON D. The turf recovered from these initial effects within ten to 21 days after application. There were no apparent differences among treatments within 21 and 39 days after application. There were no significant differences among treatments for clipping weights taken 21 days after application. That sampling was apparently done too late to reflect the initial differences among treatments.

A long-term reduction in turf quality to unacceptable levels was seen 49 days after application from all rates of XRM-5085, the high rate of TURFLON II, and the medium and high rates of TURFLON D. The turf under those treatments was recovering 58 days after application, but the XRM-5085 high and low rate treatments still had significantly lower quality than that of the control. Conversely, all the TURFLON D, TURFLON II, and XRM-5085 treatments were causing higher turf quality than that of the control 85 days after treatment. Clipping weights taken 85 day after application were higher than the control with the XRM-3972 medium and high treatments, TURFLON D low and medium treatments, and TURFLON II high treatment.

XRM-3972 did not affect turf quality at any time except at 49 days after application when its low rate resulted in higher turf quality than that of the control.

DISCUSSION

The results of this experiment must be taken into seasonal context. The treatments were applied at a time of year when drought was beginning to become evident. The drought continued in southern Illinois through August. The Control line in Figures 1 and 2 indicates this stress in its lower quality ratings through July and August. This data is valuable in that it was conducted under conditions typical of most home zoysia lawns where little or no irrigation is done. The applicator can expect to get some initial discoloration from TURFLON D, TURFLON II, XRM-5085 at their medium rates, but nothing objectionable. There is enough damage done, however, if in the event the turf is subject to long-term drought stress, it will be slower to recover than nontreated turf. This slow recovery may not even be noticed by the casual observer.

Evaluation of Meyer zoysiagrass in response to Dow chemicals, 1989.

		Turf Quality Ratings[a]										Clipping		Color
		July						August		Sept	Oct	July	Oct	Sept
		10	11	12	14	20	31	18	28	6	3	31	3	6
												g	g	
Turflon D	4	8.9	9.6	8.3	8.5	6.3	6.8	5.0	5.0	8.8	5.8	32.74	64.00	8.0
Turflon D	8	9.0	8.9	6.8	7.0	5.5	6.8	5.5	4.3	8.0	6.5	30.80	68.65	8.0
Turflon D	12	8.7	8.6	6.8	6.5	5.5	5.5	5.3	4.3	7.8	6.8	22.09	49.78	8.5
Turflon II	3	8.9	8.9	8.3	8.3	6.8	6.3	5.5	5.3	7.3	5.0	15.13	51.17	7.0
Turflon II	6	8.8	8.8	7.5	7.3	6.0	7.8	5.5	5.0	8.0	6.3	30.53	47.92	7.5
Turflon II	9	9.0	8.9	6.3	6.8	5.8	6.3	5.0	4.5	8.0	6.3	16.67	62.22	8.8
XRM 5085	2	8.7	8.7	8.8	8.8	6.8	6.0	4.3	3.5	6.5	5.8	22.32	38.55	5.8
XRM 5085	4	8.9	9.0	8.3	8.0	6.5	6.8	5.3	4.0	7.0	6.8	29.51	45.20	7.3
XRM 5085	6	8.7	8.5	7.5	7.5	5.5	6.3	5.0	3.5	6.0	7.0	24.41	49.15	6.8
XRM 3972	2/3	9.0	9.0	9.0	9.0	7.3	6.5	5.8	7.8	8.5	4.0	22.90	58.50	6.3
XRM 3972	1 1/2	8.9	8.8	9.0	9.0	7.3	6.0	5.3	6.5	8.5	4.0	21.24	89.55	6.3
XRM 3972	2	8.9	8.8	9.0	9.0	7.8	7.3	5.5	7.3	8.5	3.5	36.22	76.75	6.3
Control		8.8	8.8	9.0	9.0	7.2	6.3	5.6	6.3	8.1	4.1	18.80	29.39	6.8
LSD (α=0.05)		7.9	0.3	1.0	0.9	1.1	2.1	1.8	1.3	1.2	1.0	19.07	32.60	1.6

[a]Turf Quality Ratings based on a scale of 1 to 9; 9 = best, 6 = unacceptable to professional turf, 5 = unacceptable to home turf.

[b]Color Ratings based on a scale of 1-9, 9 = darkest.

THE EVALUATION OF SINGLE APPLICATIONS OF PROGRASS APPLIED IN THE FALL

J. E. Haley and T. W. Fermanian

INTRODUCTION

Prograss (ethofumesate, Nor Am Chemical Company) has exhibited both pre and postemergence control of annual bluegrass (Poa annua) in established perennial ryegrass, Kentucky bluegrass and fairway-height creeping bentgrass. To make a significant impact on the annual bluegrass population multiple applications per season are usually needed. The purpose of this study was to evaluate the effect of single applications of Prograss on the annual bluegrass population in a mature perennial ryegrass turf.

MATERIALS AND METHODS

Prograss was applied at rates of 1.0 and 2.0 lbs ai/A on 26 October 1988. At this time P. annua populations ranged from 20% to 25% in all plots. Treatments were replicated 3 times and an untreated check was included with each replication. Prograss was applied at a spray volume of 40 gpa using a backpack sprayer.

RESULTS

In March both rates of Prograss significantly reduced weed populations (Table 1). Spring germination of annual bluegrass was apparent in all plots, however plots treated with the high rate of Prograss had 24% less P. annua cover than the untreated check.

Table 1. The evaluation of Prograss applied 26 October 1988 to an annual bluegrass - perennial ryegrass turf.[1]

	Rate	% Starting Cover with Poa annua	% Cover with Poa annua[2]	
	lb ai/A	10/26	3/29	5/05
Prograss	1.0	23.3	20.0b	75.0a
Prograss	2.0	20.0	15.0b	58.3b
check	---	21.7	60.0a	76.7a
$LSD_{0.05}$		NS	4.6	10.3

[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 cover with Poa annua represents a visual estimate of the plot area covered with annual bluegrass.

A STUDY OF NEMATODES ON BENTGRASS PUTTING GREENS IN NORTHERN AND CENTRAL ILLINOIS: PRELIMINARY RESULTS IN AN ONGOING STUDY

R.F.Davis, R.T.Kane, G.R.Noel, and H.T.Wilkinson[1]

INTRODUCTION

Nematodes are dynamic and perennial in their relationship with turfgrass. The nematode problems on creeping bentgrass greens in the midwest are believed to be severe at times and may cause chronic root damage yearly, but little research has been done on the nematodes of cool season turf grasses. The lack of knowledge about nematodes on cool season turf grasses in the midwest suggests that research on this subject would be useful.

The specific objectives of this research are the following: 1) to determine nematode population dynamics patterns in the top 5.0 cm of golf course putting green soil in central and northern Illinois for nematodes in the genera *Tylenchorhynchus* (stunt), *Helicotylenchus* (spiral), *Criconemella* (ring), and *Hoplolaimus* (lance) throughout the bentgrass growing season; 2) to determine the relationship between the populations of *Tylenchorhynchus*, *Helicotylenchus*, *Criconemella*, and *Hoplolaimus* and disease severity on bentgrass putting greens; and 3) to determine patterns in vertical distribution of nematodes in the top 5.0 cm of golf course putting green soils in central and northern Illinois.

Achieving the above objectives is of practical importance. This work should provide a more accurate, standardized sampling method which will enable advisory personnel to determine more accurately what nematode populations warrant treatment and during what time of the year nematicide application will be most effective.

METHODS

Field tests were conducted on two putting greens at each of two golf courses in the Chicago area and at the research turf farm on the University of Illinois in Urbana during 1989.

Each of the bentgrass greens in Chicago was divided into 20 3 ft x 10 ft plots. Markers were buried just off the greens so that the plots could be identified at later dates. In late May, the 10G formulation of phenamiphos (Nemacur, Mobay-Bayer Corp.) was applied to 10 plots on each green at the rate of 2.3 pounds of formulation/100 ft^2) while the other 10 plots were not treated. Soil samples for nematode evaluation were collected from each plot immediately before nematicide application, at the end of June, at the end of July, in early September, and in early November. Each sample consisted of approximately 20 soil cores (1.25 cm x 5.0 cm). Thatch and foliage were removed from each core and all cores were crushed and blended together. Nematodes were extracted using the centrifugation/sugar flotation technique from 50 cm^3 of soil. Root weights for each plot were also recorded.

The same treatments, procedures, and sampling dates were used for the 36 bentgrass plots (5 ft x 12 ft) on the turf farm. However, the cores taken from 12 of the plots were subdivided into a 0-2.5 cm depth section and a 2.5-5.0 cm

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depth section to study nematode stratification.

PRELIMINARY RESULTS

These results represent the data from the first year of a multi-year study.

Nematode counts were variable even on the same green. The three most common genera of plant-parasitic nematodes found were *Tylenchorhynchus*, *Helicotylenchus*, and *Criconemella*. *Hoplolaimus* was also found frequently, but in low numbers. Nematode populations appeared to have two peaks during the year. One occurred in the late spring or early summer, and the other occurred in the fall. Population declines ranged from slight to dramatic during the hottest part of the summer. The apparent peaks in nematode population coincide with known times of peak growth for the bentgrass.

Nematode populations in nematicide treated plots were lower after only 4 weeks and continued to decline throughout the summer. At the last sampling date in November, populations had not fully recovered to their initial levels.

Nematode damage was only observed on the turf farm during the early summer when the grass was under great water stress. Reduced root mass was observed in plots not treated with nematicide and which also had higher nematode numbers. When the water stress was relieved, the grass recovered and no further damage was observed.

Definite patterns in vertical stratification among nematode genera were observed. *Tylenchorhynchus*, *Helicotylenchus*, and *Criconemella* were recovered most frequently from the top 2.5 cm of soil. Most of the root mass was also found in the top 2.5 cm of soil. *Helicotylenchus* was the most highly stratified of these three genera. *Hoplolaimus* was usually more concentrated between 2.5 and 5.0 cm depths than between 0 and 2.5 cm depths. Except for the May sample, over 95% of the total root mass was found in the top 5.0 cm of soil.

SUMMARY

Results obtained during the first year of this project demonstrated that nematodes were associated with reduced root mass and that certain nematode species are restricted in their distribution within the soil profile.

Further research is needed to confirm these results and to allow for accurate conclusions that should lead to more standardized sampling procedures and timing, a better understanding of when nematicides may be helpful, and a more thorough understanding of the ecology of the four turf nematode genera being studied.

CHEMICAL EFFICACY TRIALS FOR THE CONTROL OF FUNGAL PATHOGENS IN TURFGRASSES

BY

Henry T. Wilkinson, M.C. Shurtleff and R.T. Kane, Department of Plant Pathology

INTRODUCTION

In a continuing effort to evaluate the efficacy of registered and experimental fungicides, a field evaluation program is conducted each season on the campus, Urbana. The goal of these trials are to provide both the turfgrass industrial firms and the state consumers with valuable information pertaining to what chemicals, rates, formulations and methods of application will provide satisfactory control of several turfgrass diseases.

You will find data in this section, describing numerous chemicals tested for control of several different diseases. You may also visually inspect the treatment areas during the annual Field Day. Should you have additional questions, give us a call.

RESULTS OF FUNGICIDE TREATMENTS FOR THE CONTROL OF DOLLAR SPOT AND BROWN PATCH: 1989

There were several treatments that resulted in excellent control of dollar spot. These included: 8, 10, 15-18, 23, 24, 29-32, 36, 37, 41, 42, and 44. Generally, a treatment producing a mean disease severity of 2% or less is considered excellent and acceptable. Control of 3-5% is very good but disease is still fairly obvious and above 5%, the disease severity is not acceptable to the golf or lawn industry. The treatments included in this trial combine timing and rate of application. For several of the compounds the timing and rate interacted, in some cases producing superior control and in others not resulting in a significant increase. For example, with the use of Banner the frequency of application appears to be more important than the application of 2 or 4 oz/M. In the case of Cyproconazole, the same situation appears to be true. It is recommended that the control program with the lowest total amount of chemical applied which still controls the disease would be the best. In addition, my research has shown that total required fungicide can be reduce in many cases by the combination with soluble nitrogen, tank mixed prior to application. This approach will be encouraged and included in the 1990 program. Please consider this treatment type in your planning.

Some general comments will assist you in interpreting the results completely. First, the fungicides were applied after the disease severity was about 30-35%. This allows me to assess the degree of therapeutic activity and the speed with which the grass recovers and the fungicide becomes effective. These data are more difficult to analyze and are not included in this report because no other pathological tests report that type of data. If you are interested in this, contact me and I will be glad to supply you with it and explain the analysis and interpretation. A second feature which I use is the assessment of turf quality and grass growth response. This is a visual assessment and it is subjective. Generally, I look for color, leaf width and leaf extension rates. In general, the simple chemical treatments do not dramatically affect these traits. It should be noted that Banner at the rate of 4 oz/M does darken up the grass and cause a more rapid rate of growth. The experimental compound, Cyproconazole also appears to have a positive effect on the color and growth of the grass. This compound has been evaluated in this regard only one year. The Cleary 123 treatment also produced a superior quality turf when compared to other treatments including Spectro 124.

Realize that the treatments are evaluated every 7 days, starting from the date of first application. The data that you are presented represents only the mean of the disease control achieved after the control program has been in effect for 28 days. The entire program is conducted until the untreated areas of turf start to improve naturally do to changes in the weather conditions. Finally, the effect of the previous year's treatments are assessed during the following spring to determine if there is any positive or negative carry-over in terms of disease pressure. This is most critical for treatments that include nitrogen.

Control of brown patch was conducted only using natural infestations and not artificially inoculated turf. The use of artificially inoculated turf is a better program and insures the receipt of results, but I was unable to accomplish this because there were insufficient funds to purchase the needed machinery to inoculate the turfgrass. Hopefully this item will be available during 1990. Based on the short appearance of brown patch during the 1989 season, only treatments 18 and 32 reduced the severity of brown patch. significantly while treatment 9 reduced the disease severity, but not to an acceptable level. All other treatments were not recorded as having a marked effect on brown patch, but due to the unequal distribution of the disease in the experimental turf, these results are tentative

Finally, none of the treatments proved to be toxic or reduce the growth of the grass. The treatments listed include several different formulations and it has been my observation that the efficacy of a fungicide will depend on the activity of the compound, the formulation, the rate, the timing, and the conditions under which it must operate. The important point is that the formulation can have a dramatic effect on the efficacy. I would also encourage you to consider this and include in your treatments different formulations for the purposes of determining in the field which has the lowest rate/control ratio. Again, those program that can reduce the total fungicide applied and still control the disease will be the best in my opinion.

TEST PARAMETERS (DOLLAR SPOT/BROWN PATCH)

APPLICATION DATES			
April 1	May 1	June 1	____

Start = Ang 1, then every 7, 14, 21, or 28 days.

1. Plot size: $(1.2 \times 1.5)m^2$
2. Soil type: Drummer Silt loam
3. % O.M.: 2.5
4. pH: 7.0
5. Type of Equip: Back-Pack sprayer
6. Nozzle Type: Brass, flat-fan
7. Nozzle Size: E101
8. Pressure Rate: 35 psi
9. Gals/Acre: 215
10. Ground Speed: 0.85 mph
11. Air Temp: 80-98 F
12. % RH: 70-95
13. Soil Temp: 79-93
14. Plant Stage of
    Growth at Applic: mid-summer - Fall
15. Disease, Weed, or
    Insect Stage of
    Growth at Applic: About 10-20% disease
16. Amount of First
    Rainfall after Applic: Plots receive about 1"/wk
17. Amount of Irrigation
    after Applic: See #16

DOLLAR SPOT AND BROWN PATCH TREATMENTS

TRT.NO	CHEMICAL CO.	FUNGICIDE	FORM/M (oz)	TIME
1.				
2.				
3.				
4.				
5.				
6.				
7.	RHONE-POULENC	26019	2	21
8.	CIBY-GEIGY	BANNER 1.1EC	2	14
9.	CIBA-GEIGY	BANNER 1.1EC	4	28
10.	CIBA-GEIGY	BANNER 1.1E	1	21
11.	RHONE-POULENC	26019	1	14
12.	CIBA-GEIGY	CGA-455	0.5	14
13.	CIBA-GEIGY	CGA-455	0.5	21
14.	CIBA-GEIGY	CGA-455	1	21
15.	CIBA-GEIGY	PACE	3.5	14
16.	CIBA-GEIGY	PACE	7	14
17.	ELANCO	RUBIGAN	1.5	14
18.	ELANCO	RUBIGAN + THIRAM	1.5 + 4	14
19.	ELANCO	THIRAM	4	14
20.	BASF	BAS 480	0.63	14
21.	BASF	BAS 480	1.25	14
22.	BASF	BAS 480	2.50	14
23.	SANDOZ	CYPROCONAZOLE	.13	21
24.	SANDOZ	CYPROCONAZOLE	.17	21
25.	SANDOZ	CYPROCONAZOLE	.17	28

DOLLAR SPOT AND BROWN PATCH TREATMENTS, CON'T

TRT.NO	CHEMICAL CO.	FUNGICIDE	FORM/M (oz)	TIME
26.	SANDOZ	CYPROCONAZOLE	.25	28
27.	SANDOZ	CYPROCONAZOLE	.17	28
28.	SANDOZ	CYPROCONAZOLE	.25	14
29.	SANDOZ	CYPROCONAZOLE	.25	21
30.	SANDOZ	CYPROCONAZOLE	.34	21
31.	FERMENTA	DAC 2787	3	14
32.	FERMENTA	DAC 2787	6	14
33.	FERMENTA	DAC 90DG	1.85	14
34.	FERMENTA	DAC 90DG	3.5	14
35.	FERMENTA	SDS 66518 (85%)	1.85	14
36.	FERMENTA	SDS 66608	5	14
37.	FERMENTA	SDS 66608	7.5	28
38.	FERMENTA	SDS 66811 (10%)	0.15	14
39.	FERMENTA	SDS 66811	0.3	21
40.	FERMENTA	SDS 66811	0.6	28
41.	W.A. CLEARY	CLEARY 123	3	7
42.	W.A. CLEARY	SPECTRO 124	4	7
43.	SANDOZ	SAN 832F	3	14
44.	SANDOZ	SAN 832F	4	14
45.	WATER	---	-	-

DOLLAR SPOT DATA SUMMARY - 1989

Treatment No.	Disease Severity X	Treatment No.	Disease Severity X
1		24	.3a
2		25	17c
3		26	7b
4		27	10c
5		28	13c
6		29	0a
7	10c	30	0a
8	0a	31	.6a
9	8b	32	2a
10	.3a	33	5b
11	7b	34	4b
12	17c	35	4b
13	15c	36	2a
14	4b	37	2a
15	2a	38	13c
16	6a	39	28d
17	2a	40	15c
18	2a	41	0a
19	7b	42	2a
20	15c	43	4b
21	7b	44	1a
22	7b	45	45e
23	0a		

The mean disease severity - the mean of disease severity ratings (percentage of area with disease symptoms) was calculated from observations made after all treatments had been applied for a 28 day period. Data for observations made on days 28, 35, 42, 49, and 56 were combined to produce the reported means. On each observation day, three replicated plots for each treatment were observed. Means followed by the same letter are not significanlty different (P - 0.05) according to Duncan's multiple range test.

SUMMER PATCH: Magnaporthe poae

Summer patch caused by Magnaporthe poae continues to be a very serious problem of bluegrass. Similar fungi also attack annual bluegrass and bentgrass. Much new information has been gathered in recent years including a better understanding of when the fungus causing this disease becomes active in the spring of the year. As one part of our attempt to develop a control program for summer patch, numerous chemical fungicides are being tested at different rates and using different schedules. A list of these fungicides is given below.

BACKGROUND INFORMATION:

1. Grass species: blend of Adelphi, Baron, Raml, Sydsport, Glade.

2. Height: 2 inches.

3. Nitrogen: 4 lbs/yr.

4. Irrigation: 1 inch/wk during growing season.

5. Fungicide treatments: irrigated 1/2 inch before and after; applied in 5 gal/M; areas = 3 x 10 ft; applied with backpack sprayer.

6. Disease ratings: turf examined weekly for the presence and size of summer patches.

7. All treatments were applied in April or when the soil temperature was about 68-70 F at the 2 inch depth.

TEST PARAMETERS (SUMMER PATCH)

	APPLICATION DATES			
	April 1	May 1	June 1	

1. Plot size: (1 x 3)m_2
2. Soil type: Drummer silt loam
3. % O.M.: 2.5
4. pH: 7.0
5. Type of Equip: Back-pack sprayer
6. Nozzle Type: Brass flat fan
7. Nozzle Size: E101
8. Pressure Rate: 35 psi
9. Gals/Acre: 215
10. Ground Speed: 0.85 mph
11. Air Temp: 55-85
12. % RH: 90-95
13. Soil Temp: 20-22 C at 2" deep
14. Plant Stage of
    Growth at Applic: Full green
15. Disease, Weed, or
    Insect Stage of
    Growth at Applic: No symptoms
16. Amount of First
    Rainfall after Applic: Plots received about 1" (2.5 cm) per wk
17. Amount of Irrigation
    after Applic: See #16

SUMMER PATCH TREATMENTS

TRT.NO	CHEMICAL CO.	FUNGICIDE	FORM/M (oz)	TIME
1.				
2.				
3.				
4.				
5.				
6.				
7.	RHONE-POULENC	26019	2	1X
8.	CIBA-GEIGY	BANNER 1.1E	4	1X
9.	CIBA-GEIGY	BANNER 1.1E	2	2X
10.	CIBA-GEIGY	BANNER 1.1E	2	14DAY
11.	ELANCO	RUBIGAN 1AS	2	3X
12.	ELANCO	RUBIGAN 1AS	3.75	3X
13.	ELANCO	RUBIGAN 1AS	4.0	3X
14.	SANDOZ	CYPROCONOZOLE	0.17	28DAY
15.	SANDOZ	CYPROCONOZOLE	.34	28DAY
16.	SANDOZ	CYPROCONOZOLE	.67	28DAY
17.	FERMENTA	SDS66791	3	14DAY
18.	FERMENTA	SDS66791	6	28DAY
19.	FERMENTA	SDS66811	4.2	14DAY
20.	FERMENTA	SDS66811	8.4	28DAY
21.	FERMENTA	SDS66811	16.8	28DAY
22.	MOBAY	LYNX 2F	2	28DAY
23.	MOBAY	LYNX 2F	4	1X
24.	MOBAY	BAYLETON 25T	4	1X
25.	NONE	NONE, WATER		28DAY

RESULTS ON THE TESTING OF FUNGICIDES FOR THE CONTROL OF SUMMER PATCH: 1989, FIELD

The disease severity in the experimental bluegrass nursery resulting from summer patch was less than 1% and proved to be insufficient for determining the efficacy of the treatments applied. None of the treatments were toxic and non were observed to affect the quality of the turf in either a negative or positive direction. It is anticipated that artificial inoculum will be used during the 1990 tests, but the addition of artificial inoculum does not insure the development of disease. Considerably more results will be generated by the companion laboratory and growth chamber study of chemical control of the patch causing fungi. The results of this trial have been made available to those organizations supporting the project. The next update will be in January, 1990

RELATING THE TURFGRASS GROWTH AND DISEASE DEVELOPMENT

By

Professor H.T. Wilkinson

University of Illinois, Urbana-Champaign, IL

The science of turfgrass pathology has been developing rapidly during the past ten years. Our understanding of which microorganisms cause disease in turfgrass has progressed significantly. All the answers are not in hand, but the future is very exciting. Turfgrasses represent a wide range of different plants that have basic genetic differences. Some of the grass plants produce rhizomes and some do not. Some grow only in temperatures above freezing and some can grow or remain green at temperatures below freezing. If we look at a single species of turfgrass plant, we can also see a remarkable ability to adapt. Most cool season grass species are hormonally controlled. That is, they respond to their environment by producing various hormones (growth regulating chemicals). The environment is not the only parameter that plants respond to. They also respond to fertilizers and stress. The growth and performance a turf can be dramatically affected by both of these. In particular, stress can have both direct and indirect effect on turfgrass. For example, compaction and drought can affect the ability of a grass plant to produce roots, absorb moisture and maintain a thick sward. Indirectly, poor root growth can predispose a plant to attack by pathogens, which is another form of stress. In general, pathogens are considered to have a stressing effect on turfgrass. Some pathogens can only attack grass that is experiencing stress, while others can attack an unstressed plant. In general, however, the attack by pathogens is coordinated with the growth of the grass plant. If we understand how the grass plant grows and how this growth responds to the environment, we will have a better understanding of how and why pathogens will attack that plant.

First, I want to discuss the nature of the grass plant and point out some of the important characteristics concerning its' growth. I will, for the most part, use Kentucky bluegrass as an example. Similarly, comparisons could be made for other cool seasons grasses and warm season grasses. **What is Turfgrass???** Turfgrass is a perennial population of biannual plants. It is also a dense population of dynamic vegetative plants. What these statements tell us, is that the plants that make up your turf only live about 12-18 months before they are replaced with new plants or plantlets. This is very important because it means that most of the plants are young in a turf. There are not 100 year old plants in a turf even if the sward has been around for a century. There are thousands of grass plants in a square meter of turf and they grow vegetatively. This is very important for two reasons: i) the high density of turf insulates the soil surface and reduces fluctuations in temperature and moisture that would normally occur if the soil were exposed; and ii) the plants being so close together offer a pathogen or insect a very short distance for their next meal. Another point to consider, is that close mowing of turfgrass species has a dramatic effect on the root growth and soil-borne turfgrass diseases. It is very important to understand, that in the United States, there are about 4 distinct grass climatic regions and the state of Michigan is located in the Northeast region which is characterized by cool, humid conditions. There is also a transitional, climatic zone, but this is not found in your state. Considering bluegrass, if we were to construct a map of a bluegrass plant it would look like a network of highways and roads. The roads and highways would represent the roots and rhizomes and so on. The fact that the grass plant grows in a connected pattern is important when considering how soil-borne pathogens spread. A very useful model describing the grow of bluegrass is presented in figure one. This model breaks down the growth of a bluegrass plant by its' different tissues. With this very brief description of how grass grows, I want to focus your attention on disease development and management in turfgrass ecosystems.

Disease can be thought of as an imbalance in the turfgrass ecology. Generally, when your turf is without disease, all the microorganisms that live in your turf are in biological balance, but occasionally a microorganism will aggressively attack the grass plants and you will see the symptoms of disease on your turf. This represents an imbalanced system. The goal of a **DISEASE MANAGEMENT STRATEGY** is to balance pathogens in the turf. Disease is cosmopolitan and should be managed and not simply eliminated. Remember that disease is caused by microorganisms that live naturally in your turf and eliminating them would only imbalance your turf and likely result in other problems including disease.

I have presented a disease management strategy flow chart for you to examine (fig.2). I will only point out the highlights of each stage in this strategy. <u>Grass requires no management system unless you want it to perform in ways that are unnatural.</u> Most of the grass on a golf course is managed for example, but the grass in a pasture or road side receives on the very minimum of management. Unmanaged lawns very seldom develop severe disease. It is necessary therefore, that the quality and purpose of the turf be decided before the management program is determine. This is mentioned, because it will be the effects of the management program that ultimately will determine how the grass grows and which diseases are likely to be a problem. <u>The selection of the appropriate grass.</u> This is the most important step in minimizing stress and disease. Unfortunately, most of superintendents do not have the luxury of choosing the grass varieties that are planted on their course. The growth type, stress tolerance, disease resistance and so on differ among grass genera, species and varieties. <u>Generally, it is the bottom of the plant that should be emphasized.</u> Simply put, you sell the leaves: you mange the roots. The roots and rhizomes of a grass plant are the survival and recovery mechanisms. In the management of the golf course, it is a constant struggle to maintain proper root mass and a quality surface to play on. Too often the performance of the surface quality is given priority over the roots and rhizomes. However, by understanding when the roots and rhizomes will grow and how to encourage them, you can achieve a balance between leaf quality and root health. <u>Determine the critical stress periods.</u> Each of you should have an understanding of when the periods of critical stress are for the turfs you manage. When do drought, heat, compaction occur during the growing season? This can be different for each area on the golf course. I have observed many courses where humidity and heat stress were great on one hole, but absent on another, yet both were managed the same. <u>Understand the cultural practices available.</u> The proper use of cultural practices is the second best weapon a golf course superintendent has for reducing disease. In general, turfs that are vigorously growing and have a substantial root and rhizome mass will tolerate more disease and recover faster from stress. Of utmost importance is that you make changes in your cultural management program gradually. Do not shock the turf by abruptly changing the watering, cutting height, fertilizer and so on. This type of shock can imbalance the turf, allow disease to develop or even kill the grass. The last stage in the management strategy is <u>the application of chemicals for disease control.</u> This should be the last resort. While chemical pesticides are often necessary, the proper attention given to the other management strategies just described should reduce your <u>chemical dependency.</u>

For the remainder of this discussion, I would like to focus on how you can more effectively understand and manage disease if you will also think about the growth activities of the grass plant. The disease, yellow ring in Kentucky bluegrass appears when the turf develops too much thatch too rapidly and both the soil moisture and the temperature are high. The pathogen, which normally does not attack the grass plant, is allowed to grow so rapidly that it colonizes both dead and living tissues in the grass. The solution is to manage the growth rate of the turf to avoid rapid, excessive development of thatch in the mid-summer.

The patch diseases that develop in numerous turfs are very closely associated with the growth and activities of the grass plant. A patch disease is an epidemic in turf which means that many plants in one area of the turf are affected. There are at least five significant patch diseases that develop in the northeast climatic region. Presently, research has identified some of the pathogens that cause these diseases. More interestingly, is the nature of the development of these fungi on the grass plants. Summer patch and Poa patch (summer patch of <u>P.</u> <u>annua</u>) are two diseases with similar, but not identical developmental patterns. Both diseases are caused by a fungus that grows on the outside of the roots and rhizomes and can survive in the turf for many years. This means that the fungus can grow along the network of roots and rhizome "roads." The curious feature about this fungus is that is grows best on the roots and rhizomes when the plant is also growing well. This fungus is so closely associated with the grass plant in that it can only survive if the grass plant survives. In fact, the fungus starts to actively grow on the grass plant in the early Spring when the soil temperature is about 18-20 C and the soil is wet. You will realize that this is months before you will see symptoms of either summer patch or <u>Poa</u> patch. By understanding this synchrony between the fungus and the plant, you can appreciate that control of the disease needs to start in early spring or maybe even the previous fall. You can estimate when the fungus will be attacking the grass plant by determining when the roots and rhizomes are growing from Fig. 1. The disease take-all patch is caused by another soil-borne fungus, but again requires a living turf plant to grow best. The difference is that this fungus can grow very well on a grass plant when the soil temperature is about 12-15 C and soil moisture is high. This means that just about the time the roots are starting their spring growth, the fungus is also starting.

As we learn more through pathological research, it will be possible to understand the relationship between the growth of the pathogen and that of the plant. To achieve a lasting, disease free turf, a balanced turfgrass ecosystem must be established and maintained.

FIG. 1.

Poa pratensis Development

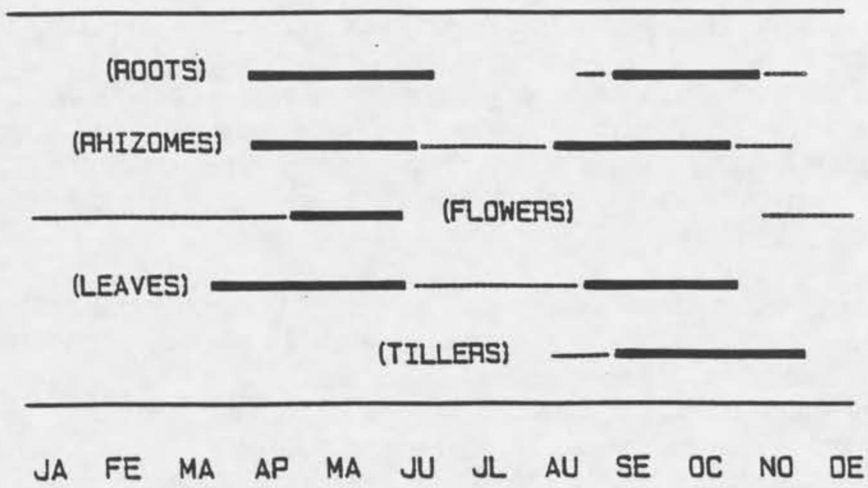

FIG. 2.

TURFGRASS DISEASE MANAGEMENT STRATEGY

DETERMINE: QUALITY / PURPOSE OF TURF

↓

SELECT: MOST APPROPRIATE GRASS

↓

MANAGE: THE BOTTOM OF THE PLANT

↓

IDENTIFY: CRITICAL STRESS PERIODS

↓

APPLY: CULTURAL PRACTICES

↓

APPLY: CHEMICAL CONTROLS

BIOLOGICAL CONTROL IN TURFGRASS

BY HENRY T. WILKINSON, UNIVERSITY OF ILLINOIS

Biological control simply defined means, the control of one biological organism by another biological organism. Biological control can refer to management of weeds, insects and pathogens. There are different classes of biological control. Plants that have resistance could be considered as a biological control agent of insects and pathogens, but generally biological control is thought of as control of a problematic insect or pathogen by a third organism, not by the plant that it is attacking. I would like to center my comments on this form of biological control and focus my examples on the biological control of pathogens, namely fungi, that attack grass plants. The grass plant represents one organism, the pathogen the second and the biological control agent a third. It is very important to realize that biological control involves three organisms. Control of pathogens using chemicals, that have no organisms present, such as fungicides, plant extracts, soil extracts, or organic matter is not considered biological control.

Biological control is a natural process that goes on continuously in all life systems. It can be said, that for every pathogen that attacks grass, there exists one or more organisms that will control that pathogen. It could be asked, if biological control is a rule of nature, why are not more used to manage the pathogens that attack grass? To answer this, it is important to understand that most natural biological controls act slowly and build up with time. They are delicate balances, that are slow to develop and can be rapidly destroyed by sudden changes in the plant ecosystem. Secondly, natural biological controls are generally not 100 precent effective as controls. They do not eliminate disease, they insure that it does not get out-of-hand. In that context, I would suggest that the goal of biological control would be to manage disease to an acceptably low level and not attempt to eliminate it.

There are several approaches to developing biological controls and all of them require extensive testing and research. There are no short cuts in this process. It might be asked why biological controls have not been developed sooner? The main reason is that they cost a tremendous amount to develop and even so, there is no guarantee that they will be completely successful. Secondly, it has been easier and successful to develop chemical fungicides to control most of the turf pathogens. If so, why does the idea of biological control continue to increase in popularity? The answer is they are safe and natural. Because biological control is a natural process and adds no toxic fungicides to the environment, they are very attractive. In addition, certain soil-borne pathogens have not been controlled satisfactorily with fungicides. More and more the public is asking questions about the use of pesticides and is demanding to develop alternate, less toxic solutions to controlling pathogens. Turfgrass is the closest and most extensively grown plant type close to the masses of people in the world. Because it is not consumed as a food stuff, we have not considered the pesticides, that have applied to it, as potentially threatening, until lately. I do not believe that we can even estimate what the possible impact of applying all kinds of fertilizers and pesticides to urban turf has had on the quality of our environment and in particular our water supplies.

I believe that the goal of biologists in studying biological control of turfgrass pathogens should be to develop natural biological control agents and try and determine how and why they control pathogens. Research at the University of Illinois has focussed on two diseases to study: high temperature Pythium blight; and patch diseases. Some success has been achieved for both, but much more research is needed to develop practical applications for the turf industry.

Pythium blight (high temperature) is a foliar disease caused by Pythium species that live naturally in the turf. This disease is generally a problem on intensely managed turfgrass when conditions of very humid and high air temperature persist for numerous hours. The disease can move up a grass plant and kill it in a matter of hours. Thousands of square feet of creeping bentgrass on a golf green can be destroyed in a matter of hours under the correct conditions. The pathogen lives naturally in the soil and can not, nor should not be eliminated. It, like many other fungi in the soil, is also beneficial in destroying dead plant debris that contributes to thatch. The living leaves are the main target for attack by the pathogen, therefore, the biological control agent must protect the leaves. Many bacteria naturally live on leaves. Nearly all of them are beneficial and cause no damage. Some of these bacteria are antagonistic to fungi and therefore beneficial for disease control. Using methods in the laboratory, the antagonistic bacteria can be identified. It can also be determined which fungi they will cause to grow slower i.e., antagonize. Once these bacteria are identified, they are prepared, using special techniques, and then applied in water to the surfaces of grass leaves. The pathogen is in the turf at the soil surface and if the bacteria are useful as biological control agents, the pathogen will not be able to grow up onto the leaves and/or kill the grass plant. Using this process, bacteria have been identified that are pretty good at slowing down the pathogen, but they are not 100 percent effective. First, they do not stop the pathogen or kill it, but merely slow it down. Secondly, they only slow the pathogen down for about 24 hr and then the pathogen continues to kill the grass leaves. Third, the bacteria do not survive on the plant leaf surface in high enough numbers to continue fighting the fungi for days. More research is needed to determine why these bacteria are not completely successful and to identify other bacteria which will have these other properties which would insure greater biological control of Pythium blight.

The second type of disease that has been researched at our University is the patch. The diseases referred to as take-all patch and summer patch have, what appears to be, natural biological control agents associated with their development. It has been observed that if these patches are allowed to remain in a turf for a period of 5-10 years, they will eventually disappear. It is suspected that natural biological agents are the cause for their disappearance. Research has tried to isolate and identify the natural agents responsible for the pathogen control. The typical appearance of either of these diseases is a "frog-eye." This is not always the case, but is fairly common. The patches, when they appear as "frog-eyes" are probably 3-4 years old or older. Generally, these diseases start out as a single plant and then the pathogen spreads from plant to plant by growing along the roots and rhizomes. It is suspected, that as the fungus is growing, certain bacteria and possibly other organisms respond to the pathogen by increasing their number on the root or rhizome where the pathogen is attacking. Gradually, the bacteria keep increasing their number and moving along the roots and rhizomes themselves. These bacteria are probably slowing down the growth of the pathogen, but not killing it. Eventually, the bacteria catch up to the advancing pathogen (the outside of the "frog-eye") and as a result, the disease appears to disappear. The process that I have described can take many years to develop naturally. The goal of research is to develop a method to put this natural biological control process into effect during the first year the grass is attacked. If successful, the disease would be controlled much sooner than it would be if simply left to natural processes. It sounds like a simple process and should be easily achieved, but it is not. In fact, if the requirements for success are listed, one can easily understand why research in biological control requires much time and resources. To achieve the biological control of a patch disease pathogen, it is necessary to have a microorganism that can be grown in a laboratory, stored at room temperature and be easily applied to mature turf in such a way that it will be able to grow onto the roots and rhizomes. Once on the roots and rhizomes, the bacteria must survive, grow in the soil, and be able to respond to the pathogen by growing even faster. While growing faster, the bacteria must, in some way, slow down the growth of the pathogen enough to reduce the severity of the disease but not eliminate the pathogen. Oh yes, the bacteria must not harm the turfgrass plant or cause a disease themself. It should be obvious, that these special bacteria are not going to be easily found or developed for practical use. But things are not hopeless. Using special techniques, persistence, and faith that they do indeed exist, bacteria have been found with a lot of these traits. Some have been found from the root and rhizomes of grass roots. They are able to biologically control summer patch and take-all patch in tests. At the present they are more effective on young grass seedlings and the art and science of getting them onto the roots of mature turf is not developed yet. Another problem is that they are not 100 percent effective, but they are not expected to be. Bacteria are generally insensitive to most fungicides. Presently, research is considering their initial use in combination with low levels of fungicides. As research continues, better and more effective bacteria may be identified that will reduce and potentially eliminate the need for fungicides for a particular patch disease.

The future for biological control of turfgrass pathogens should be bright. It is a perennial crop, which means, that once established, biological control agents stand a good chance of surviving. Turfgrass is an intensely managed plant community and therefore, management practices that assist the biological control agents can be implemented fairly easily. Research and time are the ingredients that will breed the successful development of practical biological controls for turfgrass diseases. In the not to distant future, biotechnology could also assist in development of biological control agents, but these are not going to be truly natural microorganisms. Their use is uncertain at this time.

RELATING TURF GROWTH TO DISEASE CONTROL

By

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University of Illinois, Urbana-Champaign, IL

The proper establishment and maintenance of grass only important in producing a high quality turf, but is also essential if a lawn is to reduce the threat of disease. I will use the processes of sod transplantation and maintenance to illustrate the relatedness of proper establishment to the reduction of stress in a turf. Much of what I will say also relates to the establishment of a lawn from seed, as well. The sodding process is different from that of seeding because a living plant is being transplanted. Consider for a moment the idea, that if handled properly, the life and quality of sod can be extended in terms of a longer lasting lawn with less disease, when the sod is grown over a broader range of soils.

Sod establishment can be divided into three phases: i) sod production; ii) sod bed preparation; and iii) post transplant management. The selection of the grass specie to be used is the most critical decision that is made in turf establishment. At no other time will there be as much control over characteristics such as spring greenup, disease resistance, leaf texture, vigor of growth, density, or survival. In addition, the decision of blending or mixing can be made. For both seed and sod, the selection of the grass species or varieties is very important and should be considered very carefully. Also, the geographic location and purpose of the turf should be considered in selecting the seed, for the general quality of a turf will change with the season, i.e. one variety may be of higher quality in April, but lower quality in July. For example, the bluegrass I-13 is of greater quality in April than in July while variety Adelphi is about the same during both months. Likewise, the response of bluegrass, in terms of quality, to the level of maintenance can vary among bluegrass varieties. For example, the quality of Adelphi will significantly increase if the rate of nitrogen is increased from 2 lbs/M/yr to 4 lbs/M/yr. Even more important are the differences in rooting among the different varieties. The variety Parade produces many more shoots than roots compared to the variety Touchdown (data from the University of Iowa, N. Christians).

The establishment of a sod is a very important process and if done poorly can cause many problems, including disease development, to plague a lawn for years to come. In the state of Illinois, the most important problems that develop in turf are those that reduce the vigor of the root system. Stresses such as drought, poor or compacted soils, reduce interfacing and inappropriate management cause weak root development. A poor root system will lead to stress and possibly disease. Diseases that attack the roots and rhizomes are the most destructive, because these structure are the recovery and survival mechanisms of the grass plant. Several important questions can be asked concerning the development of proper root system. How does the sod-soil affect interfacing? How does the sod age affect rooting? Can core aerifying of the sod bed increase the rooting of sod? Does fertilization of the sod bed soil increase interfacing?

The soil under a turf can determine the type of grass that will do well as a lawn. Soils heavy in clay generally support less dense lawns, show more stress and more disease. Unfortunately, many lawns are established on these poor soils. In the case of sod, the sod-soil is generally an excellent soil and often of a different textural class than the sod-bed soil. This presents the possibility of developing an interfacing problem. Interfacing refers to the process of two different soil layers coming together and acting as one layer. The greater the difference in the texture, drainage and organic matter between the two layers, the poorer the chance they will interface. In Illinois, sod soils can range from silty clays to peat soils. This range of soil types combined with the range of sod bed soils found in the state present a challenge to the turf industry to establish and maintain high quality lawns.

What sod should be used, "peat" or "mineral," and does the age of the sod affect establishment? Research has shown us that the most important characteristic of a sod, in terms of interfacing, is the age of the sod. The optimization of this factor will generally be more important than interfacing problems. This is good news, because the age of the sod can be managed. In fact, one-year-old peat sod established stronger roots than did mineral sod, but both significantly out performed three-year-old sod. The method used to establish how strongly a sod roots is that of pull-strength. The actual force (lbs/square foot) are measured. The sod bed soil will have an effect on the rooting but only during the early months of establishment. A clay soil will retard the establishment of sod compared to a silt soil. This is not surprising, but generally this problem is not seen after 12 months. The first 6 weeks following the laying of sod appear to be critical in the proper establishment. Special care should be given during this period. I would again state that the age of the sod is the most important parameter in terms of root establishment and sod that is about 12-18 months old is the best in terms of rooting and handling.

The second phase of establishing a lawn for optimal performance is the sod bed preparation. Are soil preparations necessary for this? They are very important and often overlooked or underestimated. During the preparation of a site you should consider the soil type, soil cultivation, soil moisture and heat, previous vegetation and the geographic location of your area. I will not discuss all of these, but instead introduce you to some new ideas relating to this subject. Again, the importance of root establishment can not be emphasized too much. To improve the interfacing of sod into poor soils, the surface area under the sod was increased. When sod is laid, it is placed on a flat surface. Therefore, each square foot of sod must root into only one square foot of soil. If we core aerify a soil with 1/2 inch tines on two inch centers, the surface area of the soil is increased more than 2 times. This could offer a greater opportunity for roots to establish. It was found that this difference was realized even after 12 months from the time of laying the sod. In both poor soils and in good soils, the coring improved the quality of the sod, but the root strengths were not equal. In good soils, the cores improved the root strength, but in poor soils there was an initial period where the root strength appear weaker than uncored soil. However, after 12 months both the quality and the strength of roots in poor soils that were cored were greater than uncored.

Does a sod need nitrogen incorporated into the sod bed soil for optimal establishment? In poor soils, the rooting strength can be increased by the incorporation of nitrogen, but not in all cases. For example, during the first four weeks following sod establishment, only urea improved the rooting while slow-release forms did not improve the rooting significantly. After 12 months, the slow-release forms of nitrogen improved the rooting in poor soils. Generally, in good quality soils the use of nitrogen is less important than the sod age or soil preparation.

The final phase of sod establishment is that of post transplant management. There are two important periods to consider: short term management and long term management. Short term management is that period of time (6-12 weeks) immediately following the transplanting of the sod. During this time, the root and rhizome activities are paramount to the success of the sod. Excessive heat and limited moisture are the two main threats during this process. It is very important during this period that the sod be watered deep and the sod cooled. It is not advisable to apply fertilizer or pesticides to the top of a newly sodded lawn until after the critical period. The length of this period will vary depending on the climatic condition and the quality of the sod bed. The long term management is what most of you do for a living. I will not comment on this topic today except to point out that lawns are dynamic and change with time. A newly established lawn (one or two years) is not the same as lawn that is 5-10-years-old. Lawns must be rejuvenated if they are to continue to grow and maintain the optimal root and rhizome mass. Lawns that have excellent roots and rhizomes will tolerate more stress and develop less disease.

1989 NATIVE GRASS DEMONSTRATION

T. B. Voigt

INTRODUCTION

Native grasses and forbs once covered many acres of Illinois prairie. At one time the vegetation was used for hay production or pasturing livestock. Beginning in the 1800s much of the native plantings were replaced by imported grass and legume species which were considered to be more tolerant of grazing or hay production pressures. Presently, however, the use of native grasses in ornamental plantings, conservation plantings, erosion control, and low maintenance landscapes is increasing. Since 1988, the University of Illinois Department of Horticulture has been examining several native grasses to determine their potential for use as ornamental plants by examining their winter survival rates, growth habit, diameter, height, and potential for use in ornamental plantings .

MATERIALS AND METHODS

Seventeen native grasses were planted in May, 1988, into Flanagan silt loam prepared by rototilling. Ten 2.25 inch plugs of each species were planted three feet apart within rows. The planting rows were spaced six feet apart. There was no randomization in the plot design. Irrigation was supplied during the first growing season to insure establishment. Weeds were controlled mechanically. During the 1989 growing season mechanical weed control was the sole cultural activity.

OBSERVATIONS

Table 1 lists plants in the demonstration, as well as their survival rates, growth habits, rate of lateral spread, and height. For the purpose of this study, survival rate is defined as a percentage of the original planting to survive the winter and grow during the 1989 growing season. Growth habits are bunch-type or rhizomatous. In ornamental plantings, aggressive spreaders such as vanilla grass may become a nuisance. Diameter is the current range of diameters of each species in inches. This also indicates the amount of lateral growth that has occurred during two growing seasons by each 2.25 inch plug. Height is reported as range of heights within each species measured from the ground to the top of inflorescences.

Several species show potential for use in ornamental plantings. Big bluestem, bluejoint grass, purple lovegrass, Junegrass, switchgrass, prairie dropseed, Indiangrass, and tufted hairgrass all seem to have characteristics that would suggest use in ornamental plantings. Collection of data on these plants will continue; consult future Illinois Research Reports for more complete recommendations.

Table 1. Native grasses in demonstration.

	Survival Rate (%)[1]	Growth Habit[2]	Diameter (in inches)[3]	Height (in feet)[4]
Big Bluestem *Andropogon gerardii*	100	R	18-24	6-7
Sand Bluestem *Andropogon hallii*	90	R	18-30	6-7
Side Oats Grama *Bouteloua curtipendula*	90	R	12-18	2-3
Blue Grama *Bouteloua gracillis*	90	BT	8-18	1.5
Prairie Brome *Bromus kalmii*	10	BT	NA	1-2
Bluejoint Grass *Calamagrostis canadensis*	100	R	18-30	4-5
Tufted Hairgrass *Deschampsia ceaspitosa*	70	BT	12-24	2-3
Nodding Wild Rye *Elymus canadensis*	100	BT	18-30	2-4
Purple Lovegrass *Eragrostis spectabilis*	100	BT	8-15	1-1.5
Vanilla Grass *Hierochloe odorata*	100	R	2-3	1-2
Bottlebrush Grass *Hystrix patula*	90	BT	8-15	2.5-3.5
Junegrass *Koeleria cristata*	100	BT	8-15	1-2
Switchgrass *Panicum virgatum*	100	R	20-30	4-5
Indiangrass *Sorghastrum nutans*	100	R	15-20	6-7
Cordgrass *Spartina pectinatus*	100	R	12-20	5-6
Prairie Dropseed *Sporabolus heterolepsis*	100	BT	8-15	2-3
Porcupine Grass *Stipa spartea*	80	BT	8-15	2-3

[1] Percentage of the original planting to survive winter
[2] BT= bunch-type, R=rhizomatous
[3] Range of diameters of each species in inches.
[4] Range of heights within each species to the top of inflorescences.

1989 PERENNIAL WILDFLOWER EVALUATION RESULTS

T. B. Voigt

INTRODUCTION

There is much current interest in wildflower culture and use. These plants are presently grown in landscape plantings, low maintenance plantings, natural gardens, roadsides, industrial settings, commercial sites, and golf course rough areas. When combined with native grasses, perennial wildflowers create a permanent, evolving plant mix that is relatively inexpensive to purchase and establish, controls erosion, and has high visual impact and interest.

Turf Seed, Inc., Hubbard, Oregon, sponsored a national trial to evaluate the suitability of twenty-five perennial wildflowers to a wide range of climates, soils, and geographic areas. The 1989 evaluation is the second of a two-year study begun in 1988. The addition of eighteen native perennial wildflowers is new to this year's evaluation.

MATERIALS AND METHODS

Twenty-five perennials were broadcast seeded 20 April 1988, into 2' x 5' plots, each replicated twice. Prior to seeding, the area was rototilled and lightly rolled to insure a firm seed bed. After planting into the Flanagan silt loam soil, the plots were rolled a second time to achieve good soil-to-seed contact. Each plot (except those planted with purple coneflower, yellow prairie coneflower, and Roman chamomile) was planted at a rate of 200 g seed/1000 sq ft. The plots of purple coneflower were planted at a rate of 350 g seed/1000 sq ft. The yellow prairie coneflower and Roman chamomile plots were planted at a rate of 400 g seed/1000 sq ft. During the initial growing season, the plots were irrigated and hand-weeded as necessary. No fertilizers, mulches, or herbicides were used. During the 1989 growing season, the study received little maintenance; the plots were not irrigated, fertilized, nor treated with pesticides.

The additional wildflowers evaluated in 1989 were planted in June, 1988 using 2.25 inch square plugs. Ten of each species were lined out on three foot spacings with ten feet between rows. Following planting, the area was irrigated and mechanically weeded as necessary. During the 1989 growing season, the sole cultural activity to these plants was mechanical weeding.

OBSERVATIONS

Plants in this study were evaluated for survivability, approximate flowering period, and problems such as weed competition, diseases, or aggressive tendencies.

<u>Survival</u>—In this study, a species was considered to have survived if any individual plant of a species flowered during the 1989 growing season. Survivability for both plant groups generally appeared to be good (Table 1). In Group 1, only the creeping zinnia failed to survive, and in Group 2, cream wild indigo, shooting star, rattlesnake master, and rough blazing did not survive. Lack

of survival could be attributed to post-planting care or competition from weeds and/or other plants in the evaluation.

Approximate Flowering Period—The flowering period is the time from onset of blooming to bloom completion for each species. Siberian wallflower, blue flax, small burnet, lead plant, prairie coreopsis, and prairie dock showed some, sporadic flowering following the listed dates.

Problems—In Group 1, weed competition during the second season was reduced due to the increased development of most wildflowers in the evaluation. In fact, several species in this group appeared to be quite aggressive and may present problems in a normal garden setting. Aggressive plants included dames rocket, lance-leaved coreopsis, Roman chamomile, and both yarrows. Additionally, snow in summer, dwarf columbine, Rocky Mountain penstemon, Johnny jump-up, and the maiden pinks appeared unable to compete with larger, more aggressive plants in the trial. Evaluating weed competition in the Group 2 planting was not appropriate due to the spacings between plants in the rows and between rows. Several of the plants in this group may have the potential to be rampant, but more evaluation is needed to verify this. There were no insect pest problems noticed in either planting. Only smooth aster and wild bergamot appeared to have been attacked by disease; both appeared to have powdery mildew on their foliage. This appeared in midsummer. A final problem was lodging due to wind and rain. Dwarf lance-leaved coreopsis and both asters appeared to be most prone to this.

Table 1. Perennial wildflower survival, approximate flowering period, number of days in flower during 1989 growing season.

	SURVIVAL	FLOWERING PERIOD Start	End	# of Days
GROUP 1				
White Yarrow <u>Achillea millefolium</u>	yes	5/31	10/6	37
Red Yarrow <u>A. m. rubra</u>	yes	6/14	10/6	115
Roman Chamomile <u>Anthemis</u> sp.	yes	6/14	9/7	87
Dwarf Columbine <u>Aquilegia vulgaris</u>	yes	5/24	6/6	14
Snow-in-Summer <u>Cerastium biebersteinii</u>	yes	5/12	6/6	26
Siberian Wallflower <u>Cheiranthus allionii</u>	yes	5/12	6/6	26
English Wallflower <u>C. cheiri</u>	yes	5/12	5/24	12
Dwarf Lance-Leaved Coreopsis <u>Coreopsis lanceolata</u>	yes	6/6	10/6	123
Sweet William <u>Dianthus barbatus</u>	yes	5/24	9/7	107
Maiden Pinks <u>Dianthus deltoides</u>	yes	5/24	7/12	50
Purple Coneflower <u>Echinacea purpurea</u>	yes	6/28	8/7	41
Dames Rocket <u>Hesperis matronalis</u>	yes	5/12	6/6	26
Gilia <u>Ipomopsis rubra</u>	yes	6/28	10/6	101
Blue Flax <u>Linum perenne lewisii</u>	yes	5/12	6/6	26
Forget-Me-Not <u>Myosotis sylvatica</u>	yes	5/12	5/24	12
Tall Evening Primrose <u>Oenothera lamarkiana</u>	yes	6/14	8/30	78
Missouri Primrose <u>O. missouriensis</u>	yes	6/6	6/14	8
Rocky Mountain Penstemon <u>Penstemon strictus</u>	yes	5/31	6/21	22
Prairie Coneflower <u>Ratibida columnifera</u>	yes	6/28	8/30	64
Black-Eyed Susan <u>Rudbeckia hirta</u>	yes	6/28	10/6	101
Small Burnet <u>Sanguisorba minor</u>	yes	5/24	6/14	22
Creeping Zinnia <u>Sanvitalia procumbens</u>	no			
Soapwort <u>Saponaria ocymoides</u>	yes	5/12	7/25	75

Wild Thyme _Thymus serpyllum_	yes	6/14	8/4	52
Johnny Jump Up _Viola cornuta_	yes	5/12	7/25	75
GROUP 2.				
Lead Plant _Amorpoha canescens_	yes	7/7	7/20	14
Smooth Aster _Aster laevis_	yes	9/7	9/27	21
New England Aster _A. novae-angliae_	yes	9/7	9/27	21
Cream Wild Indigo _Baptisia leucophaea_	no			
Prairie Coreopsis _Coreopsis palmata_	yes	6/14	7/7	24
Shooting Star _Dodecatheon meadia_	no			
Pale Prairie Coneflower _Echinacea pallida_	yes	6/6	7/20	45
Rattlesnake Master _Eryngium yuccifolium_	no			
False Sunflower _Heliopsis helianthoides_	yes	6/21	9/27	99
Rough Blazing Star _Liatris aspera_	no			
Wild Bergamont _Monarda fistulosa_	yes	7/7	7/25	19
Purple Prairie Clover _Petalostemum purpureum_	yes	7/7	8/4	29
Prairie Hyssop _Pycnanthemum virginiana_	yes	6/28	8/4	37
Drooping Coneflower _Ratibida pinnata_	yes	7/7	8/11	36
Black-eyed Susan _Rudbeckia hirta_	yes	6/6	7/25	50
Wild Petunia _Ruellia humilis_	yes	6/21	7/25	35
Prairie Dock _Silphium terebinthinaceum_	yes	7/12	8/30	50
Stiff Goldenrod _Solidago rigida_	yes	8/25	9/20	27

CHAMPAIGN-URBANA 1989 ANNUAL WEATHER SUMMARY

STATE WATER SURVEY DIVISION

Audrey Bryan

The weather in Champaign-Urbana in 1989 was slightly below average in both temperature and precipitation.

Annual precipitation for 1989 was 34.97 inches (-2.07 inches from the 1951-1980 average). The only months where total monthly, precipitation was above the average for that month were April, May, June, August, and September. The only records for precipitation in 1989 concerned snow. In January, the total snowfall of 1.0 inch tied for the 8th lowest snowfall for January. The record lowest amount for January is a trace, recorded in 1944. The other snowfall record occurred in October when 1.0 inch of snow was recorded on the 19th. This is the earliest date of a 1.0 inch snowfall. The old record earliest date was October 20, 1916. The average date of any measurable snowfall amount is November 26, and the average date of a 1.0 inch snowfall is December 9. Two other snowfall occurrences of note but not of record were as follows: In March, a snowfalll of 6.9 inches occurred on the 6th, closing many schools, offices, and businesses. There also was a trace of snow recorded on May 6th. This is the first time since 1960 that snowfall has been recorded in May. Total snowfall for 1989 was 31.3 inches (+4.9 inches)

Several temperature records were tied or broken in 1989. On January 31st, a new record maximum temperature was set when 66F was recorded. The old record for that date was 59F, set in 1917. On May 7th, a new record minimum temperature was set with a reading of 29F. The old record was 30F, set in 1891. August 7th also had a new record minimum temperature of 49F. The old record was 51F, set in 1889, one hundred years ago. On October 19th, a new record lowest maximum temperature was set when 36F was recorded. The old record was 41F, set in 1930. In December, four days in a row had new record low temperatures. On the 20th, the low was -18F. The old record was -12F, set in 1901. The 21st had a low of -16F, the old record was -9F, set in 1963. The 22nd had a low of -21F. The old record for that date was -12F, set in 1983. The low of -21F is also a new record low for the month of December. The old record low for the month was -20F set in 1924 on the 28th and again on the 24th in 1983. The 23rd of December also had a new record low temperature with a -18F reading. The old record was -14F, set in 1983. Two other records also occurred on the 21st and 22nd, new record low maximum temperatures of -4F were set on both days. The previous record lowest maximum temperatures for those days were set in 1960, when both days recorded a high temperature of 8F. Again on December 22, 1989, the daily mean temperature of -13F made that day the third coldest ever in Champaign-Urbana. The coldest day ever, according to daily mean temperature was on February 9, 1899, and again on December 24, 1983 when a mean temperature of -16F was recorded.

Some other temperature records or near records are as follows. January had the 4th highest average monthly maximum temperature for January with 42.2F (+9.9F). The record highest is 45.8F, set in 1933. The average monthly minimum temperature of 26.2F (+9.2F) tied for the 7th highest for January. The highest is 29.6F, set in 1933. January also had the 4th highest average monthly mean temperature of 34.2F (+9.5F). The highest for January is 37.7F, set in 1933. February had the 6th lowest average monthly maximum temperature with 28.7F (-8.6F). The record lowest is 25.3F, set in 1979. And, December had the 2nd lowest average monthly maximum temperature with 26.3F (-11.3F). The record for December is 22.8F, set in 1983. December 1989 had the lowest average monthly minimum temperature with 7.9F (-15.4F). The old record was 9.7F, set in 1983. December also had the 2nd lowest average monthly mean temperature with 17.1F (-13.4F). The record is 16.3F, set in 1933. December 1989 also had 11 days with temperature below 0F. This is a new record, the old record was 9 in 1983.

Some occurrences of note, but not of record, are as follows. The last frost in spring this past year was on May 7th. The average date of last frost is April 21. The first frost in the fall was October 9th. The average date of first frost is October 20th. The growing season from May 8th until October 9th this year lasted for 155 days (-26 days). The growing season precipitation, from April through September, was 27.15 inches (+4.75). On September 8th, tornadoes and/or funnel clouds were sighted in Champaign county. In December there were 124.7 hours of temperature below 0F, with the longest consecutive period lasting 56.5 hours. This compares to 1983, when there were 152.25 hours of temperature below 0F, with the longest consecutive period lasting 100 hours. December 22nd also had an extremely high sealevel barometric pressure reading of 30.94 inches.

The annual mean temperature for 1989 was 50.2F (-1.7F). The mean maximum was 60.2F (-1.3F) and the mean minimum was 40.3F (-2.0F). The warmest day of 1989 occurred on July 8th and 10th (95F) and the coldest day occurred on December 22nd (-21F). There were 14 days with minimum temperatures of 0F or below (+8). The highest daily average was 85F on July 10. The lowest daily average was -13 on December 22. The total number of days with a maximum temperature of 32F or lower was 49 (+11). There were 134 days with a minimum temperature of 32F or lower (+16).

Measureable precipitation occurred on 104 days (-12). One inch or more precipitation fell on 8 days (-2).

There were 36 days with thunder (-9). Hail was observed on 1 day (-3) and 5 days had freezing precipitation (-4).

There were 113 clear days (+8), 103 partly cloudy days (-21), and 149 cloudy days (+13).

Annual heating degree days totaled 6228 (+470). Cooling degree days totaled 968 (-151).

The prevailing wind direction for 1989 was south (southwest is the 30-year prevailing direction) and the average speed was 5.6 mph (-1.4 mph). The peak gust of 45.8 mph came from the west on September 8th.

ILLINOIS STATE WATER SURVEY

CLIMATOLOGICAL DATA
Champaign-Urbana, Illinois 1989

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL SUMMARY
Temperature (^{O}F)													
Highest	66	50	77	85	90	94	95	92	88	86	73	58	95
Lowest	12	-9	12	23	29	52	54	48	38	31	14	-21	-21
Mean Maximum	42.2	28.7	50.1	62.2	69.0	82.4	84.9	83.7	74.5	67.6	50.3	26.3	60.2
Mean Minimum	26.2	14.6	30.7	40.3	48.3	60.5	65.5	62.9	53.2	42.7	30.2	7.9	40.3
Monthly Mean	34.2	21.7	40.4	51.3	58.7	71.5	75.2	73.3	63.9	55.2	40.3	17.1	50.2
Departure from Average*	+9.5	-7.6	+1.3	-1.0	-4.1	-0.4	+0.0	+0.1	-3.0	-0.1	-1.2	-13.4	-1.7
Number of Days													
Maximum $\geq 90^{O}$	0	0	0	0	1	4	7	3	0	0	0	0	15
Maximum $\leq 32^{O}$	6	18	4	0	0	0	0	0	0	0	2	19	49
Minimum $\leq 32^{O}$	25	28	18	9	1	0	0	0	0	4	18	31	134
Minimum $\leq 0^{O}$	0	3	0	0	0	0	0	0	0	0	0	11	14
Heating Degree Days	947	1207	757	427	242	8	0	4	104	316	735	1481	6228
Cooling Degree Days	0	0	0	21	52	210	323	268	75	19	0	0	968
Precipitation (Inches)													
Total (liquid equivalent)	1.23	1.29	1.98	5.73	5.80	5.02	1.78	4.27	4.55	1.21	1.42	0.69	34.97
Departure from Average*	-0.74	-0.59	-1.34	+1.89	+2.21	+1.10	-2.57	+0.61	+1.53	-1.30	-1.06	-1.81	-2.07
Maximum in 24 hours	0.38	0.33	0.58	1.82	2.32	2.06	0.70	0.91	2.01	0.38	0.81	0.24	2.32
Snowfall (unmelted)	1.0	10.4	6.9	2.0	T	0	0	0	0	3.3	T	7.7	31.3
Departure from Average*	-6.2	+4.3	+1.9	+1.4	0	0	0	0	0	+3.3	-2.9	+3.1	+4.9
Number of Days With													
0.01 Inch or More	8	10	7	15	11	9	5	10	4	9	5	11	104
0.50 Inch or More	0	0	2	3	3	3	1	5	3	0	1	0	21
1.00 Inch or More	0	0	0	2	2	2	0	0	2	0	0	0	8
Thunder	1	0	4	5	2	3	5	9	2	0	5	0	36
Hail	0	0	0	1	0	0	0	0	0	0	0	0	1
Freezing Precip	2	2	0	0	0	0	0	0	0	0	0	1	5
Snow	3	12	5	3	1	0	0	0	0	3	6	15	48
Snowfall 1.0 Inch	1	4	1	1	0	0	0	0	0	1	0	4	12
Snowcover Trace or More	8	26	8	0	0	0	0	0	0	2	0	21	65
Average Sky Condition (No. of Days)													
Clear	12	9	10	10	6	8	9	6	12	15	9	7	113
Partly Cloudy	6	6	7	11	11	14	9	9	4	8	11	7	103
Cloudy	13	13	14	9	14	8	13	16	14	8	10	17	149
Wind													
Prevailing Direction	S	W	N	S	SE	NW	NE	NE	NE	S	S	W	S
Average Speed (mph)	7.5	7.2	7.0	6.5	5.9	3.6	3.1	2.9	3.6	4.9	7.6	7.1	5.6
Peak Gust (mph)	39	29	36	43.2	28.2	31.0	20.4	26.7	45.8	29.5	34.1	45.0	45.8

*Average computed from 1951-1980, Urbana data, or portions thereof.

CHAMPAIGN, ILLINOIS RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA
ILLINOIS STATE WATER SURVEY

MARCH 1989
MONTHLY SUMMARY

DATE	TEMPERATURE (F) MAX	MIN	MEAN	PRECIPITATION (IN) AMOUNT	SNOW	DEPTH	WEATHER TYPES	WIND DIR.	SPEED	SKY COVER	DEGREE DAYS HEAT
1	29	*12*	21	0.00	0.0	T		W	3.0	PC	*44*
2	36	22	29	0.00	0.0	T		E	5.0	CLDY	36
3	55	31	43	0.24	0.0	T	TRW,R,L	SE	5.6	CLDY	22
4	52	30	41	0.00	0.0	0	F	S	6.9	CLDY	24
5	30	26	28	0.00	0.0	0		N	12.7	CLDY	37
6	26	19	23	0.56	*6.9*	3	S,SP,SW+,T	N	14.0	CLDY	42
7	30	*12*	21	0.00	0.0	5		NE	6.1	CLR	*44*
8	35	*12*	24	0.00	0.0	3		E	2.1	CLR	41
9	41	22	32	0.00	0.0	2	F	SE	1.3	CLR	33
10	52	30	41	T	T	T	L,SG-,F	E	4.7	PC	24
11	65	35	50	0.00	0.0	0	F	N	4.5	PC	15
12	44	36	40	T	0.0	0	L	NE	3.2	CLDY	25
13	59	34	47	0.00	0.0	0	F	E	1.9	PC	18
14	67	39	53	T	0.0	0	L,F	S	11.6	PC	12
15	39	27	33	T	T	0	SW-	W	9.3	CLDY	32
16	55	23	39	0.00	0.0	0		S	8.5	CLR	26
17	73	34	54	0.12	0.0	0	TRW,RW,L	S	9.4	CLDY	11
18	34	24	29	T	T	0	S-	NW	8.7	CLDY	36
19	42	18	30	0.00	0.0	0		SE	4.1	PC	35
20	40	29	35	*0.58*	0.0	0	TRW-,R,RW,L	N	7.7	CLDY	30
21	38	25	32	0.00	0.0	0		N	7.0	CLR	33
22	45	23	34	0.00	0.0	0	F	E	4.1	CLR	31
23	59	26	43	0.00	0.0	0		E	3.8	CLR	22
24	67	37	52	0.00	0.0	0	F	S	5.9	CLR	13
25	70	46	58	0.00	0.0	0	F	W	4.9	CLR	7
26	*77*	43	60	0.00	0.0	0		S	8.9	CLR	5
27	71	57	64	T	0.0	0	L,F	S	11.5	PC	1
28	69	58	64	0.12	0.0	0	R,L	S	10.9	CLDY	1
29	58	46	52	0.18	0.0	0	R,L	NE	9.0	CLDY	13
30	54	42	48	0.18	0.0	0	R,L,F	N	8.6	CLDY	17
31	42	33	38	T	T	0	SG	NW	8.4	CLDY	27
TOTAL				1.98	6.9						757
AVG.	50.1	30.7	40.4					N	7.0		
DEP. FROM NORMAL	+2.3	+0.3	+1.3	-1.34	+1.9		(NORMAL)	S	-1.6		-46

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

	MAX TEMP ≥90	MAX TEMP ≤32	MIN TEMP ≤32	MIN TEMP ≤0	PRECIPITATION ≤T	≥.01	≥.10	≥.50	≥1.00	SNOW ≥1	SKY COVER CLR	PCLDY	CLDY
TOTAL	0	4	18	0	14	7	7	2	0	1	10	7	14
DEP.	0	+1	-1	+0	-	-5	+0	+0	-1	-1	+3	-2	-1

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEAT DEG DAYS	SEASONAL COOL DEG DAYS	ANNUAL PRECIP
TOTAL	11	4	0	0	5	10	5	0	0	0	0	3215	0	4.50
DEP.	+7	+1	-1	-	-	-	-1	-	-	-		+11	+0	-2.87

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 of 36 mph from NE on the 5th and from N on the 17th.

CHAMPAIGN, ILLINOIS RESEARCH CENTER — LOCAL CLIMATOLOGICAL DATA, ILLINOIS STATE WATER SURVEY — APRIL 1989 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	53	26	40	0.00	0.0	0		S	7.9	PC	25	0
2	52	45	49	1.61	0.0	0	RW,R,L,F	S	7.2	CLDY	16	0
3	52	46	49	0.35	0.0	0	RW,R,L	S	6.6	CLDY	16	0
4	58	41	50	0.00	0.0	0	F	W	10.6	CLDY	15	0
5	48	34	41	0.06	0.0	0	RW,L,A	W	5.8	CLDY	24	0
6	54	32	43	0.08	0.0	0	RW	SW	3.6	PC	22	0
7	50	31	41	0.04	0.0	0	R-,L	NW	5.7	PC	24	0
8	47	32	40	0.52	*2.0*	0	R,L,S	NW	9.9	PC	25	0
9	40	28	34	T	T	0	SW-	W	9.9	CLR	31	0
10	40	*23*	32	T	T	0	SW-	W	4.2	CLR	*33*	0
11	50	26	38	0.00	0.0	0		SW	8.0	CLR	27	0
12	54	37	46	T	0.0	0	L-	W	10.4	PC	19	0
13	55	27	41	0.00	0.0	0		S	4.1	CLR	24	0
14	69	36	53	0.27	0.0	0	R	SW	9.1	PC	12	0
15	64	42	53	0.01	0.0	0	L	W	4.5	CLR	12	0
16	73	37	55	0.00	0.0	0		S	11.7	CLR	[illegible]	0
17	72	42	57	0.01	0.0	0	TRW-	NE	9.7	CLDY	8	0
18	48	38	43	0.20	0.0	0	RW,RW-,L	N	5.5	CLDY	22	0
19	62	32	47	0.00	0.0	0	F	NW	3.5	CLR	18	0
20	69	38	54	0.00	0.0	0		S	4.7	PC	11	0
21	74	46	60	0.00	0.0	0		S	4.9	CLR	5	0
22	72	47	60	T	0.0	0	L	E	2.9	CLR	5	0
23	72	52	62	0.22	0.0	0	R-,RW	E	5.4	CLDY	3	0
24	79	53	66	0.00	0.0	0		SE	6.9	PC	0	1
25	84	62	73	0.00	0.0	0		SW	7.1	PC	0	*8*
26	*85*	57	71	0.19	0.0	0	TRW+,TRW,F	NE	5.4	PC	0	6
27	81	58	70	0.08	0.0	0	TRW,F	W	4.3	CLDY	0	5
28	75	56	66	*1.82*	0.0	0	TRW+	NE	7.0	PC	0	1
29	70	47	59	0.27	0.0	0	RW,R,L	NW	5.3	CLDY	6	0
30	63	38	51	T	0.0	0	L	N	4.3	CLR	14	0
TOTAL				5.73	2.0						427	21
AVG.	62.2	40.3	51.3					S	6.5			
DEP. FROM NORMAL	-0.4	-1.6	-1.0	+1.89	+1.4		(NORMAL)	S	-2.0		+46	+21

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	0	0	9	0	20	15	9	3	2	1	10	11	9
DEP.	0	0	+5	+0	-	+3	+2	+1	+1	+1	+3	+1	-4

	WEATHER TYPES											SEASONAL HEAT	SEASONAL COOL	JAN-APR
	F	T	IP	A	R	L	S	Z	D	H	BS	DEG DAYS	DEG DAYS	PRECIP
TOTAL	5	5	0	1	14	11	3	0	0	0	0	5642	21	10.23
DEP.	+3	0	-	0	-	-	-	0	-	-	-	+57	+21	-0.78

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 43.2 mph from the north on the 26th No records set.

CHAMPAIGN, ILLINOIS RESEARCH CENTER — LOCAL CLIMATOLOGICAL DATA, ILLINOIS STATE WATER SURVEY — MAY 1989 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	63	42	53	0.00	0.0	0		NE	6.2	PC	12	0
2	56	40	48	0.01	0.0	0	L	NW	6.0	CLDY	17	0
3	65	39	48	0.00	0.0	0		W	4.7	CLR	13	0
4	58	42	50	0.19	0.0	0	R-,L	S	7.3	CLDY	15	0
5	62	40	51	0.05	0.0	0	RW-,R-,L,F	NW	8.0	CLDY	14	0
6	41	34	38	0.02	T	0	R-,L,SW	NW	8.2	PC	*27*	0
7	56	*29*	43	0.00	0.0	0		W	4.3	CLR	22	0
8	67	36	52	0.68	0.0	0	RW,R,L	SE	4.6	CLDY	13	0
9	56	45	51	0.32	0.0	0	R,L,F	NE	9.5	CLDY	14	0
10	64	40	52	0.00	0.0	0		N	10.1	CLR	13	0
11	65	37	51	0.00	0.0	0		N	8.7	CLR	14	0
12	68	40	54	0.00	0.0	0		NW	5.5	CLR	11	0
13	65	49	57	0.02	0.0	0	RW-	NE	4.4	CLDY	8	0
14	64	44	54	0.00	0.0	1		NE	3.3	CLDY	11	0
15	66	48	57	T	0.0	0	L	N	3.2	CLDY	8	0
16	77	46	62	0.00	0.0	0		NE	3.2	PC	3	0
17	78	48	63	0.00	0.0	0		SE	5.1	PC	2	0
18	78	56	67	T	0.0	0	R-	SE	8.6	CLDY	0	2
19	68	60	64	1.73	0.0	0	TRW+,RW,F	SE	7.6	CLDY	1	0
20	74	56	65	0.00	0.0	0	F	WNW	4.8	PC	0	0
21	78	48	63	0.07	0.0	0	R,L	SW	2.6	PC	2	0
22	63	55	59	0.39	0.0	0	R,RW,L,F	SE	3.7	CLDY	6	0
23	77	54	66	0.00	0.0	0		W	5.4	PC	0	1
24	84	60	72	0.00	0.0	0		S	8.5	CLDY	0	7
25	75	62	69	*2.32*	0.0	0	TRW+,TRW	NE	4.2	CLDY	0	4
26	75	58	67	0	0.0	0	F	W	4.9	PC	0	2
27	68	47	58	0	0.0	0		N	3.6	CLR	7	0
28	66	45	56	T	0.0	0	RW-	SE	4.0	CLDY	9	0
29	84	55	70	0	0.0	0		S	7.4	PC	0	5
30	*90*	69	80	T	0.0	0	RW-	SW	8.0	PC	0	15
31	89	72	81	0	0.0	0		SW	6.2	PC	0	*16*
TOTAL AVG.	69.0	48.3	58.7	5.80	T			SE	5.9		242	52
DEP. FROM NORMAL	-4.5	-3.7	-4.1	+2.21	0		NORMAL	S	-1.1		+87	-35

NUMBER OF DAYS AND DEPARTURE

	MAX ≥90	TEMP ≤32	MIN ≤32	TEMP ≤0	PRECIPITATION T	≥.01	≥.10	≥.50	≥1.00	SNOW ≥1	SKY COVER CLEAR	PCLDY	CLDY
TOTAL	1	0	1	0	15	11	6	3	2	0	6	11	14
DEP.	+0	+0	+1	+0		+1	-1	+0	+1	0	-3	-1	+4

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-MAY PRECIPITATION
TOTAL	6	2	0	0	12	9	1	0	0	0	0	5884	73	16.03
DEP.	+3	-4	+0	-1			+0					+144	-14	+1.43

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 1889-1980 data. Snow depth at 7AM LST. Sky 7 AM-7PM LST. Other data midnight-midnight. Metric Conversions: C=5/9x(F-32). 1 inch = 2.54 centimeters - 2.54 millimeters.
REMARKS: 1960 was the last time snowfall was recorded in May in Champaign-Urbana. New record low temp on 7th (29F) old record was 30F in 1891. Peak gust was 28.2 mph from the SE on the 18th.

CHAMPAIGN, ILLINOIS — LOCAL CLIMATOLOGICAL DATA — JUNE 1989
RESEARCH CENTER — ILLINOIS STATE WATER SURVEY — 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	85	64	75	0.07	0.0	0	RW-	SW	4.7	CLR	0	10
2	82	61	72	0.00	0.0	0		W	2.7	PC	0	7
3	81	60	71	0.83	0.0	0	RW	W	4.3	PC	0	6
4	72	54	63	0.00	0.0	0		NE	2.2	CLDY	2	0
5	78	58	68	0.03	0.0	0	RW-	NE	2.4	CLDY	0	3
6	84	58	71	0.00	0.0	0		SW	2.5	CLR	0	6
7	85	58	72	0.00	0.0	0		S	2.3	CLDY	0	7
8	83	60	72	0.00	0.0	0		SW	2.0	CLDY	0	7
9	73	59	66	0.00	0.0	0		NW	5.3	PC	0	1
10	76	53	65	0.00	0.0	0		NE	2.9	PC	0	0
11	81	55	68	0.02	0.0	0		N	4.7	CLDY	0	3
12	82	64	73	0.11	0.0	0		N	6.1	CLDY	0	8
13	77	65	71	T	0.0	0	L	W	5.6	CLDY	0	6
14	79	61	70	0.00	0.0	0		W	5.1	PC	0	5
15	69	56	63	0.00	0.0	0		N	4.6	CLDY	2	0
16	70	*52*	61	0.00	0.0	0		W	3.2	CLDY	*4*	0
17	82	55	69	0.00	0.0	0		SW	6.7	PC	0	4
18	84	64	74	0.10	0.0	0	RW	S	4.8	PC	0	9
19	86	61	74	0.00	0.0	0	F	NE	2.7	PC	0	9
20	85	66	76	0.00	0.0	0	F	NE	2.9	PC	0	11
21	89	63	76	0.00	0.0	0	F	E	1.8	CLR	0	11
22	*94*	63	79	0.00	0.0	0	F	S	3.9	PC	0	14
23	93	69	81	*2.06*	0.0	0	TRW+,RW F	S	2.7	PC	0	*16*
24	89	68	79	0.00	0.0	0		NE	3.2	CLR	0	14
25	91	66	79	0.00	0.0	0		ENE	2.0	CLR	0	14
26	92	69	81	1.38	0.0	0	TRW+,F,H	SW	3.5	CLDY	0	*16*
27	83	67	75	0.42	0.0	0	TRW+,R,L	NW	2.9	CLDY	0	10
28	84	59	72	0.00	0.0	0		NE	3.6	PC	0	7
29	80	*52*	66	0.00	0.0	0		NE	3.6	PC	0	1
30	83	56	70	0.00	0.0	0	F	E	1.8	CLR	0	5
31												
TOTAL AVG.	82.4	60.5	71.5	5.02				NW	3.6		8	210
DEP. FROM NORMAL	-0.4	-0.4	-0.4	+1.10			NORMAL	SSW	-2.4		-10	-15

NUMBER OF DAYS AND DEPARTURE

	MAX ≥90	TEMP ≤32	MIN ≤32	TEMP ≤0	PRECIPITATION T	≥.01	≥.10	≥.50	≥1.00	SNOW ≥1	SKY COVER CLEAR	PCLDY	CLDY
TOTAL	4	0	0	0	10	9	5	3	2	0	8	14	8
DEP.	-2	0	0	0		-1	-1	+0	+1		-1	-1	+0

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-JUN PRECIPITATION
TOTAL	8	3	0	0	7	2	0	0	0	1	0	5892	283	21.05
DEP.	+7	-4		-1								+134	-29	+2.53

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: 1951-1980 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data midnight-midnight. Metric Conversions: C=5/9x(F-32). 1 inch = 2.54 centimeters = 25.4 millimeters.
REMARKS: Peak gust was 31.0 from the SW on the 23rd.

CHAMPAIGN, ILLINOIS
RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA
ILLINOIS STATE WATER SURVEY

JULY 1989
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	86	61	74	0.00	0.0	0	H	ESE	1.5	PC	*0*	9
2	78	66	72	T	0.0	0	L	SE	3.6	CLDY	0	7
3	72	65	69	0.17	0.0	0	F	NE	5.2	CLDY	0	4
4	86	65	76	0.00	0.0	0	H	NE	4.1	CLR	0	11
5	89	63	76	0.00	0.0	0	H	NE	3.1	CLR	0	11
6	91	70	81	0.00	0.0	0	F,H	NE	2.1	CLR	0	16
7	94	64	79	0.00	0.0	0	F,H	W	2.6	PC	0	14
8	*95*	66	81	0.00	0.0	0		SE	2.8	CLDY	0	16
9	92	72	82	0.00	0.0	0	H	SW	5.0	CLR	0	17
10	*95*	74	85	0.00	0.0	0	F,H	SW	5.0	CLR	0	*20*
11	94	72	83	T	0.0	0	TRW-	W	4.7	PC	0	18
12	81	67	74	0.00	0.0	0		N	3.4	CLDY	0	9
13	84	62	73	0.00	0.0	0		N	4.3	CLR	0	8
14	80	*54*	67	0.00	0.0	0		NE	3.5	CLR	0	2
15	79	61	70	T	0.0	0	L	NE	2.3	CLDY	0	5
16	85	63	74	0.00	0.0	0		NE	2.8	CLR	0	9
17	87	58	73	0.00	0.0	0		S	1.8	PC	0	8
18	82	58	70	0.01	0.0	0	RW-	S	4.1	CLDY	0	5
19	80	66	73	*0.70*	0.0	0	TRW,RW,F	NE	1.8	CLDY	0	8
20	69	64	67	0.48	0.0	0	TRW	NE	5.6	CLDY	0	2
21	78	65	72	0.42	0.0	0	TRW+,F	E	2.1	CLDY	0	7
22	84	63	74	0.00	0.0	0	F	SSE	2.3	CLDY	0	9
23	84	68	76	T	0.0	0	L	SE	2.1	PC	0	11
24	87	70	79	T	0.0	0	TRW-,F	SE	1.5	PC	0	14
25	88	69	79	0.00	0.0	0	F	SE	1.7	PC	0	14
26	89	71	80	T	0.0	0	L,F	W	2.2	PC	0	15
27	90	72	81	0.00	0.0	0		W	3.9	PC	0	16
28	84	65	75	0.00	0.0	0		NE	3.7	CLR	0	10
29	84	61	73	T	0.0	0	L,F	SE	2.7	CLDY	0	8
30	85	69	77	T	0.0	0	L	W	2.6	CLDY	0	12
31	79	67	73	0.00	0.0	0	F	NE	2.9	CLDY	0	8
TOTAL AVG.	84.9	65.5	75.2	1.78				NE	3.1		0	323
DEP. FROM NORMAL	-0.6	+0.7	+0.0	-2.57			NORMAL	SW	-1.9		0	+7

NUMBER OF DAYS AND DEPARTURE

	MAX ≥90	TEMP ≤32	MIN ≤32	TEMP ≤0	PRECIPITATION ≥T	≥.01	≥.10	≥.50	≥1.00	SNOW ≥1	SKY COVER CLEAR	PCLDY	CLDY
TOTAL	7	0	0	0	13	5	4	1	0	0	9	9	13
DEP.	-1	0	0	0	-	-4	-2	-2	-1	0	-1	-5	+6

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-JUL PRECIPITATION
TOTAL	12	5	0	0	5	6	0	0	0	7	0	0	606	22.83
DEP.	+10	-2	0	0	-	-	-	0	-	-	-	0	-22	-0.04

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 1889-1980 data. Snow depth at 7AM LST. Sky 7AM-7PM LST. Other data midnight-midnight. Metric Conversions: C=5/9x(F-32). 1 inch = 2.54 centimeters = 25.4 millimeters.
REMARKS: Peak gust was 20.4 mph from the North on the 20th.

CHAMPAIGN, ILL. LOCAL CLIMATOLOGICAL DATA AUGUST 1989
WATER SURVEY RESEARCH CENTER ILLINOIS STATE WATER SURVEY SUMMARY

DATE	MAX TEMP	MIN TEMP	MEAN TEMP	T	PRECIP (INCHES)	SNOW	SNOW DEPTH	WEATHER TYPES	WIND DIR	WIND SPD	SKY COVER	HEAT DEG. DAYS	COOL DEG. DAYS
08/01/89	84	66	75		0.00	0.0	0		NE	2.6	PC	0	10
08/02/89	88	64	76		0.00	0.0	0		SE	1.8	CLR	0	11
08/03/89	92	66	79		0.00	0.0	0	F	S	5.0	CLDY	0	14
08/04/89	92	75	84		0.00	0.0	0		SW	4.9	PC	0	19
08/05/89	91	69	80		0.03	0.0	0	RW-,H	W	4.2	PC	0	15
08/06/89	78	57	68		0.00	0.0	0		NW	4.4	CLDY	0	3
08/07/89	75	49	62		0.00	0.0	0		N	2.8	PC	3	0
08/08/89	80	48	64		0.00	0.0	0		W	1.6	CLR	1	0
08/09/89	82	56	69		0.00	0.0	0		SW	2.5	CLR	0	4
08/10/89	83	55	69		0.00	0.0	0	F	SE	1.3	CLR	0	4
08/11/89	84	60	72		0.00	0.0	0	F	NE	1.7	CLR	0	7
08/12/89	85	59	72	T	0.00	0.0	0	TRW-,H	NNE	2.1	CLR	0	7
08/13/89	86	59	73		0.00	0.0	0		SW	2.5	PC	0	8
08/14/89	86	63	75		0.04	0.0	0	TRW-,F	SE	3.8	PC	0	10
08/15/89	86	65	76		0.03	0.0	0	RW-,F	W	2.9	CLDY	0	11
08/16/89	77	63	70		0.00	0.0	0		NE	3.1	CLDY	0	5
08/17/89	81	58	70		0.00	0.0	0	F	NE	3.4	CLDY	0	5
08/18/89	82	61	72		0.00	0.0	0		NE	3.2	PC	0	7
08/19/89	84	58	71		0.00	0.0	0		S	3.9	PC	0	6
08/20/89	87	70	79		0.00	0.0	0		W	4.8	CLDY	0	14
08/21/89	83	68	76	T	0.00	0.0	0	TRW-,F	S	2.5	CLDY	0	11
08/22/89	85	69	77		0.90	0.0	0	TRW+	SW	3.7	CLDY	0	12
08/23/89	82	67	75		0.91	0.0	0	TRW+,RW,F	NE	3.3	CLDY	0	10
08/24/89	80	68	74		0.00	0.0	0	F	NE	3.4	CLDY	0	9
08/25/89	76	65	71	T	0.00	0.0	0		E	2.1	CLDY	0	6
08/26/89	86	67	77		0.02	0.0	0	TRW,F	SE	1.1	CLDY	0	12
08/27/89	89	68	79		0.56	0.0	0	TRW+	S	1.5	CLDY	0	14
08/28/89	84	68	76		0.72	0.0	0	TRW+,F	S	3.0	CLDY	0	11
08/29/89	82	67	75		0.93	0.0	0	TRW+,RW	W	2.8	CLDY	0	10
08/30/89	84	60	72		0.00	0.0	0		SE	1.6	PC	0	7
08/31/89	80	61	71		0.13	0.0	0	T,RW	S	3.2	CLDY	0	6
TOTAL					4.27	0.0			NE	2.9		4	268
AVERAGE	83.7	62.9	73.3										
DEPARTURE								NORMAL	SW	-1.9		+4	+11
FROM NORMAL	+0.1	+0.1	+0.1		+.61								

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	3	0	0	0	13	10	6	5	0	0	6	9	16
DEP.	-2	0	0	0	-	+2	0	+2	-1	0	-4	-5	+9

	WEATHER TYPES											SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-AUG PRECIPITATION
	F	T	IP	A	R	L	S	Z	D	H	BS			
TOTAL	11	9	0	0	12	0	0	0	0	2	0	4	874	27.10
DEP.	+7	+2	-	-	-	-	-	-	-	-	-	+4	-11	+0.57

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 = 65F T= Trace; Normals 1889-1980 Data. Snow depth at 7AM LST SKY 7AM-7PM LST. Other data midnight-midnight.

Metric Conversions: C=5/9x(F-32). 1 inch = 2.54 centimeters = 25.4 millimeters.

REMARKS: New record low temp on the 7th with 49F, old record 51F set in 1889. Peak gust was 26.7 mph from the SW on the 23rd.

CHAMPAIGN, ILL. — WATER SURVEY RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA — ILLINOIS STATE WATER SURVEY

SEPTEMBER 1989 SUMMARY

DATE	MAX TEMP	MIN TEMP	MEAN TEMP	T	PRECIP (INCHES)	SNOW	SNOW DEPTH	WEATHER TYPES	WIND DIR	WIND SPD	SKY COVER	HEAT DEG. DAYS	COOL DEG. DAYS
09/01/89	80	66	73		1.54	0.0	0	TRW+,RW	NNE	5.0	CLDY	0	8
09/02/89	76	60	68		0.00	0.0	0		NE	4.6	CLR	0	3
09/03/89	76	56	66		0.00	0.0	0		E	2.6	CLR	0	1
09/04/89	79	54	67		0.00	0.0	0		S	2.5	PC	0	2
09/05/89	86	62	74		0.00	0.0	0	F	SSE	1.9	CLDY	0	9
09/06/89	82	69	76	T	0.00	0.0	0	L,F	S	3.3	CLDY	0	11
09/07/89	88	70	79	T	0.00	0.0	0	L,F	SW	3.8	CLDY	0	14
09/08/89	83	67	75		2.01	0.0	0	TRW+,R,F	S	3.8	CLDY	0	10
09/09/89	81	66	74		0.00	0.0	0		W	6.1	CLDY	0	9
09/10/89	70	62	66		0.00	0.0	0		NE	3.7	CLDY	0	1
09/11/89	76	59	68		0.00	0.0	0		NNE	1.7	CLDY	0	3
09/12/89	75	55	65	T	0.00	0.0	0	L	NE	5.6	CLDY	0	0
09/13/89	58	51	55		0.20	0.0	0	L	NE	7.0	CLDY	10	0
09/14/89	59	53	56		0.80	0.0	0	R,L	NE	6.8	CLDY	9	0
09/15/89	67	54	61	T	0.00	0.0	0	L	NE	4.8	CLDY	4	0
09/16/89	75	53	64		0.00	0.0	0		N	2.9	PC	1	0
09/17/89	77	49	63		0.00	0.0	0		WSW	1.1	PC	2	0
09/18/89	77	52	65		0.00	0.0	0	F	E	1.9	CLR	0	0
09/19/89	78	52	65		0.00	0.0	0	F	E	1.8	CLR	0	0
09/20/89	78	50	64		0.00	0.0	0	F	NE	2.0	CLR	1	0
09/21/89	80	58	69		0.00	0.0	0		NE	1.9	CLDY	0	4
09/22/89	77	52	65	T	0.00	0.0	0	L	N	4.9	CLDY	0	0
09/23/89	57	37	47		0.00	0.0	0		N	6.6	CLR	18	0
09/24/89	63	35	49		0.00	0.0	0		E	2.0	CLR	16	0
09/25/89	70	37	54		0.00	0.0	0		W	2.0	CLR	11	0
09/26/89	66	46	56		0.00	0.0	0		NE	6.1	CLR	9	0
09/27/89	67	38	53		0.00	0.0	0		E	3.3	CLR	12	[illegible]
09/28/89	75	38	57		0.00	0.0	0		SSW	3.4	CLR	8	0
09/29/89	80	46	63		0.00	0.0	0		W	3.1	PC	2	0
09/30/89	80	48	64		0.00	0.0	0		SE	3.0	CLR	1	0
TOTAL					4.55	0.0			NE	3.6		104	75
AVERAGE	74.5	53.2	63.9										
DEPARTURE								NORMAL	SW	-1.6		+47	-39
FROM NORMAL	-3.8	-2.3	-3.0		+1.53								

NUMBER OF DAYS AND DEPARTURE

	MAX-TEMP >=90	MAX-TEMP <=32	MIN-TEMP <=32	MIN-TEMP <=0	PRECIPITATION T	PRECIPITATION >=.01	PRECIPITATION >=.10	PRECIPITATION >=.50	PRECIPITATION >=1.00	SNOW >=1	SKY COVER CLEAR	SKY COVER PCLDY	SKY COVER CLDY
TOTAL	0	0	0	0	9	4	4	3	2	0	12	4	14
DEP.	-3	0	0	0	-	-5	-1	+1	+1	0	+1	-6	+5

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-SEP PRECIPITATION
TOTAL	7	2	0	0	4	7	0	0	0	0	0	108	949	31.65
DEP.	+4	-2	-	-	-	-	-	0	-	-	-	+51	-50	+2.10

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 = 65F T= Trace; Normals 1889-1980 Data. Snow depth at 7AM LST SKY 7AM-7PM LST. Other data midnight-midnight.

Metric Conversions: C=5/9x(F-32). 1 inch = 2.54 centimeters = 25.4 millimeters.

REMARKS: Patches of frost on the ground on 25th and 28th. Tornado sightings around Champ. Co. on the 8th. Peak gust was 45.8 mph from the west on the 8th.

CHAMPAIGN.ILL. WATER SURVEY RESEARCH CENTER

LOCAL CLIMATOLOGICAL DATA
ILLINOIS STATE WATER SURVEY

OCTOBER 1989 SUMMARY

DATE	MAX TEMP	MIN TEMP	MEAN TEMP	T	PRECIP (INCHES)	T	SNOW (INCHES)	SNOW DEPTH	WEATHER TYPES	WIND DIR	WIND SPD	SKY COVER	HEAT DEG. DAYS	COOL DEG. DAYS
10/01/89	73	56	65		0.00		0.0	0	F	E	2.9	CLDY	0	0
10/02/89	67	48	58		0.00		0.0	0		NW	5.1	PC	7	0
10/03/89	61	41	51		0.00		0.0	0		N	4.6	CLR	14	0
10/04/89	62	34	48		0.00		0.0	0		N	2.1	CLR	17	0
10/05/89	77	39	58		0.07		0.0	0	R-,L	S	6.4	CLDY	7	0
10/06/89	59	45	52		0.01		0.0	0	L	NW	4.2	PC	13	0
10/07/89	57	37	47		0.00		0.0	0		NW	3.8	CLR	18	0
10/08/89	59	38	49	T	0.00		0.0	0	L	WNW	3.8	PC	16	0
10/09/89	64	32	48		0.00		0.0	0		S	5.8	CLDY	17	0
10/10/89	66	39	53		0.00		0.0	0		W	5.1	CLR	12	0
10/11/89	79	35	57		0.00		0.0	0		S	8.2	CLR	8	0
10/12/89	81	54	68		0.00		0.0	0		W	3.3	CLR	0	3
10/13/89	86	51	69		0.00		0.0	0		SW	3.0	CLR	0	4
10/14/89	86	53	70		0.00		0.0	0		SW	5.1	CLR	0	5
10/15/89	82	61	72		0.00		0.0	0		S	6.9	CLR	0	7
10/16/89	78	50	64		0.38		0.0	0	RW,R	NE	6.6	PC	1	0
10/17/89	50	40	45		0.18		0.0	0	R,L	N	8.2	CLDY	20	0
10/18/89	42	34	38		0.01	T	0.0	0	L.SW	N	7.1	CLDY	27	0
10/19/89	36	33	35		0.34		2.8	T	S	NNW	8.3	CLDY	30	0
10/20/89	44	31	38		0.05		0.5	T	S	W	7.3	CLDY	27	0
10/21/89	62	34	48		0.00		0.0	0		W	4.8	CLR	17	0
10/22/89	66	31	49		0.00		0.0	0		SE	4.4	PC	16	0
10/23/89	76	46	61		0.00		0.0	0	F	SE	3.2	PC	4	0
10/24/89	78	49	64		0.00		0.0	0	F	SSE	3.1	PC	1	0
10/25/89	78	52	65		0.00		0.0	0		SE	2.8	CLR	0	0
10/26/89	76	46	61		0.00		0.0	0	F	SE	1.8	CLR	4	0
10/27/89	78	46	62		0.00		0.0	0	F	SE	2.8	CLR	3	0
10/28/89	73	42	58		0.00		0.0	0		SE	2.3	CLR	7	0
10/29/89	76	49	63		0.00		0.0	0		S	4.3	PC	2	0
10/30/89	75	48	62		0.15		0.0	0	RW	S	6.6	CLR	3	0
10/31/89	48	31	40		0.02		0.0	0	RW	W	6.7	CLDY	25	0
TOTAL					1.21		3.3			S	4.9		316	19
AVERAGE	67.6	42.7	55.2				3.3							
DEPARTURE									NORMAL	SW	-1.4		-4	-1
FROM NORMAL	+1.4	-1.7	-0.1		-1.30		+3.3							

NUMBER OF DAYS AND DEPARTURE

	MAX-TEMP >=90	MAX-TEMP <=32	MIN-TEMP <=32	MIN-TEMP <=0	PRECIPITATION T	PRECIPITATION >=.01	PRECIPITATION >=.10	PRECIPITATION >=.50	PRECIPITATION >=1.00	SNOW >=1	SKY COVER CLEAR	SKY COVER PCLDY	SKY COVER CLDY
TOTAL	0	0	4	0	10	9	4	0	0	1	15	8	8
DEP.	0	0	+1	0	-	-1	-1	-1	-1	+1	+3	-1	-2

	WEATHER TYPES F	T	IP	A	R	L	S	Z	D	H	BS	SEASONAL HEATING DEGREE DAYS	SEASONAL COOLING DEGREE DAYS	JAN-OCT PRECIPITATION
TOTAL	5	0	0	0	5	5	3	0	0	0	0	424	968	32.86
DEP.	+2	-2	-	-	-	-	-	0	-	-	-	+47	-51	+0.80

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 = 65F T= Trace; Normals 1889-1980 Data. Snow depth at 7AM LST SKY 7AM-7PM LST. Other data midnight-midnight.

Metric Conversions: C=5/9x(F-32). 1 inch = 2.54 centimeters = 25.4 millimeters.

REMARKS: Record earliest 1 inch of snow recorded on the 19th (old record was Oct 20,1916). Record lowest max temp on the 19th.36F (old record was 41F,Oct 19,1930). Peak gust 29.5 mph from Northwest on the 19th.

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